

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

جامعة الموصل – كلية علوم الحاسوب والرياضيات
قسم الامن السيبراني

CIRCUTE DESIGN

المحاضرة الثالثة
Logic Gates

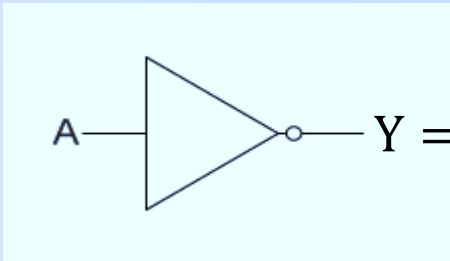
Sura Sabah I. Ahmed

Not Gate

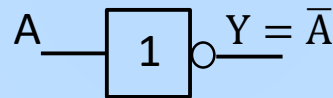
The Inverter :

- The Inverter (**NOT**) circuit performs the operation called “Inversion” or “Complementation”.
- The Inverter changes one logic level to the opposite, i.e. it changes a “1” to “0” and a “0” to “1”.

The Logic symbol of NOT Gate is:



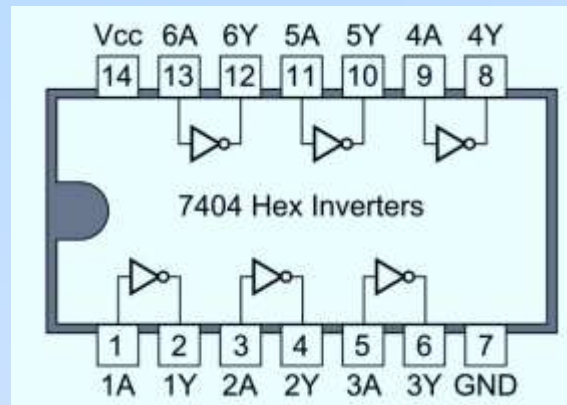
The output equation : $Y = \bar{A}$



The truth table NOT gate:

A	Y
0	1
1	0

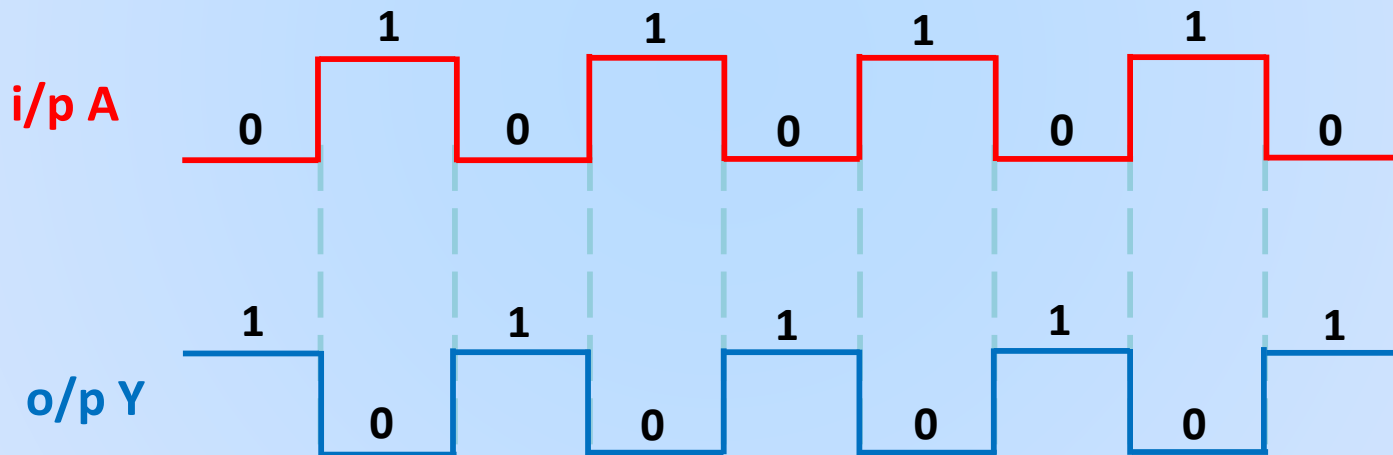
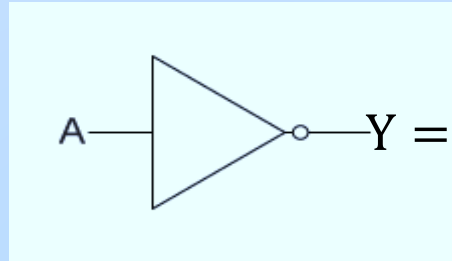
The pin diagram of the chip (IC 7404)



NOT Gate

Example:

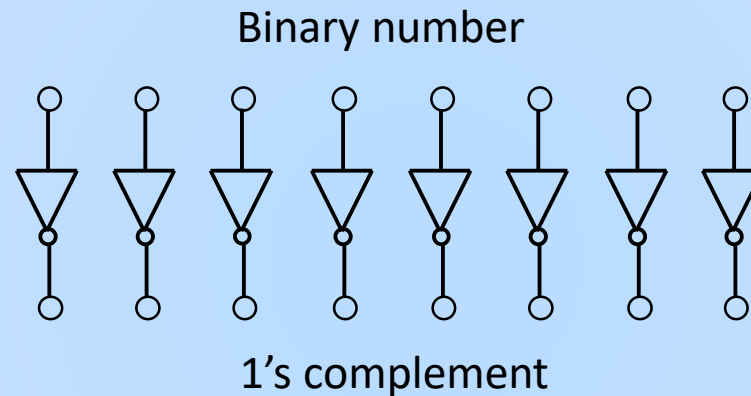
A waveform (**A**) shown below is applied to an inverter, determine the output waveform (**Y**) corresponding to the input (**A**)?



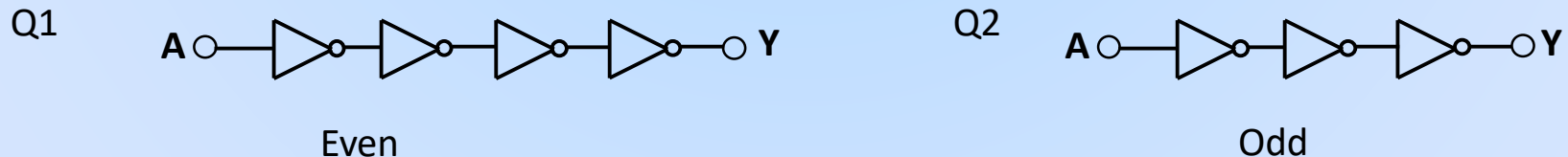
NOT Gate

Application Example:

- The figure shown below is a circuit for producing the 1's complement of an 8 bit binary number.
- The bits of the binary number are applied to the inverter inputs and the 1's complement of an 8 bit binary number appear on the o/p.



Q) What is the output y for the following circuits?



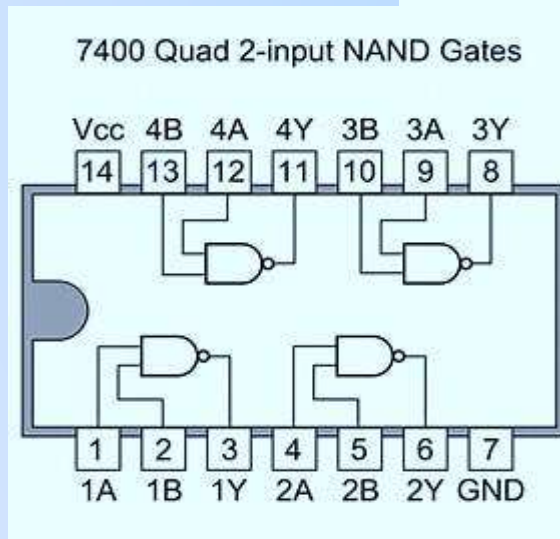
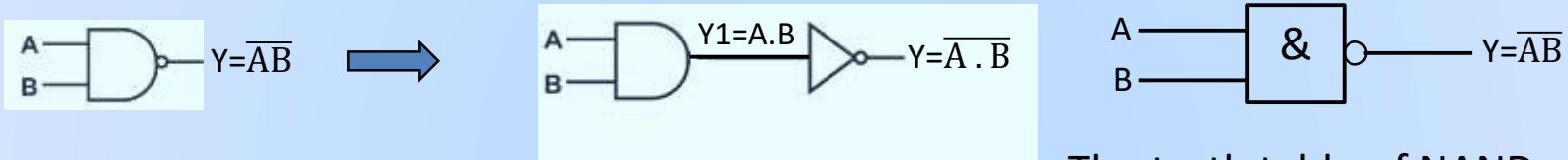
NAND Gate

The NAND gate (**AND + NOT**):

The NAND gate is a popular logic element because it can be used as a **universal gate**.

The name “NAND” is a contraction of **NOT-AND** and implies an AND function with a complemented (Inverse) output.

The symbol for 2-in NAND gate



The truth table of NAND gate:

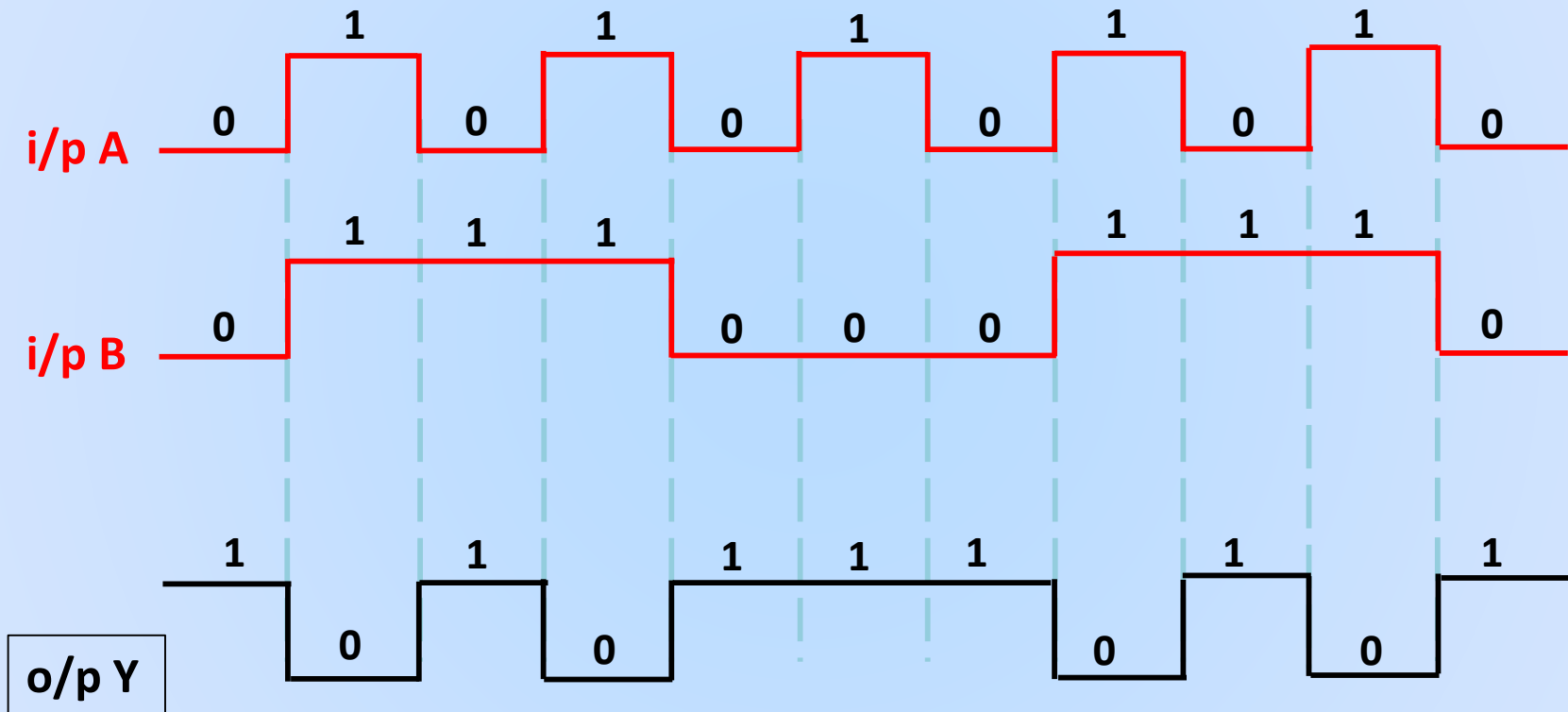
INPUTS		OUTPUTS	
A	B	Y1	Y
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

The NAND gate produces a LOW o/p only when the all inputs are HIGH, and the output is HIGH when any of the inputs is LOW.

NAND Gate

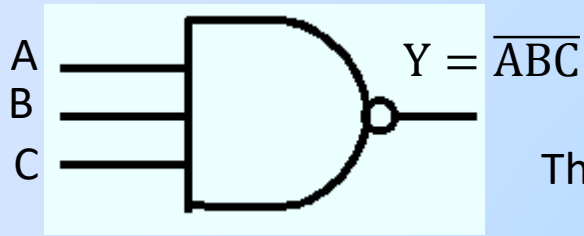
Pulsed operation :

Example: If the two waveforms (A & B) shown below are applied to the NAND gate inputs. Determine the resulting output waveform?



NAND Gate

3- inputs NAND gate:



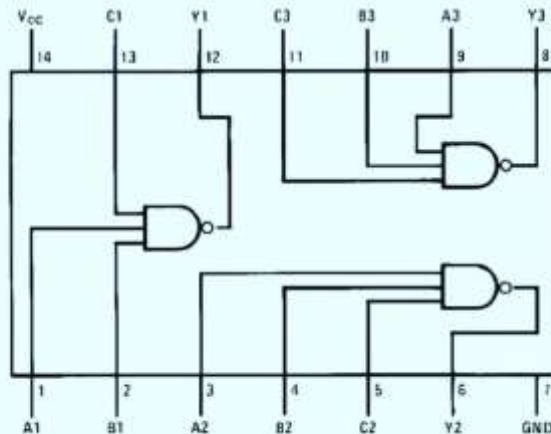
The o/p equation: $Y = \overline{ABC}$

The truth table of three inputs NAND gate:

INPUTS			OUTPUT
A	B	C	$Y = \overline{ABC}$
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

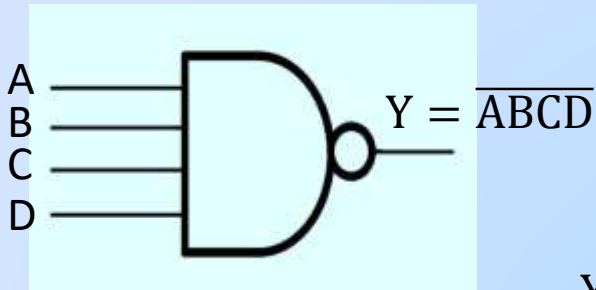
74ALS10 Triple 3-Input NAND Gate

LOGIC SYMBOL



NAND Gate

Four inputs NAND gate:



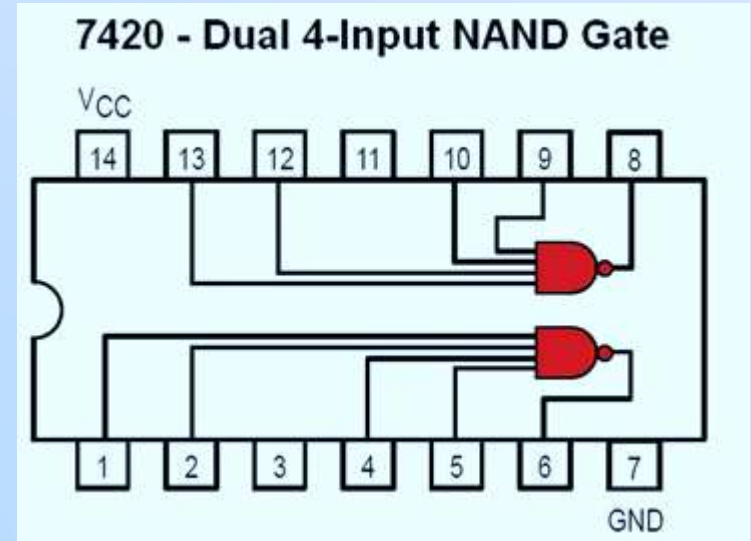
The symbol

$$Y = \overline{ABCD}$$

The equation

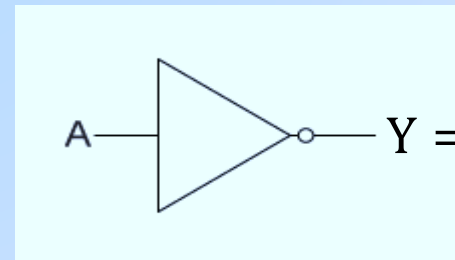
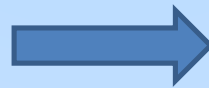
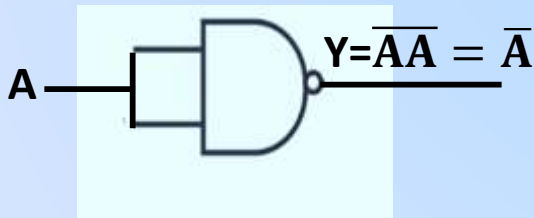
H.W:

Write the truth table and the output equation of the 4-inputs NAND gate?



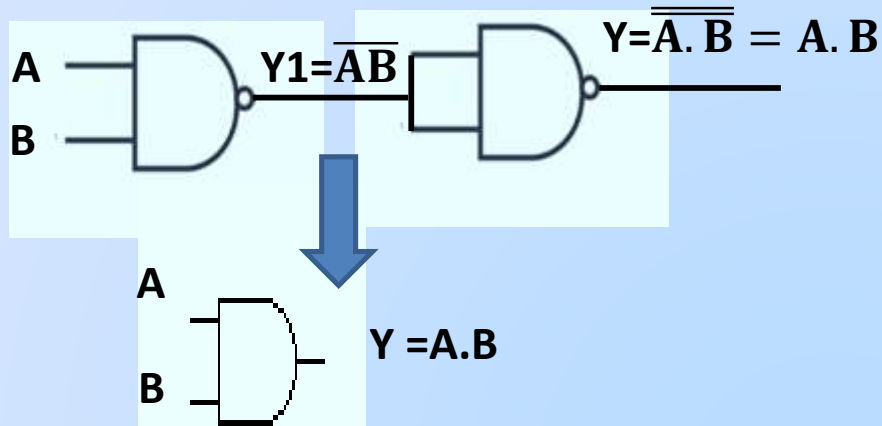
Universal properties of NAND gate:

1) NAND gate used as an Inverter:-



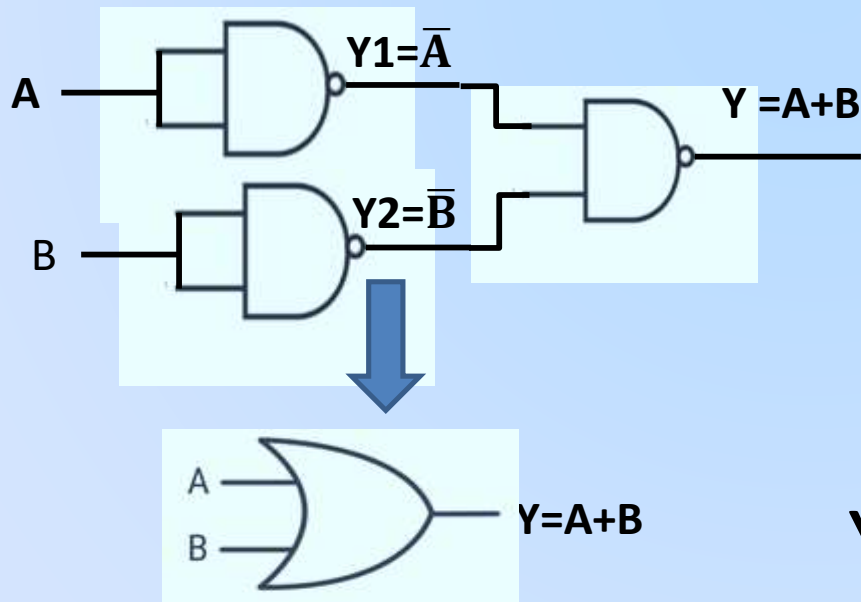
NAND Gate

2) NAND gate used as an AND gate:-



A	B	$Y1 = \overline{A \cdot B}$	$Y = A \cdot B$
0	0	1	0
0	1	1	0
1	0	1	0
1	1	0	1

3) NAND gate used as an OR gate:-

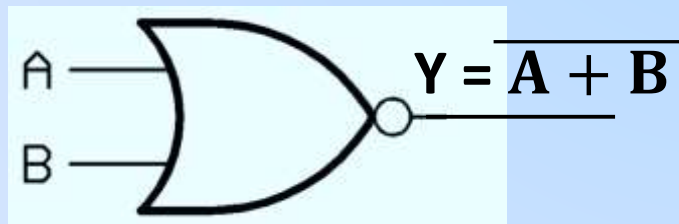
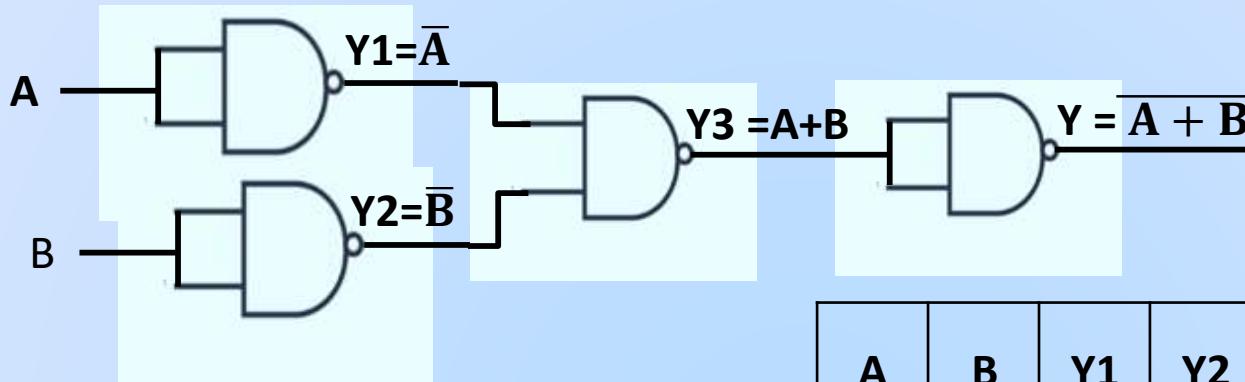


A	B	$Y1$	$Y2$	$Y = A + B$
0	0	1	1	0
0	1	1	0	1
1	0	0	1	1
1	1	0	0	1

$$Y = A + B = \overline{\overline{A} \cdot \overline{B}} = \overline{\overline{A} \cdot \overline{B}} = A + B$$

NAND Gate

4) NAND gate used as an NOR gate:-



A	B	Y1	Y2	Y3=A+B	Y= $\overline{A + B}$
0	0	1	1	0	1
0	1	1	0	1	0
1	0	0	1	1	0
1	1	0	0	1	0

Thank you