TUTORIAL 3: Logic Gates Overview

1. For a 2-input NOR gate functioning as a negative-AND gate, output X is HIGH if both inputs A and B are HIGH.

FALSE — A=1, B=1; $\overline{AB}$ = 0 (LOW) — TRUE / FALSE

2. A two-input XNOR gate will produce a HIGH output when both inputs are equal.

TRUE — $X = A \odot B = AB + \overline{A}\overline{B}$; A=0, B=0: X = 0+1 = 1 (HIGH); A=1, B=1: X = 1+0 = 1 (HIGH) — TRUE / FALSE

Inverted

$\overline{A}$	$\overline{B}$	X
1	1	0
1	0	0
0	1	0
0	0	1

AND

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

3. A NOR gate with inverters at the inputs has the same logic function as an AND gate.

TRUE — NOR Gate, $X = \overline{A+B}$; with inverter, $X = \overline{\overline{A}+\overline{B}}$; $\overline{\overline{A}+\overline{B}} = A \cdot B$ (De Morgan's) = AND Gate — TRUE / FALSE

4. A 2-input NAND gate and a 2-input NOR gate produces the same output when both inputs are HIGH.

TRUE

NAND

A	B	X
1	1	0

NOR

A	B	X
1	1	0

TRUE / FALSE

5. The _____ gate produces a HIGH output when all inputs are LOW.

	A	B	X
(a.) NOR	0	0	1
(b.) NAND	0	0	1
c. XOR	0	0	0
d. AND	0	0	0

6. A 2-input logic gate **X** produces a HIGH output when input A is LOW and input B is HIGH. Which of the following is **NOT** logic gate **X**?

	A	B	X
a. OR	0	1	1
(b.) NOR	0	1	0 (LOW)
c. NAND	0	1	1
d. XOR	0	1	1

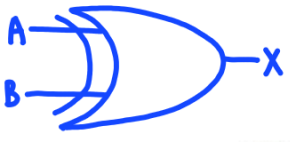
7. Complete the following questions:

i) Draw the logic symbol of an XOR gate.

ii) Give appropriate labels to the inputs and output.

iii) Write its truth table.

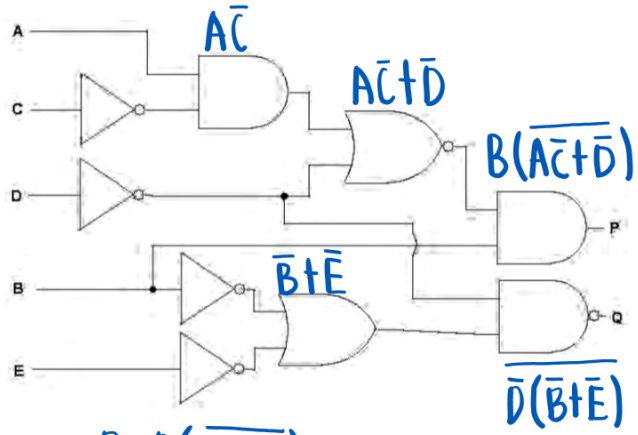
i) XOR



iii)

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

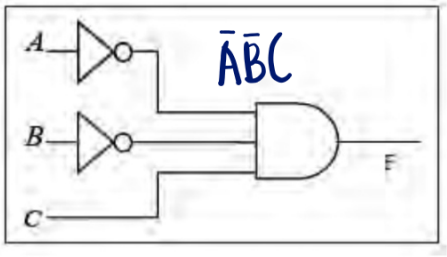
8. Write the Boolean expressions of output P and Q.

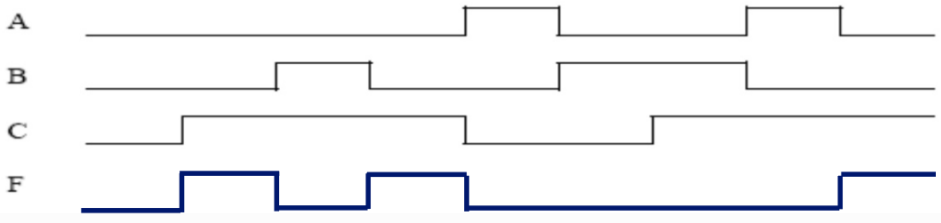


P = ? $P = B(\overline{A\bar{C}+\bar{D}})$

Q = ? $Q = \bar{D}(\bar{B}+\bar{E})$

9. Complete the timing diagram based on the given input for the following logic diagram.





10. Draw symbol for the following gates:

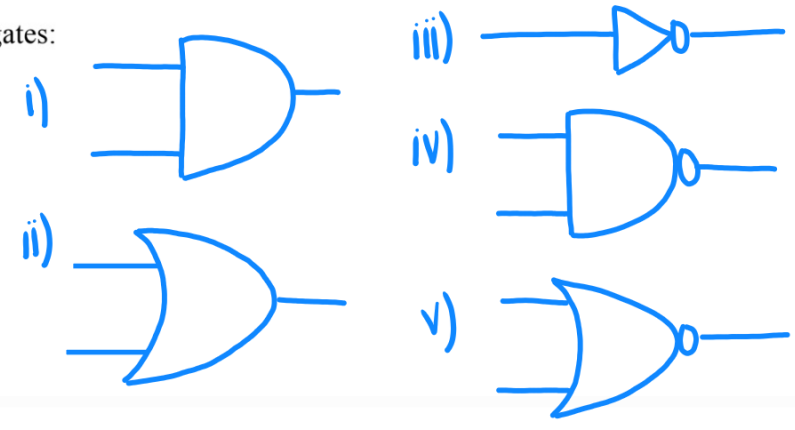
i) 2-input AND gate

ii) 2-input OR gate

iii) Inverter

iv) 2-input NAND gate

v) 2-input NOR gate



11. Given an AND gate with 3 inputs, what should the input values be to get an output of 1 (HIGH)? All inputs are 1(HIGH)

12. Given an OR gate with 3 inputs, what should the input values be to get an output of 1 (HIGH)?

At least one input is 1(HIGH)

13. Fill in the table below, follow the example given.

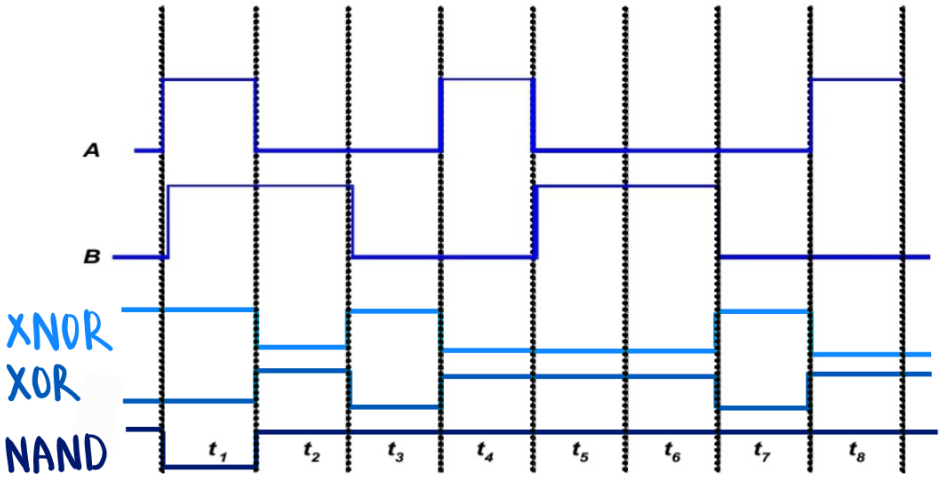
Gate	Input			Output
	A	B	C	
AND	1	0	1	X = 1+0+1 = 0
OR	0	1	0	X = 0+1+0 = 1
AND	1	1	1	X = 1+1+1 = 1
OR	0	0	0	X = A + B + C = 0 + 0 + 0 = 0
NOR	1	1	1	X = 1+1+1 = 0
AND	1	0	0	X = 1+0+0 = 0

14. Given the input waveform(s) below, show the appropriate output waveform, ***X***, with a timing diagram.

i) XNOR

ii) XOR

iii) NAND



15. Identify the following devices according to logic function:

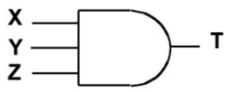
i) 74LS04 Hex Inverter.

ii) 74ALS10 Triple 3-input NAND Gate.

iii) 74HC00 Quad 2-input NAND Gate.

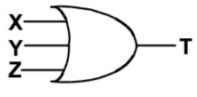
16. Given the logic gates below, write the logic expression for it.

i)



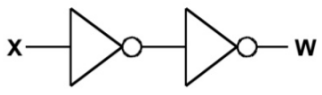
T = XYZ

ii)



T = X+Y+Z

iii)



$W = \overline{\overline{X}} = X$