



The Islamic University of Gaza

Faculty of Engineering

Department of Computer Engineering

Digital Electronics LAB

[LAB 03]

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Supervisor

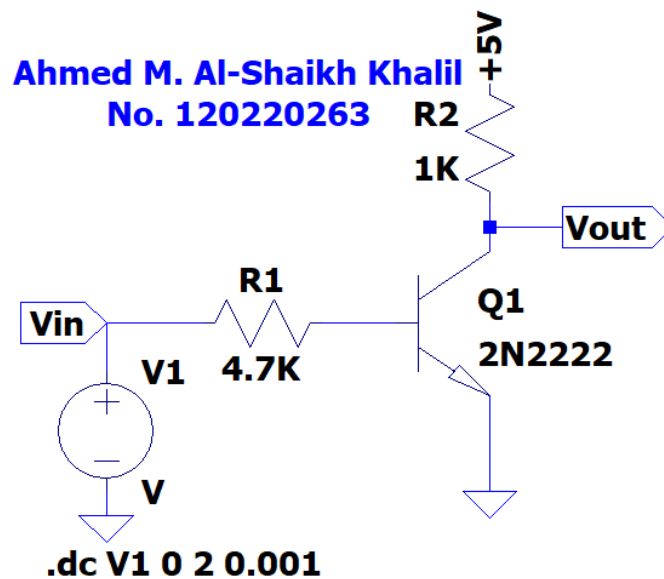
Eng. Saja Nabeel Nabhan

❖ Objectives:

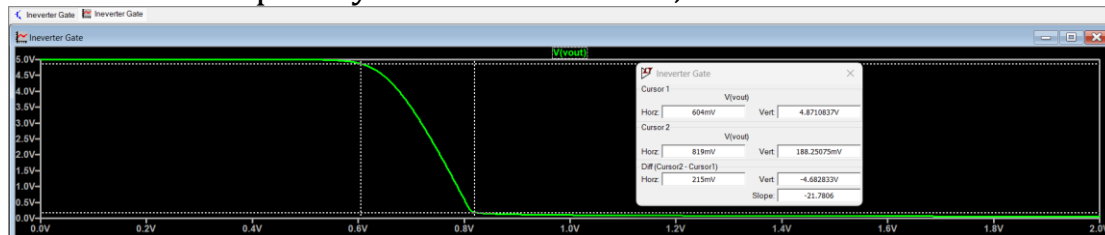
- To be familiar with the operation of BJT Inverter.
- Be familiar with logic gates using resistors and bipolar transistor connected with RLT techniques.
- Studying the internal connection of AND, OR, NAND, and NOR.
- To determine the VTC of these gates.

❖ Part (1): Inverter Gate:

A. Connect the circuit shown in Fig. (3.1) using LTspice.



B. Use DC-sweep analyses and sketch VTC, attach the result.



B. From the **result** and using the **calculations**, find:

V_{IL}	604mV	TW	215 mV
V_{IH}	819 mV	LS	4.68 V
V_{OH}	4.8710837 V	N_{ml}	415.74925 mV
V_{OL}	188.25075 mV	N_{mh}	4.0520837 V

$$TW = V_{IH} - V_{IL} = 819 \text{ mV} - 604 \text{ mV} = 215 \text{ mV}$$

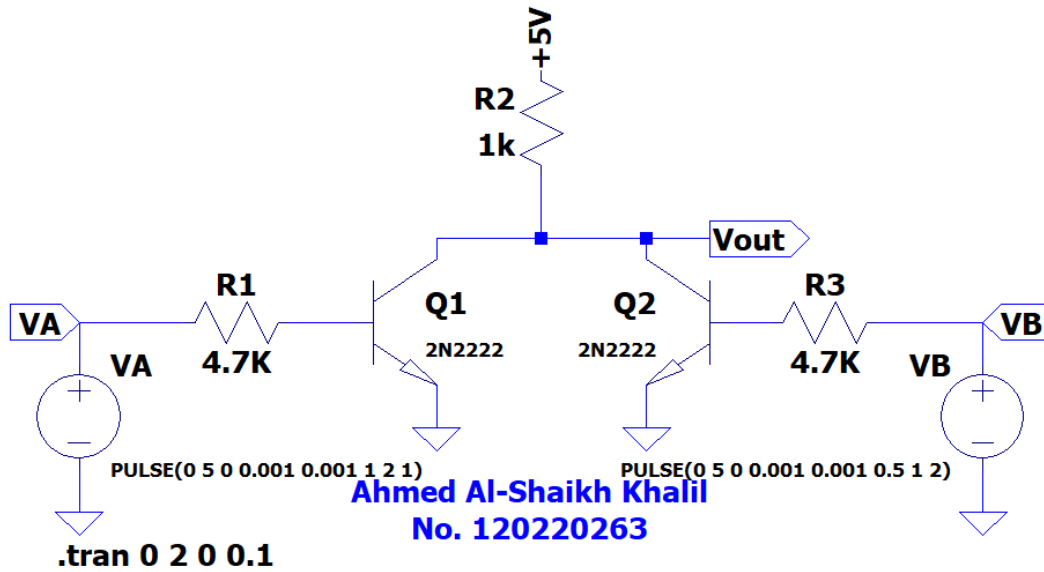
$$LS = V_{OH} - V_{OL} = 4.8710837 \text{ V} - 188.25075 \text{ mV} = 4.68 \text{ V}$$

$$N_{ml} = V_{IL} - V_{OL} = 604 \text{ mV} - 188.25075 \text{ mV} = 415.74925 \text{ mV}$$

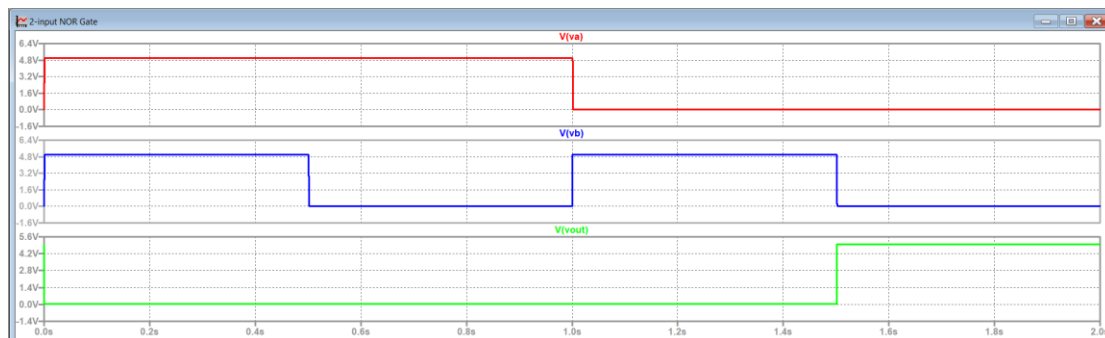
$$N_{mh} = V_{OH} - V_{IH} = 4.8710837 \text{ V} - 819 \text{ mV} = 3.9791 \text{ V}$$

❖ Part (2): 2-Input NOR gate:

A. Construct the circuit shown in Figure 3.4 in LTspice.



B. Investigate its truth table by using Transient Analyses using the method we learned in Lab 2.

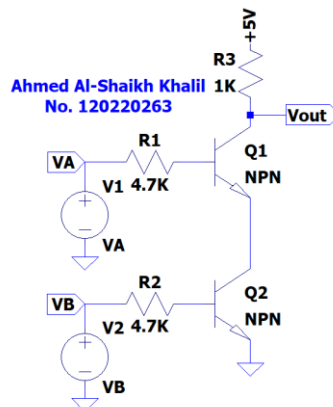


Using the graphical representation, we can write the truth table as follows:

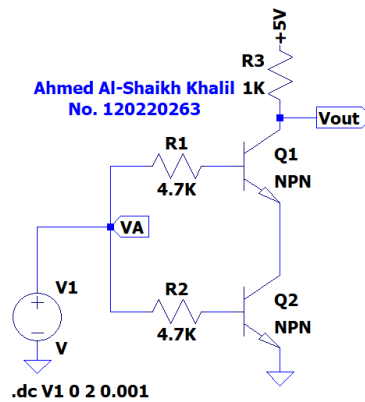
V_A	V_B	V_{out}
1	1	0
1	0	0
0	1	0
0	0	1

❖ Part (3): 2-Input NAND gate:

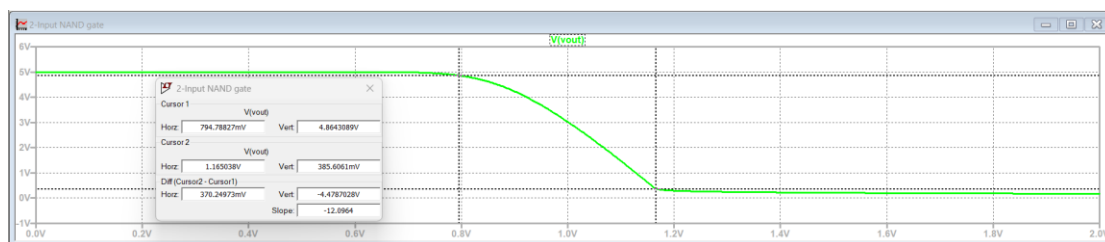
A. Connect the circuit shown in Fig. 3.5 using LTspice:



B. Connect the inputs VA and VB to the same Voltage Source.



C. Plot the voltage transfer characteristics (VTC), Then determine V_{OH} & V_{OL} .



V_{OL}	385.6061mV
V_{OH}	4.8643089V