LABORATORY WORK REPORT №4

« Simple digital circuits design and simulation »

Principles of Circuits

Student: CAO Xinyang
Program of Computer Science and Technology

group №
Name Surname

1. **Work purpose: to study transistor switch, logic families and simple logic schemes**

Goals:

1) Design transistor switch

2) Simulate transistor switch in LtSpice

3) Design simple logic scheme

4) Additional task – logic element design in LtSpice

2. **Starting data**

2.1 Parameters of the voltage source:

$$V_{cc} = 5\,V$$

2.2 Transistor type – FZT849

3. **Transistor switch mode**

3.1 Parameters of scheme element (with calculations)

3.1.1 Collector current you choose I_C =7 A

3.1.2 Collector resistor value

$R_C = \frac{V_{CC} - V_{CE_{sat}}}{I_C}$ =0.664 Ω

3.1.3 Base current (minimum value)

$I_{B_{sat}} = \frac{V_{CC} - V_{CE_{sat}}}{\beta R_C}$ =0.047 A

3.1.4 Saturation base current you choose $I_{B_{sat}}$= 0.047 A

3.1.5 Base resistor value
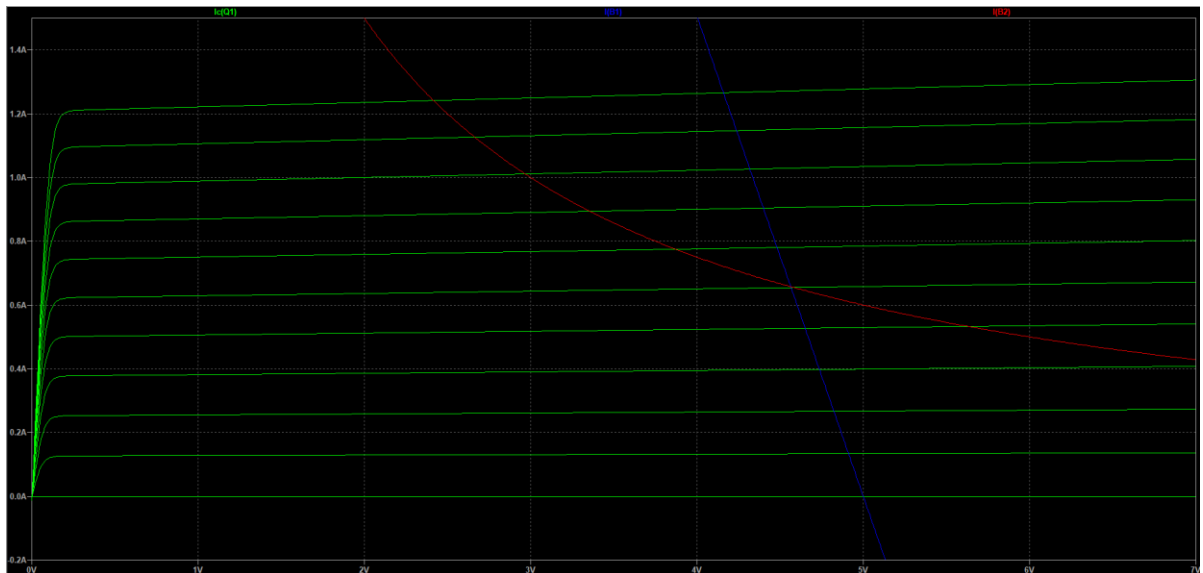
$R_B = \frac{V_i - V_{BE}}{I_B}$=80.85 Ω

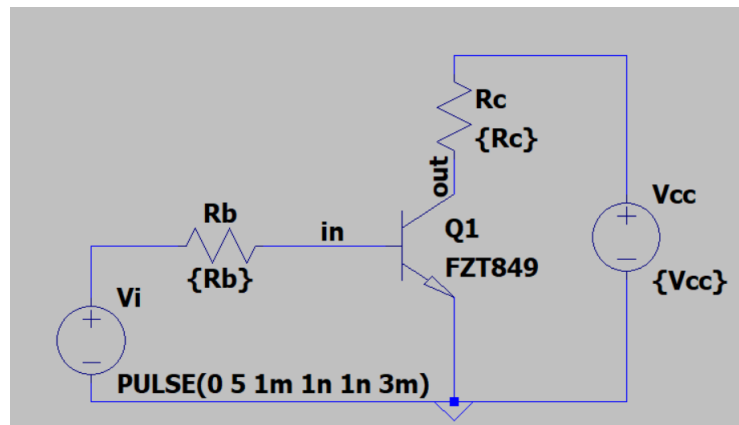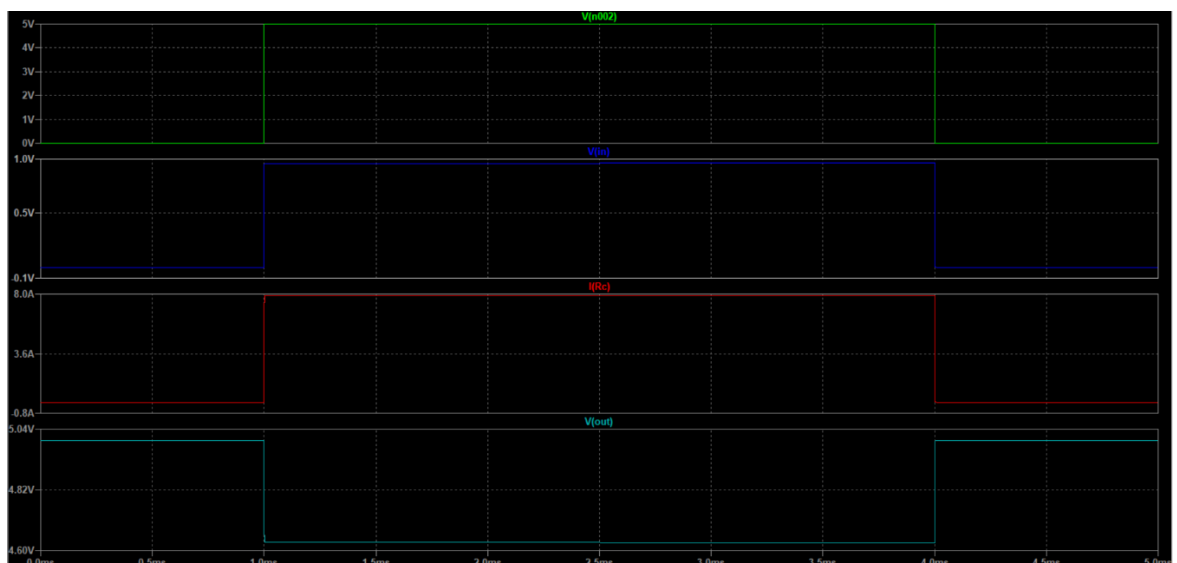Fig. 1 – Output volt-ampere characteristic

Fig.2 - Inverter circuit

Fig. 3 – Time diagram for BJT switch

Conclusions on the first part of the laboratory work - We set different parameters according to different triode models.

4. Combinational Logic Circuits

The combination logic circuit and true table are shown on figure 4.

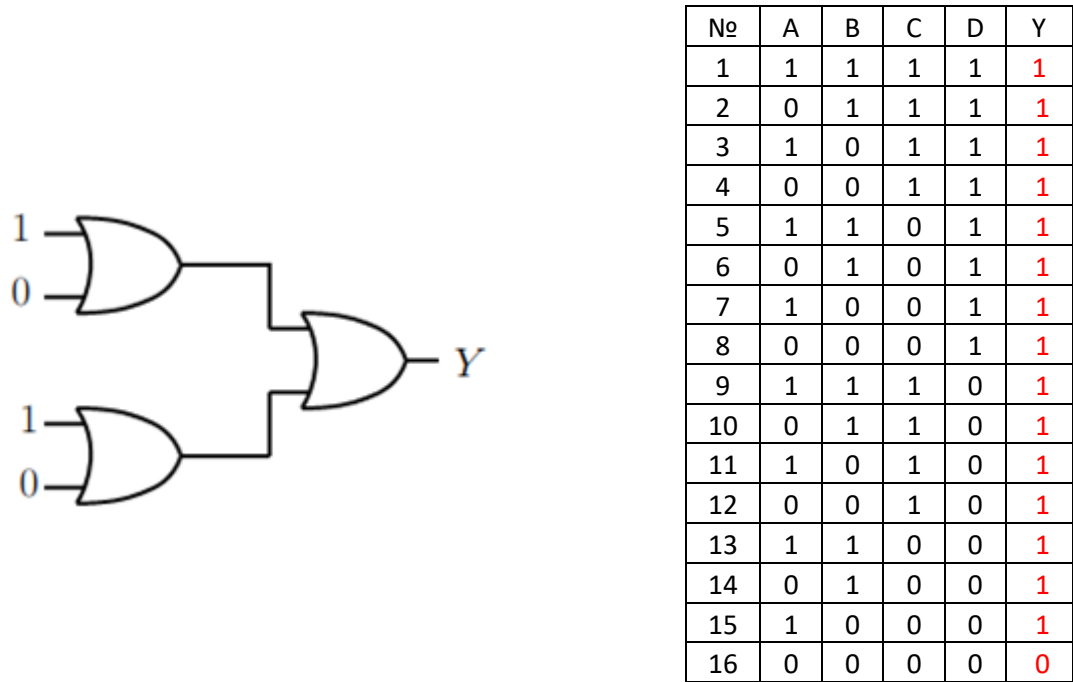| №	A	B	C	D	Y
1	1	1	1	1	1
2	0	1	1	1	1
3	1	0	1	1	1
4	0	0	1	1	1
5	1	1	0	1	1
6	0	1	0	1	1
7	1	0	0	1	1
8	0	0	0	1	1
9	1	1	1	0	1
10	0	1	1	0	1
11	1	0	1	0	1
12	0	0	1	0	1
13	1	1	0	0	1
14	0	1	0	0	1
15	1	0	0	0	1
16	0	0	0	0	0

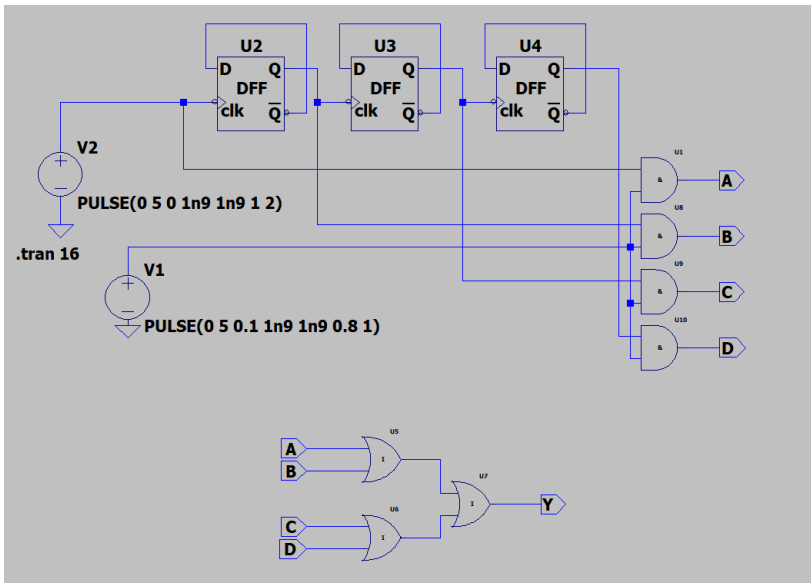Fig. 4 - The combination logic circuit and true table

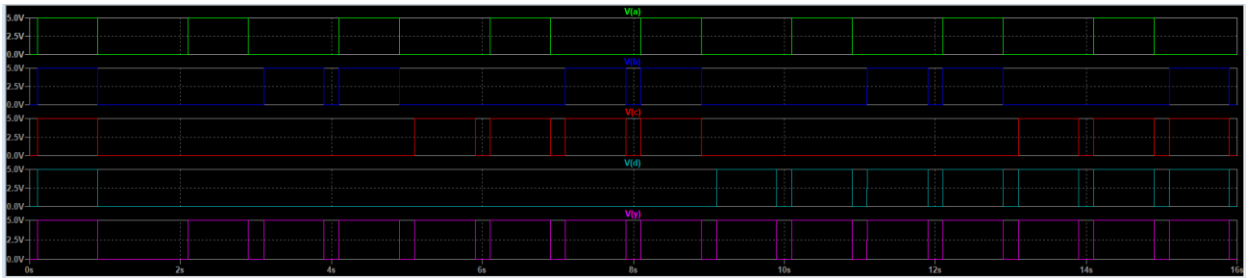Fig.5 – Simulation model from LtSpice

Fig. 6 – Simulation results

Conclusions on the second part of the laboratory work - We judge the truth table corresponding to the logic gate according to the output waveform.

5. Logic families

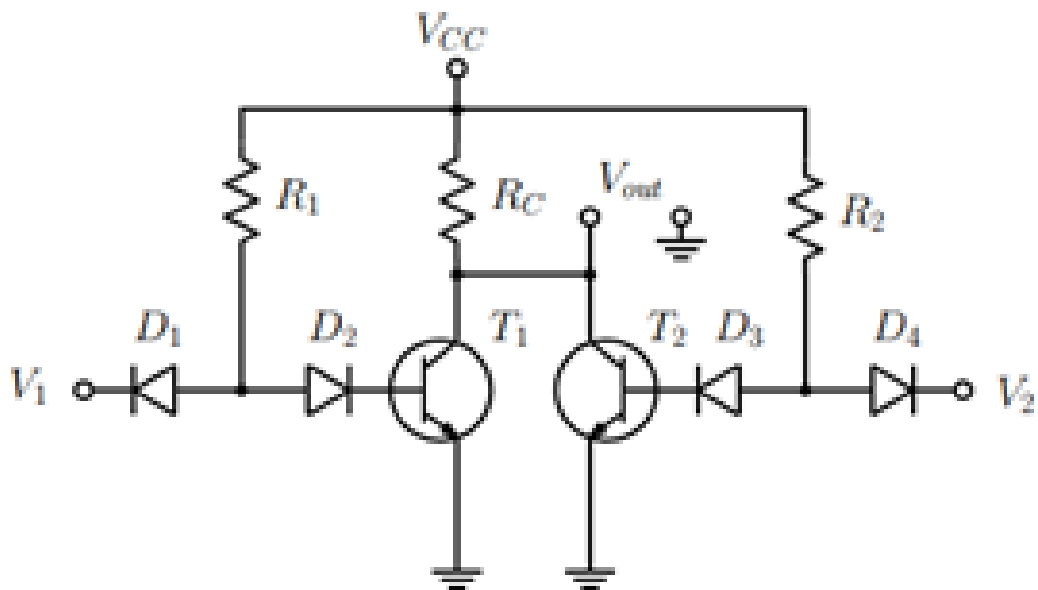Logic element is shown in fig. 7.
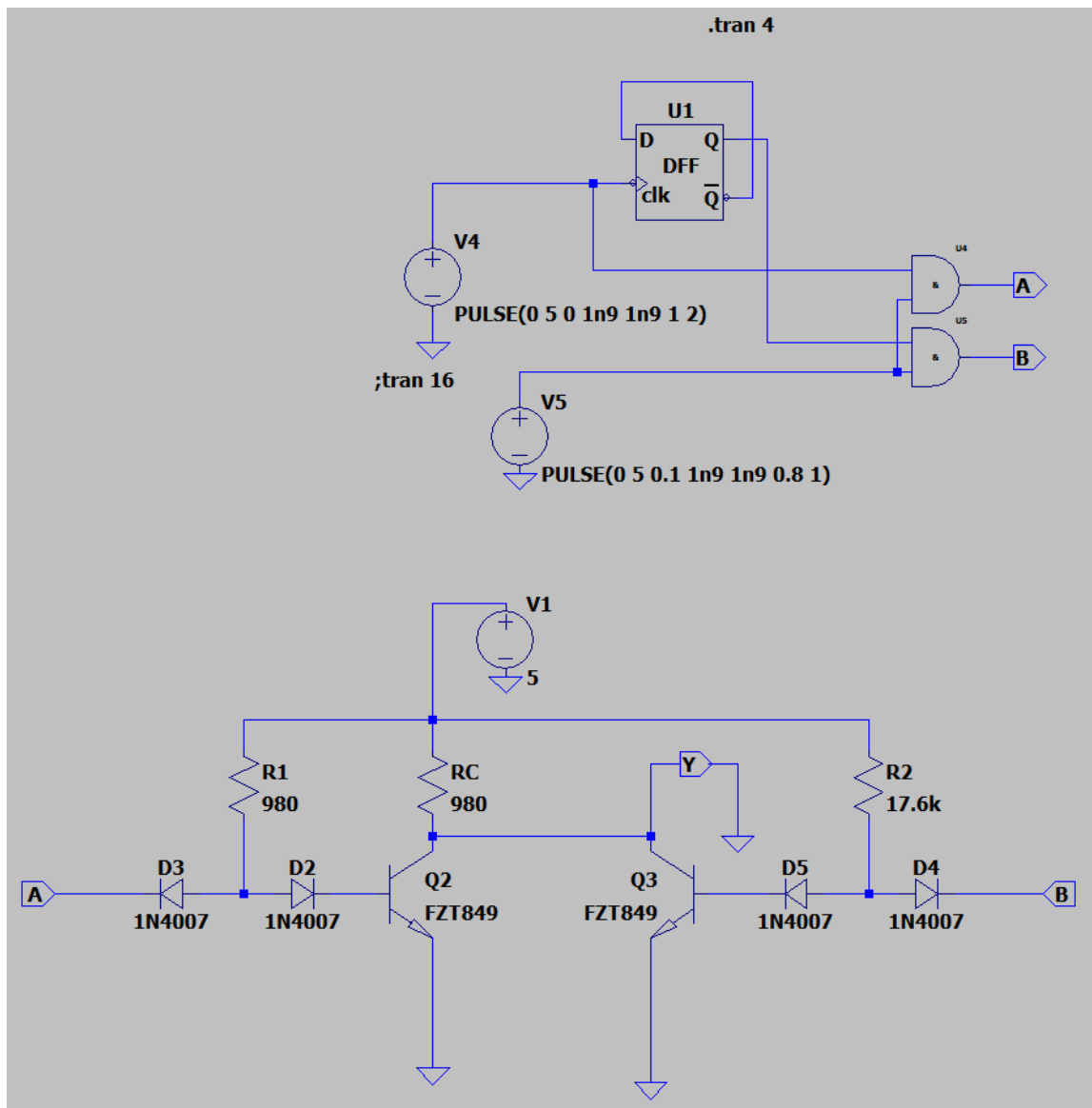

Fig. 7 – Logic element scheme and true table

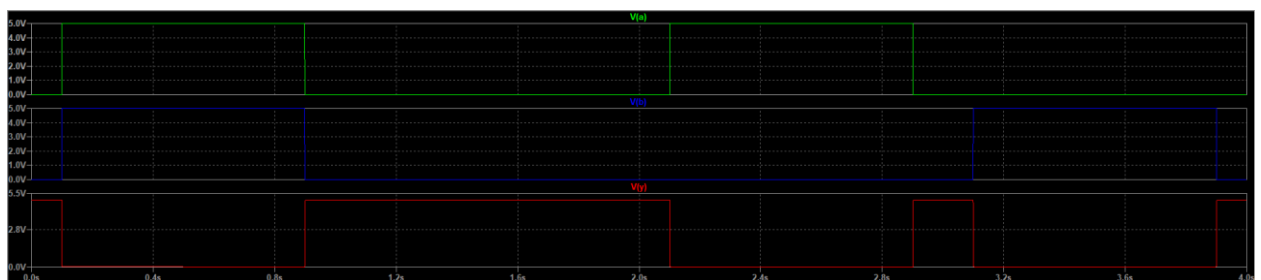Fig. 8 – Simulation model from LtSpice

Fig. 9 – Simulation results

Conclusions on the third part of the laboratory work - We drew the corresponding logic circuit and recorded its output results.