Literature:

Diode: p 166 – 172, 183-184, 197-210

Assignments:

2.1:

A logic circuit is shown in Fig. 1. The voltage drops of the diodes connected to A and B are 0.7 V and the voltage drop of the LED is 2 V.

- When A is connected to 0 V and B to 0 V, is the LED on or off? Why?
- When A is connected to 0 V and B to 5 V, is the LED on or off? Why?
- When A is connected to 5 V and B to 0 V, is the LED on or off? Why?
- When A is connected to 5 V and B to 5 V, is the LED on or off? Why?
- What logic gate is it?

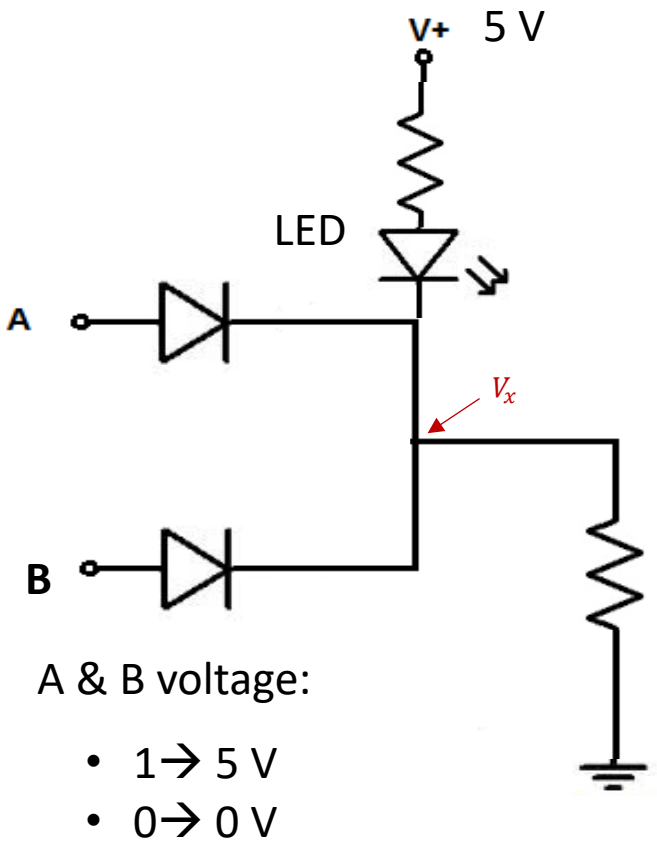

Fig. 1

Solution:

- When A=0 (0V) and B=0(0V) ➔ diode A and B are off ➔ The voltage across the LED > 2 V ➔ LED is on (1)
- When A=0 (0V) and B=1(5V) ➔ diode A is off, but diode B is on ➔ V_x = 5-0.7 = 4.3 V ➔ The voltage across the LED = 5$-V_x = 0.7$ V < 2 V ➔ LED is off (0)
- When A=1 (5V) and B=0(0V) ➔ diode A is on, and diode B is off ➔ V_x = 5-0.7 = 4.3 V ➔ The voltage across the LED = 5$-V_x = 0.7$ V < 2 V ➔ LED is off (0)
- When A=1 (5V) and B=1(5V) ➔ diode A is on, and diode B is on➔ V_x = 5-0.7 = 4.3 V ➔ The voltage across the LED = 5$-V_x = 0.7$ V < 2 V ➔ LED is off (0)
- It is a NOR gate.

2.2:

Half-wave rectifier LT spice simulation:

$V_{in} = 4sin(2\pi 50t)$, diode 1N4007, R = 1 KΩ, and C = 0.0001 F

plot the voltage across the resistor for the following cases:

1. Half-wave rectifier with a resistor R.
2. Half-wave rectifier with a capacitor C.
3. Half-wave rectifier with a capacitor C and a resistor R.
4. Half-wave rectifier with a capacitor C and a resistor R.
   Change the capacitance of the capacitor to make the output signal smoother.

Solution for 4: We need to pick the type of the diode to 1N4007 in this simulation.

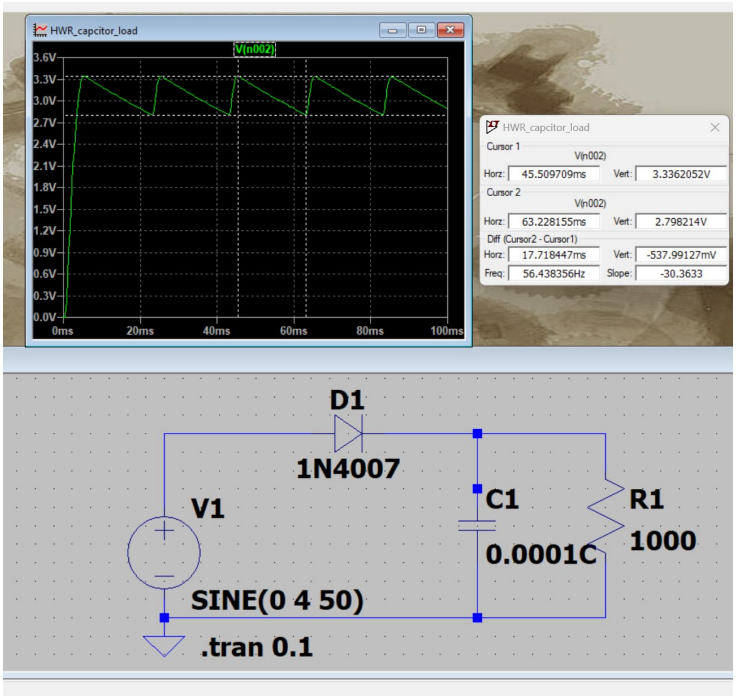

Fig 2. C = 0.0001 F, the ripple amplitude of the output signal is around 0.5 V

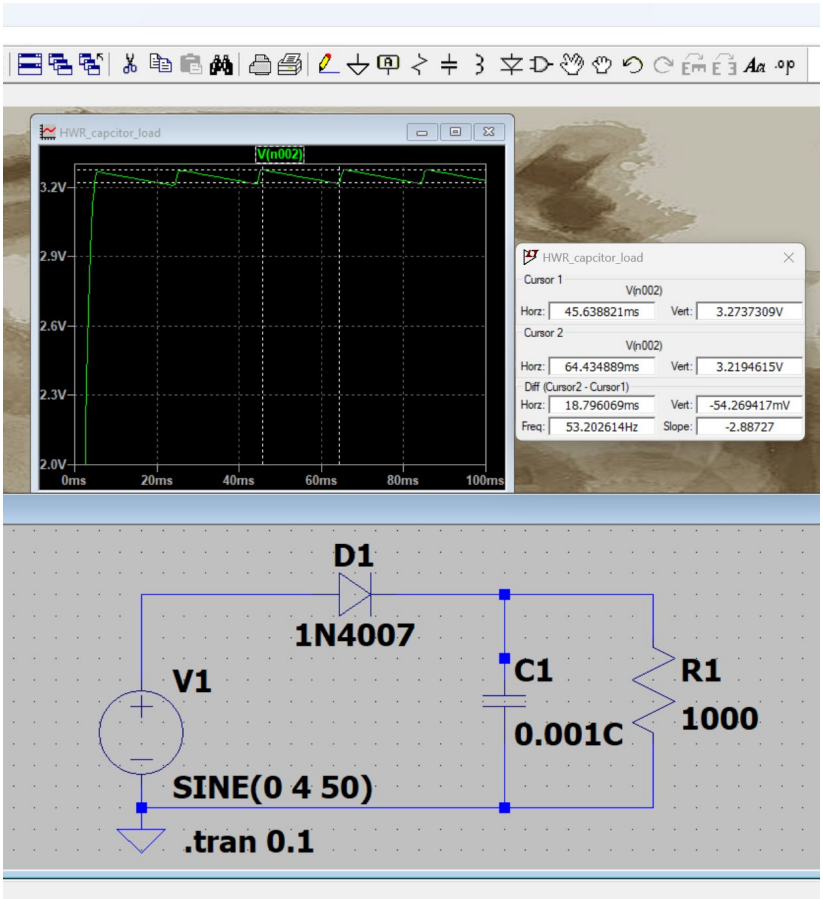

Fig 3. Increasing C = 0.001 F, the ripple amplitude of the output signal is reduced to around 0.05 V

2.3:

Full-wave rectifier LT spice simulation:

$V_{in} = 4sin(2\pi 50t)$, diode 1N4007, R = 1 KΩ, and C = 0.0001 F

plot the voltage across the resistor for the following cases:

1. Full-wave rectifier with a resistor R.
2. Full-wave rectifier with a capacitor C.
3. Full-wave rectifier with a capacitor C and a resistor R.
4. Full-wave rectifier with a capacitor C and a resistor R.
   Change the capacitance of the capacitor, i.e., change the value of C, to make the output signal smoother.

Solution for 4: We need to pick the type of the diode to 1N4007 in this simulation.

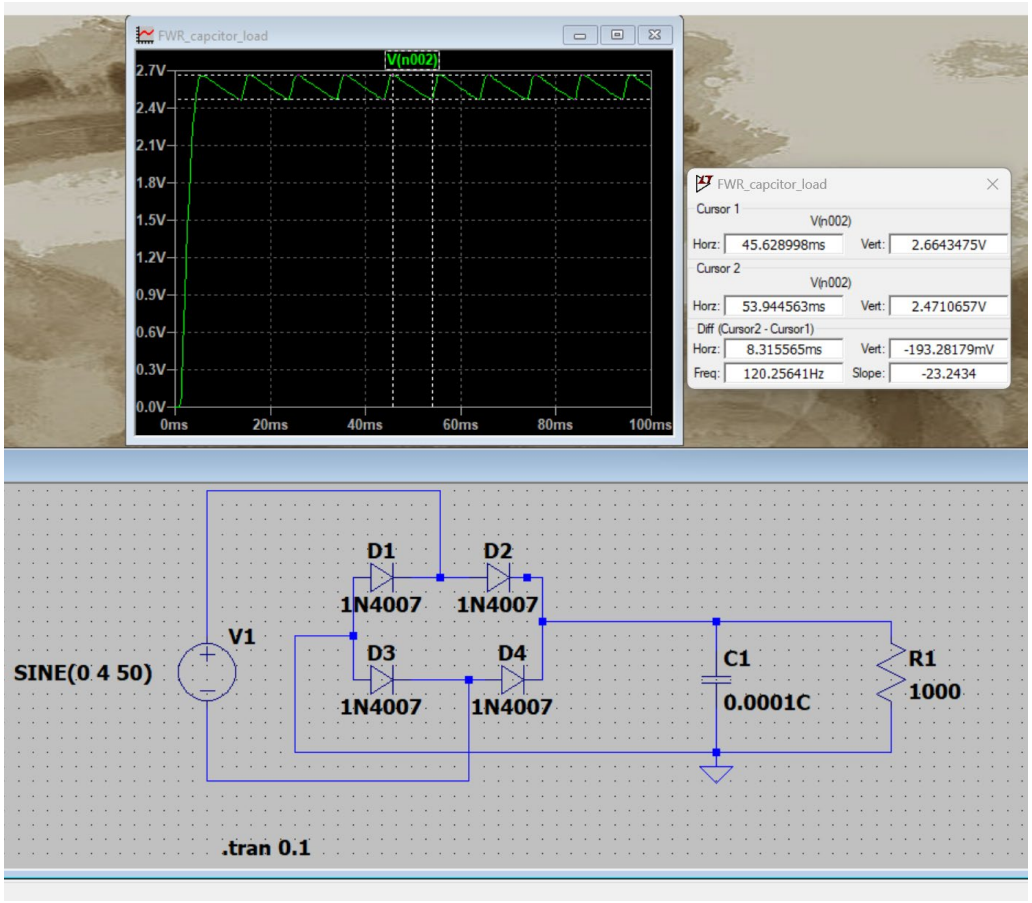

Fig 4. C = 0.0001 F, the ripple amplitude of the output signal is around 0.2 V, which is around the half of that of the half-wave rectifier in Fig. 2.

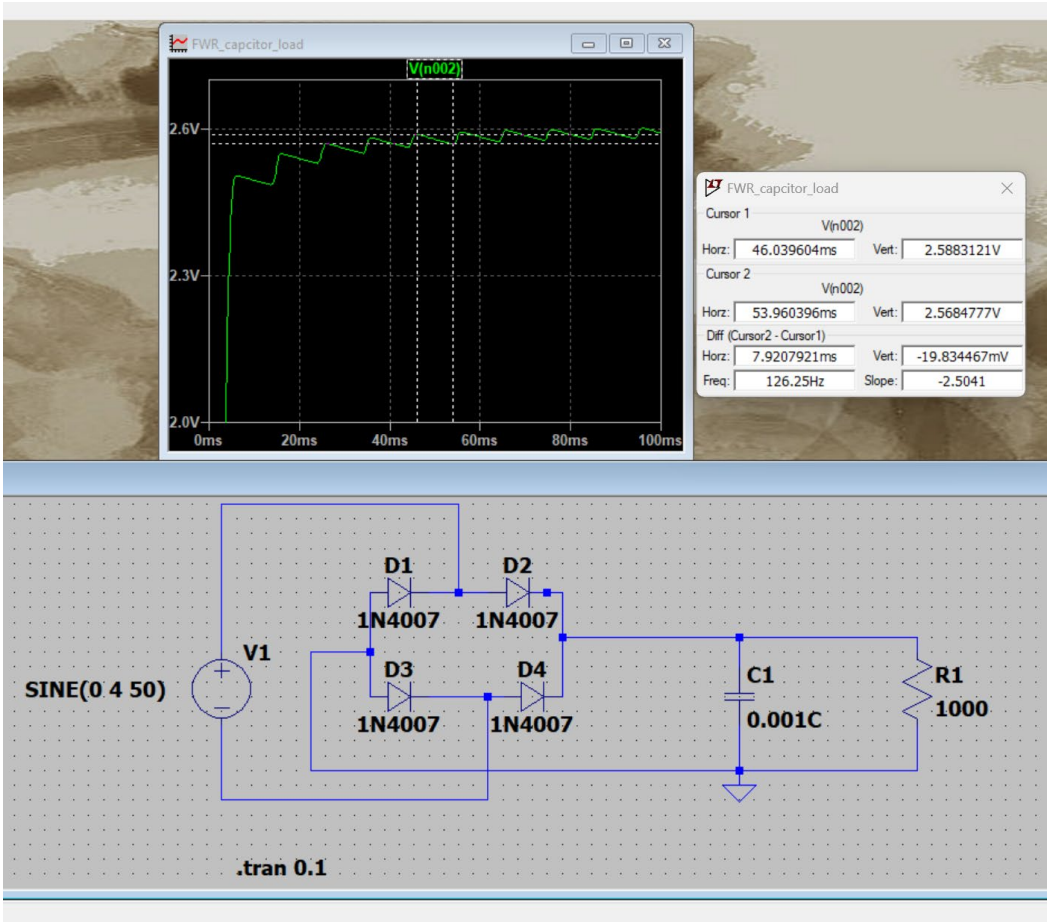

Fig 5. Increasing C = 0.001 F, the ripple amplitude of the output signal is reduced to around 0.02 V.