Experiment 5 Preliminary Work
Operational Amplifiers

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1 Introduction

In preliminary work of the Experiment 5 , the steps for the pre-experiment are conducted and presented.

2 Step 1

Videos in ODTUCLASS related to this experiment is watched and observations are noted.

3 Step 2

"Notes on Op-Amps" documents is studied.

4 Step 3

In this step following 4 op-amp circuits are constructed in the LTSpice environment and simulated. $V_{in(t)}$ is taken as $3sin(1000\pi)$ Volts. Then data are fetched from LTSpice and plotted in MATLAB.

4.1 a)

Basic comparator circuit is constructed in LTSpice environment. The schematic is given in the Figure 1.

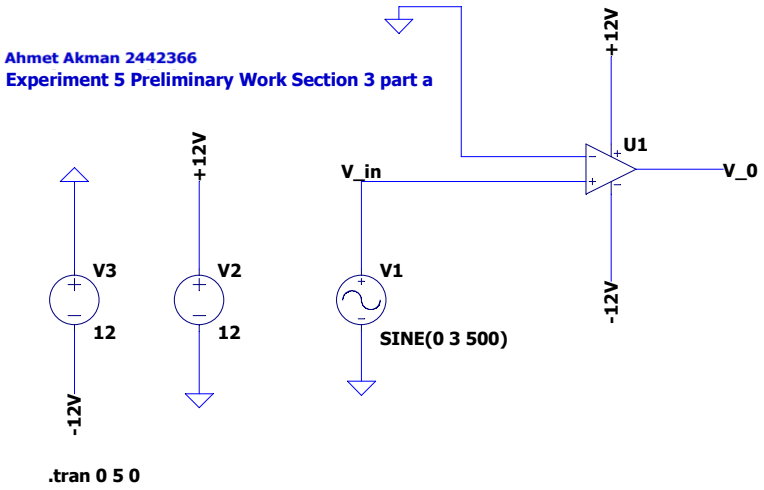

Figure 1: Circuit schematic for the basic comparator.

Then plots given in Figures 5,6 and 7 are obtained.

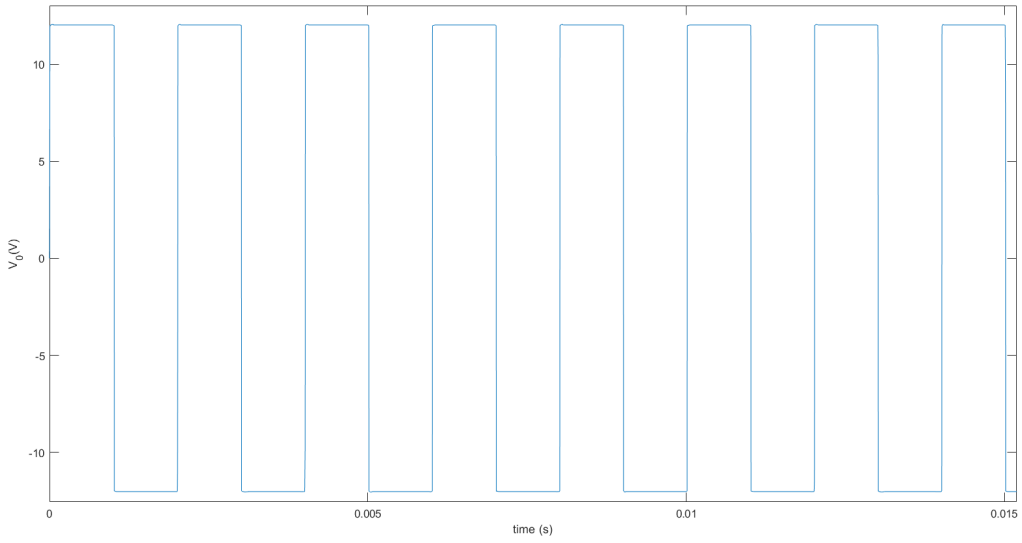

Figure 2: V_0 vs t

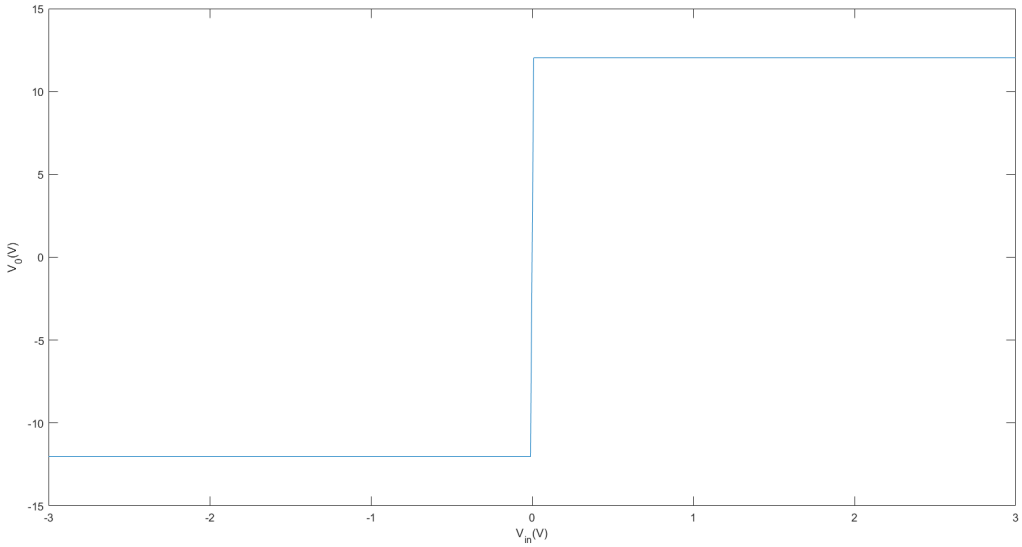

Figure 3: V_0 vs Vin

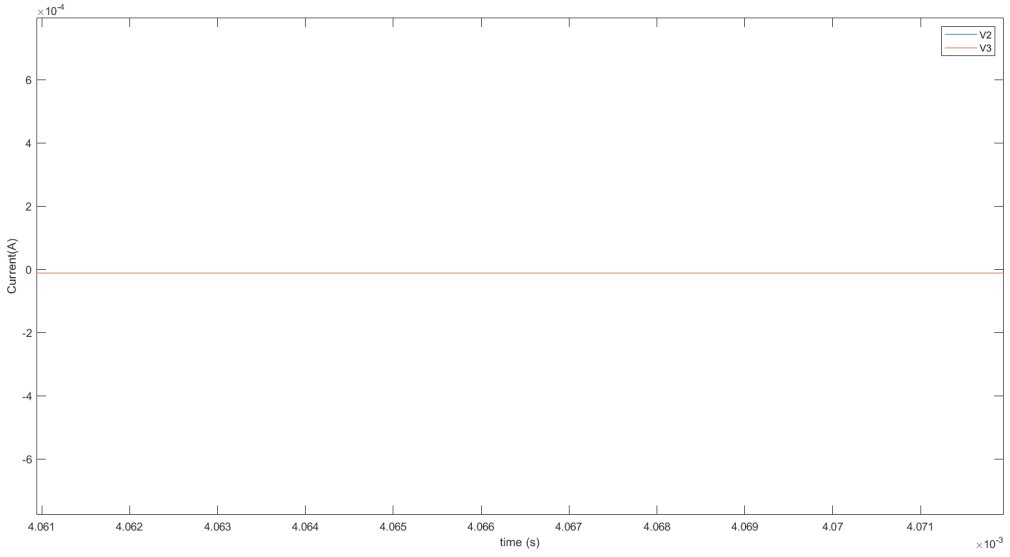

Figure 4: i vs t

4.2 b)

Buffer circuit is constructed in LTSpice environment. The schematic is given in the Figure 8.

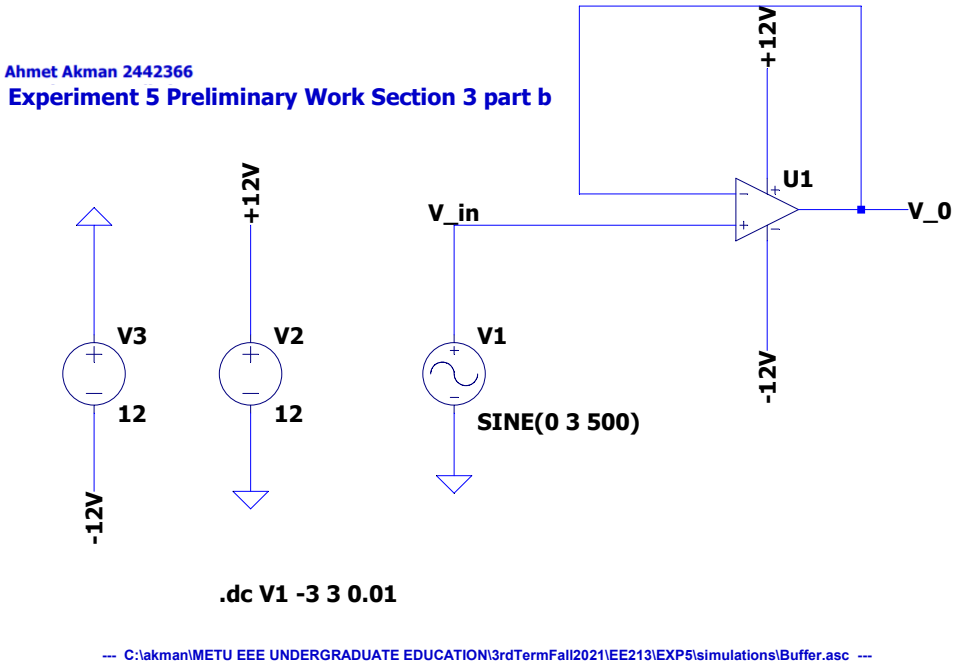

Figure 5: Circuit schematic for the buffer.

Then plots given in Figures 9 , 10 and 11 are obtained.

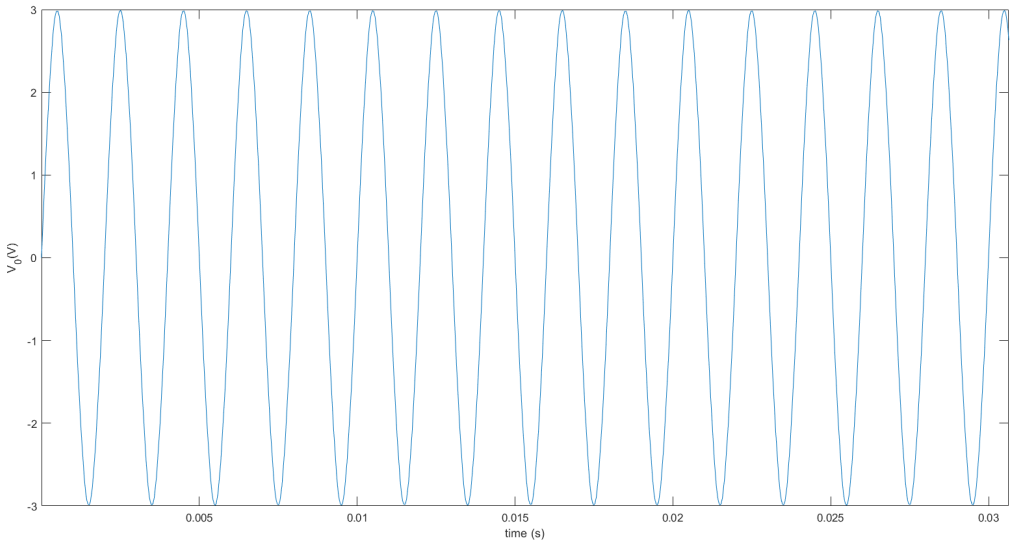

Figure 6: V_0 vs t

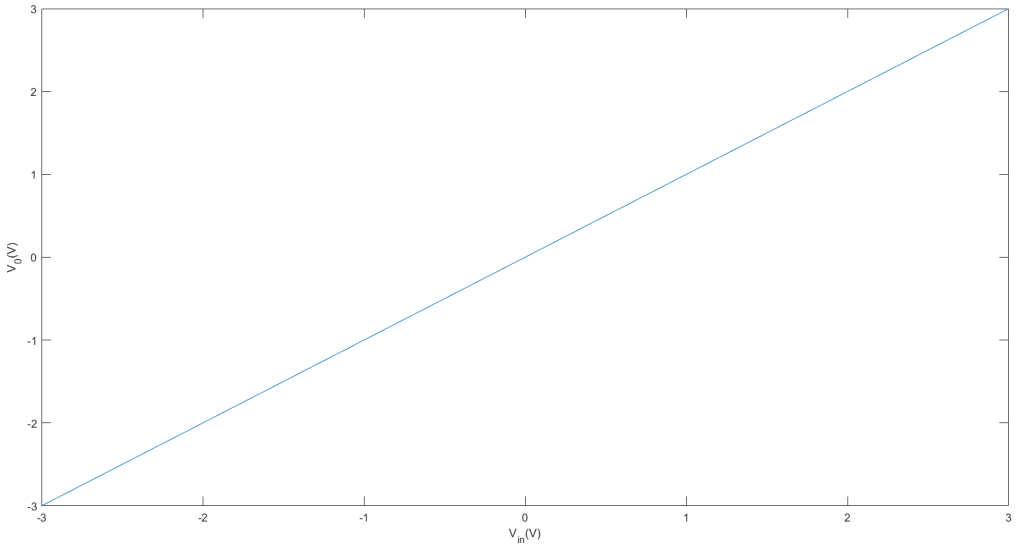

Figure 7: V_0 vs Vin

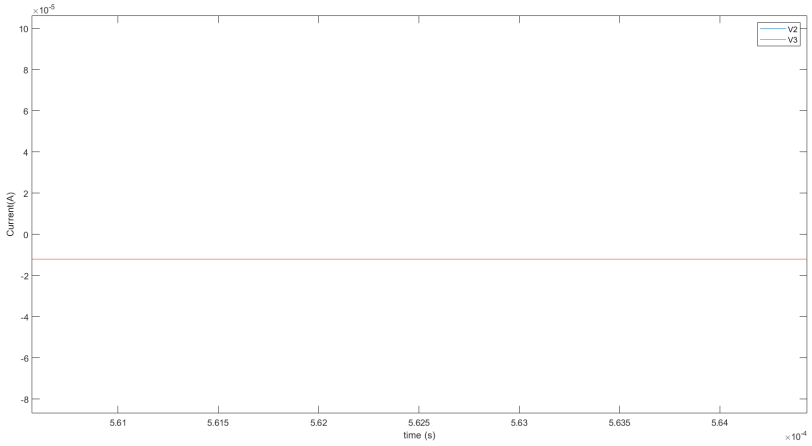

Figure 8: i vs t

4.3 c)

Inverting amplifier circuit is constructed in LTSpice environment. The schematic is given in the Figure 12.

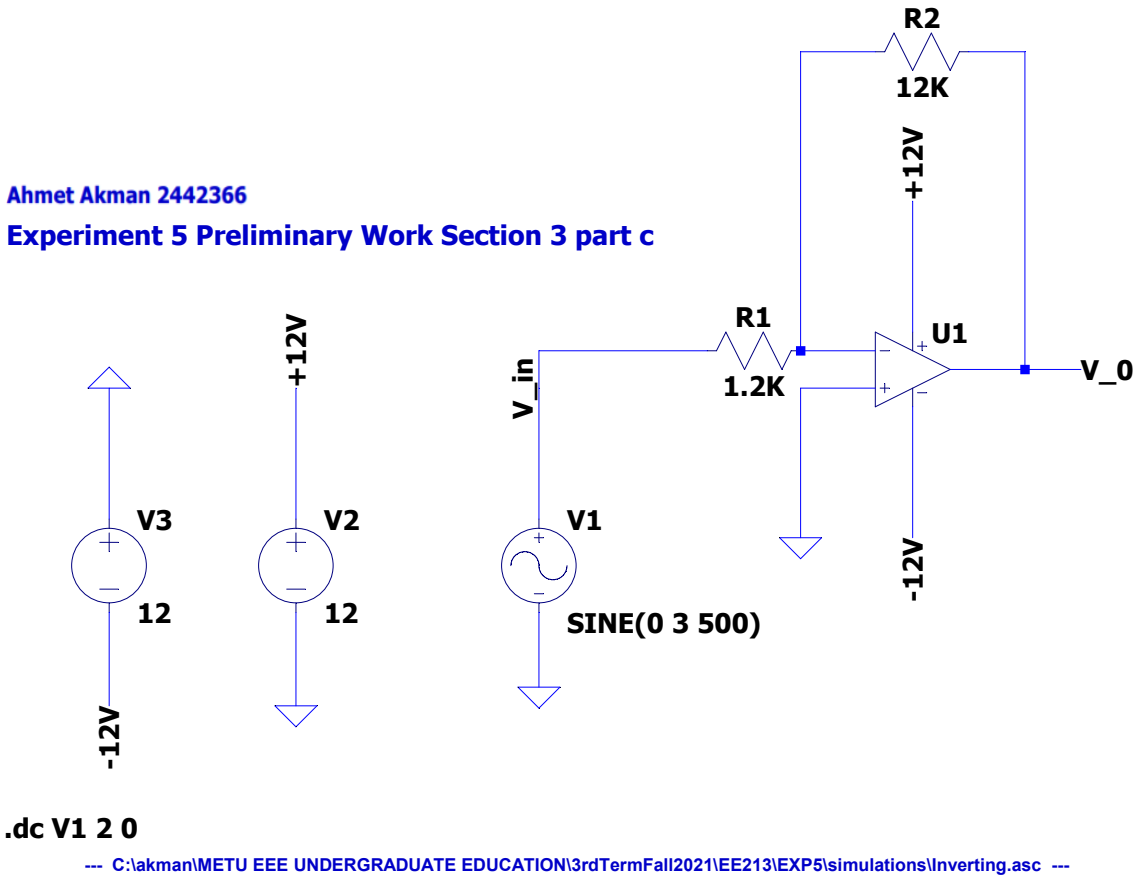

Figure 9: Circuit schematic for the inverting amplifier.

Then plots given in Figures 13,14 and 15 are obtained.

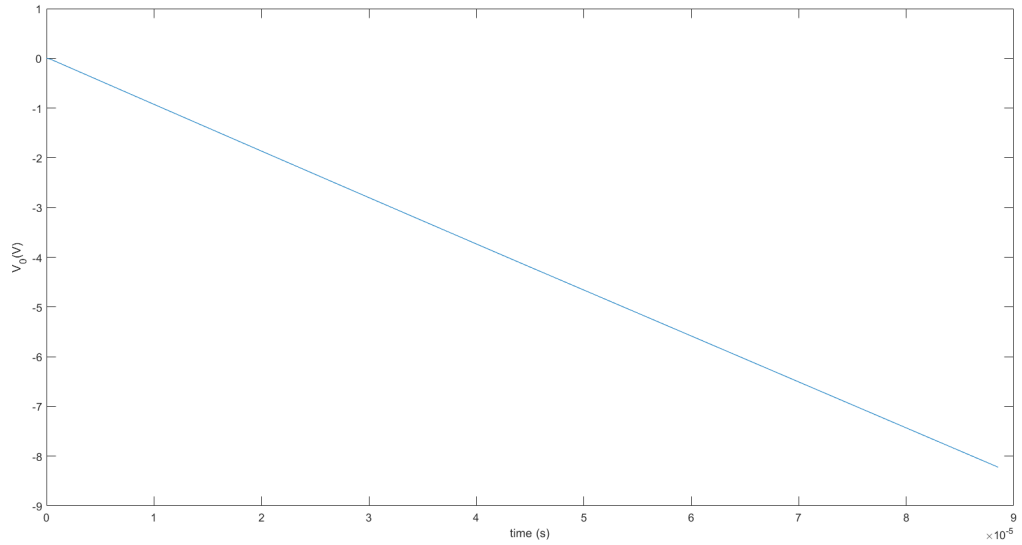

Figure 10: V_0 vs t

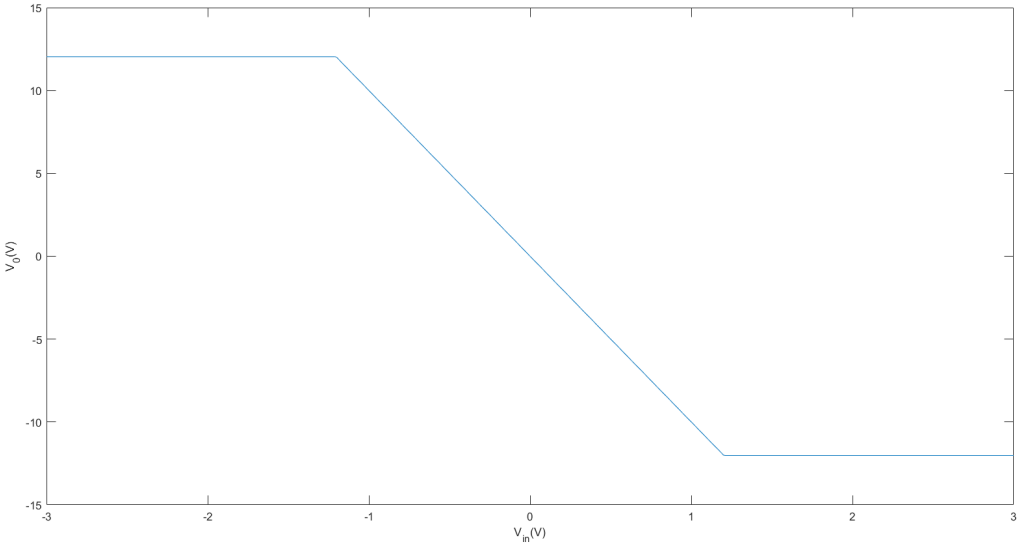

Figure 11: V_0 vs Vin

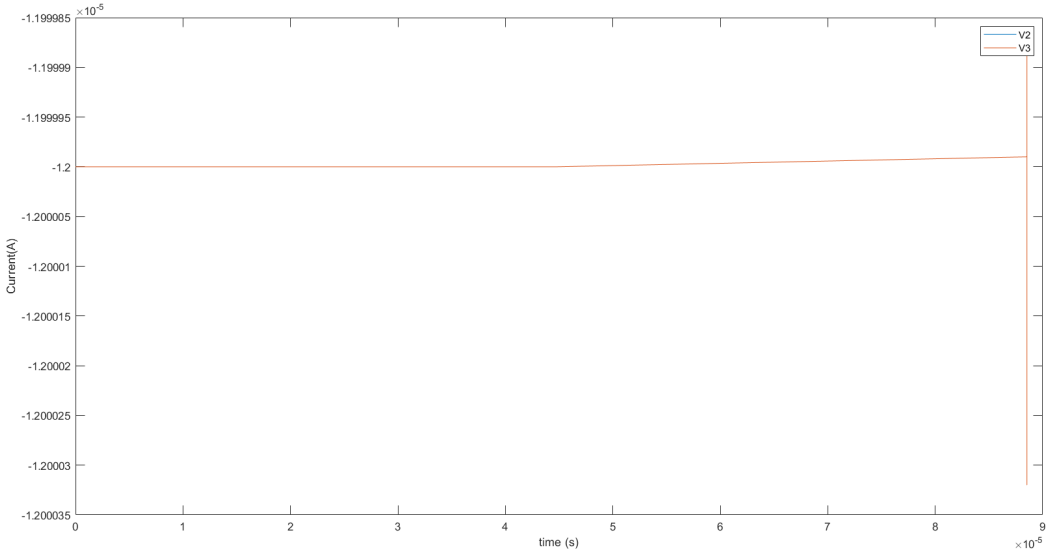

Figure 12: i vs t

4.4 d)

Non-inverting amplifier circuit is constructed in LTSpice environment. The schematic is given in the Figure 16.

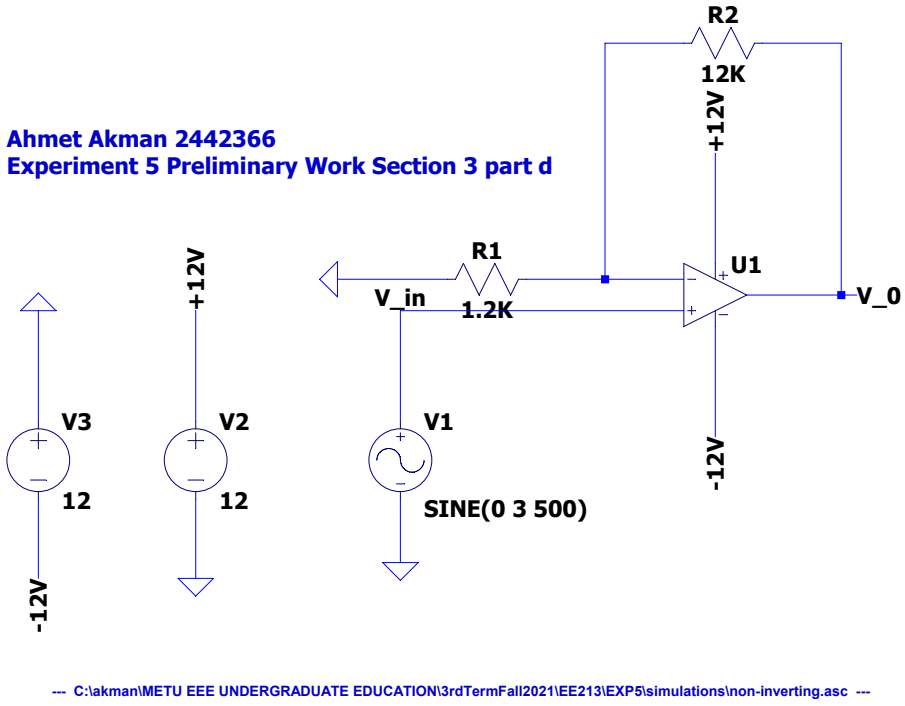

Figure 13: Circuit schematic for the basic comparator.

Then plots given in Figures 17,18 and 19 are obtained.

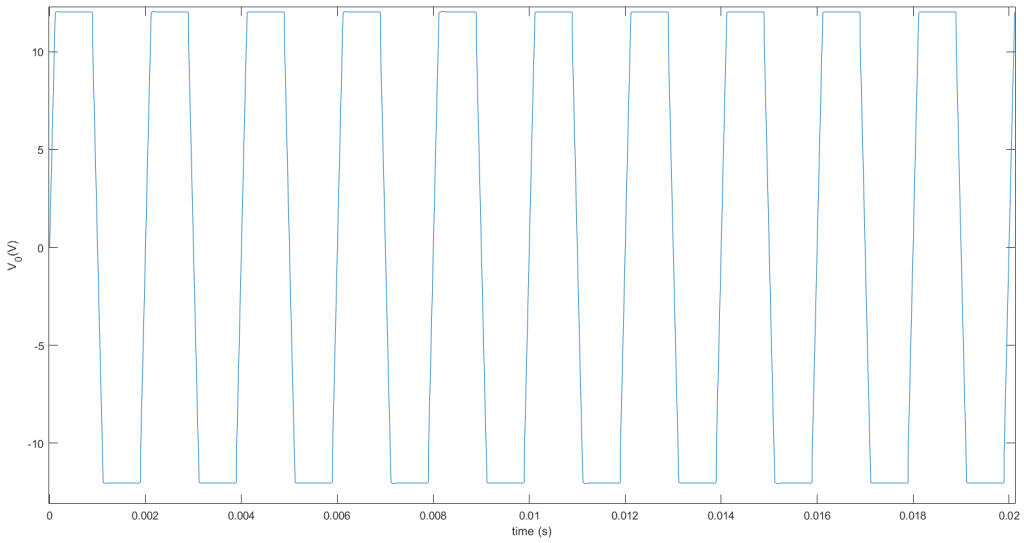

Figure 14: V_0 vs t

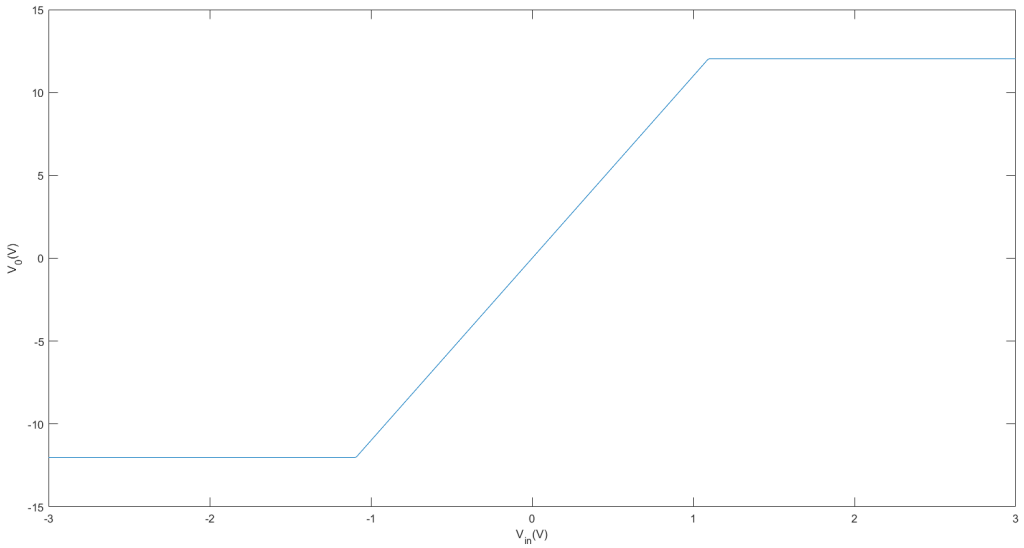

Figure 15: V_0 vs Vin

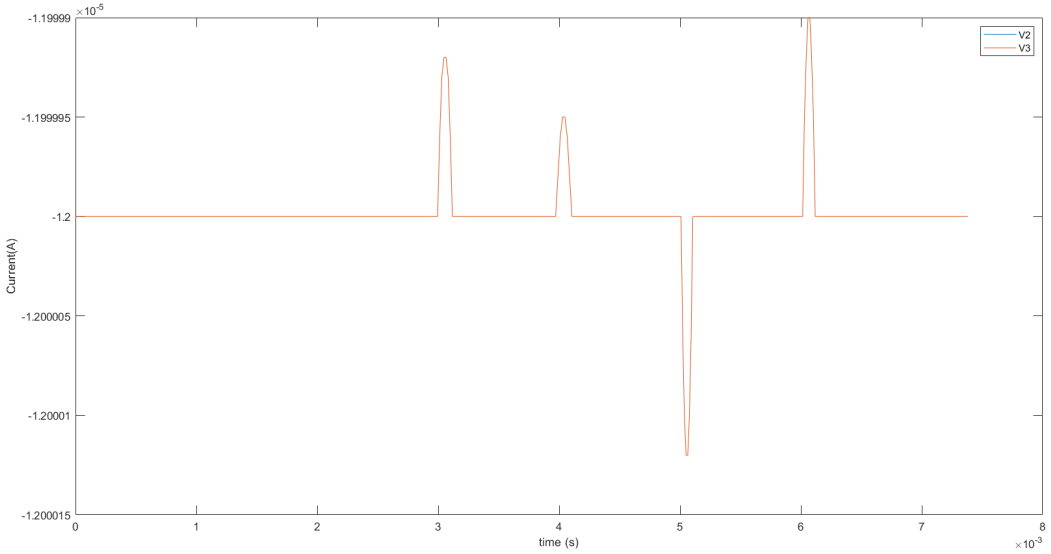

Figure 16: i vs t

5 Step 4

In this step following 2 op-amp circuits are constructed in the LTSpice environment and simulated. V_a is taken as $4sin(1000\pi)$ Volts. V_b is taken as $2sin(1000\pi)$ Volts. Then data are fetched from LTSpice and plotted in MATLAB.

5.1 a)

Summing amplifier circuit is constructed in LTSpice environment. The schematic is given in the Figure 20.

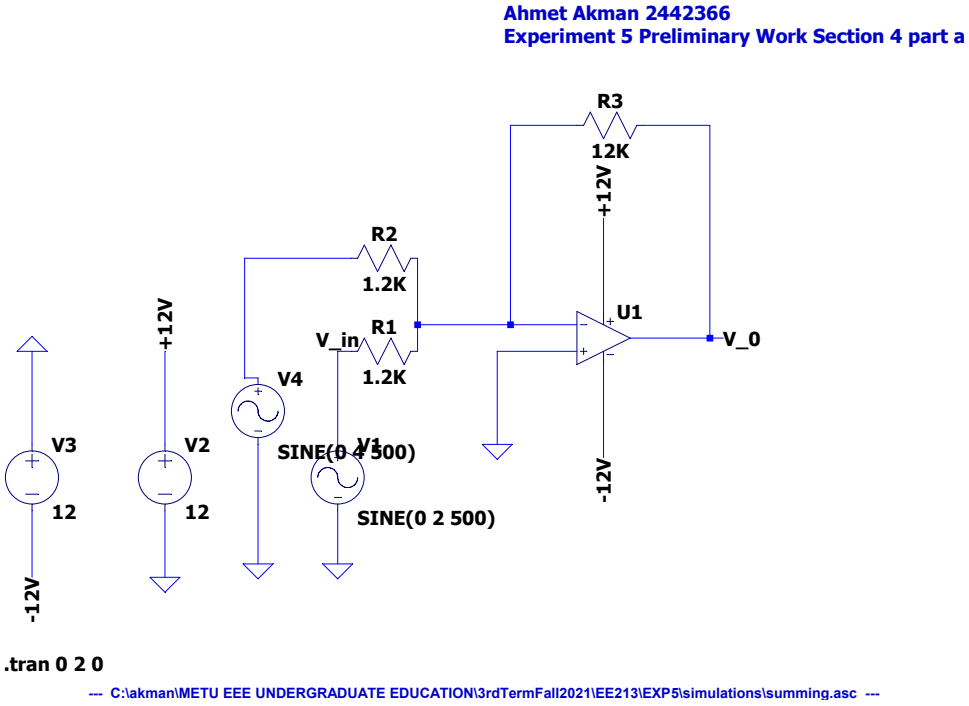

Figure 17: Circuit schematic for the summing amplifier.

Then plots given in Figure 21 is obtained.

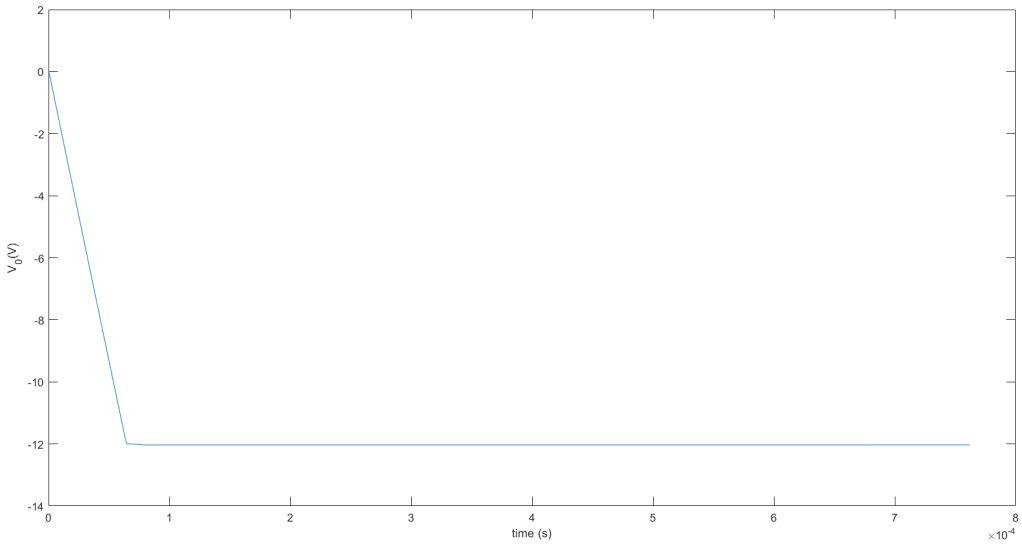

Figure 18: V_0 vs t

5.2 b)

Difference amplifier circuit is constructed in LTSpice environment. The schematic is given in the Figure 22.

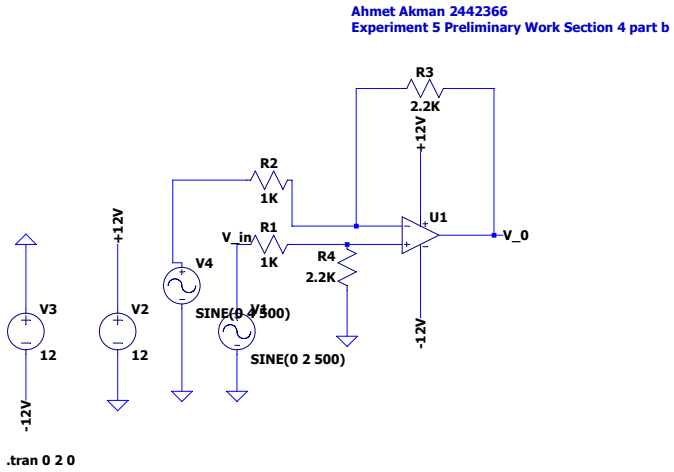

Figure 19: Circuit schematic for the difference amplifier.

Then plots given in Figure 23 is obtained.

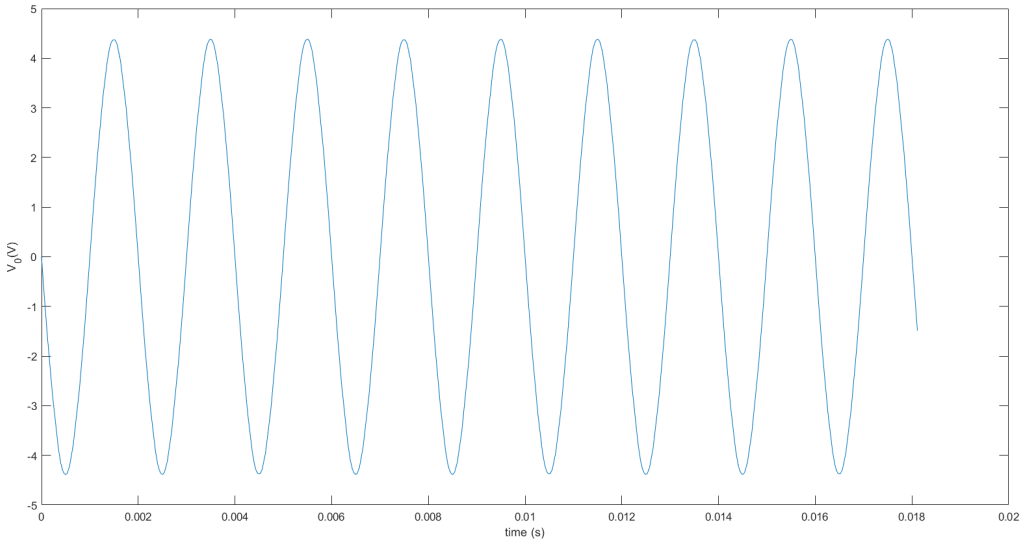

Figure 20: V_0 vs t

6 Step 5

To obtain the expression relating the output voltage $V_0(t)$ to the input voltage $V_{in}(t)$ of a inverting amplifier setup, the circuit in Figure 8 is taken as the reference. Then current throught input terminals and the voltage of those terminals are taken as 0 since it is ideal amplifier. So the circuit simplifies to 2 terminals and 2 resistors. Then the following simplifications are followed.

$$\frac{Vin - 0}{R_1} = i$$

$$\frac{0 - Vo}{R_2} = i$$

So, the relation becomes as,

$$\frac{Vout}{Vin} = -\frac{R_2}{R_1}$$

Therefore it seems the plot given in Figure 5 approximately corresponds our findings.

7 Conclusion

In conclusion, in preliminary work of experiment 5, "Operational Amplifiers" needed simulation are made and necesseray data are plotted. Then the expreession for the inverting amplifier obtained and compared.