

Experiment 6 Preliminary Work

Operational Amplifiers - II

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1 Introduction

In preliminary work of the Experiment 6 , the steps for the pre-experiment are conducted and presented.

2 Step 1

For this step circuit given in Figure 1 is taken as the reference.

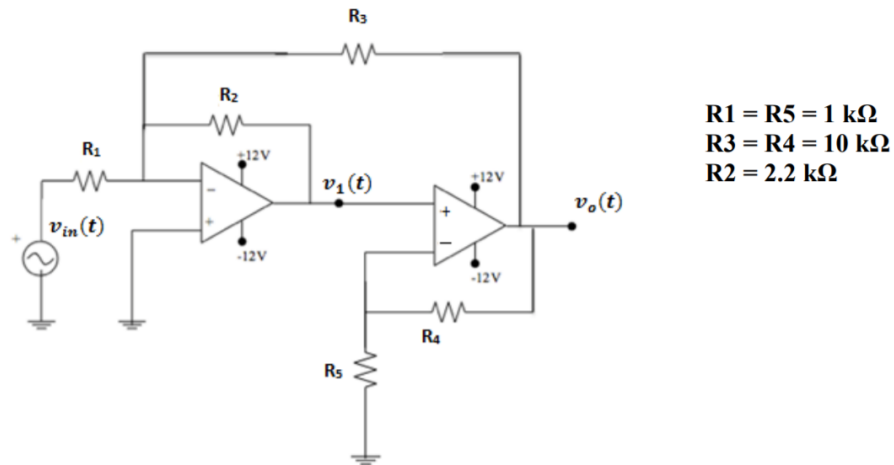


Figure 1: Circuit schematic for the step 1

2.1 a)

The expression relating $V_o(t)$ to V_{in} is obtained via hand calculations which is given in Figure 2.

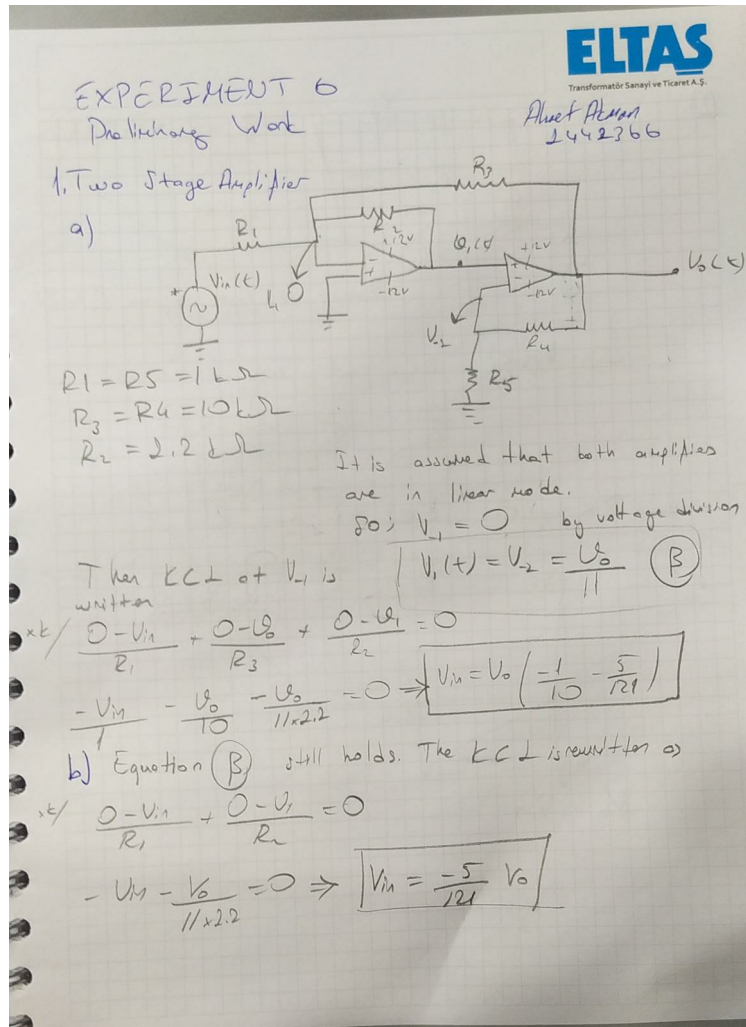


Figure 2: Hand calculations for the expression relating $V_0(t)$ to V_{in}

$V_0(t)$ vs V_{in} is sketched in the Figure 3 according to the calculations in Figure 2.

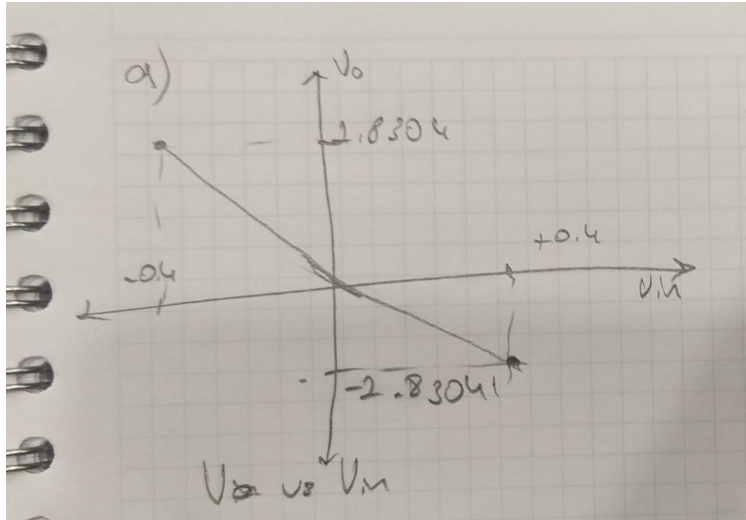


Figure 3: $V_o(t)$ vs V_{in} sketch

2.2 b)

The expression relating $V_o(t)$ to V_{in} without R3 is obtained via hand calculations which is given in Figure 2. $V_o(t)$ vs V_{in} is sketched in the Figure 4 according to the calculations in Figure 2.

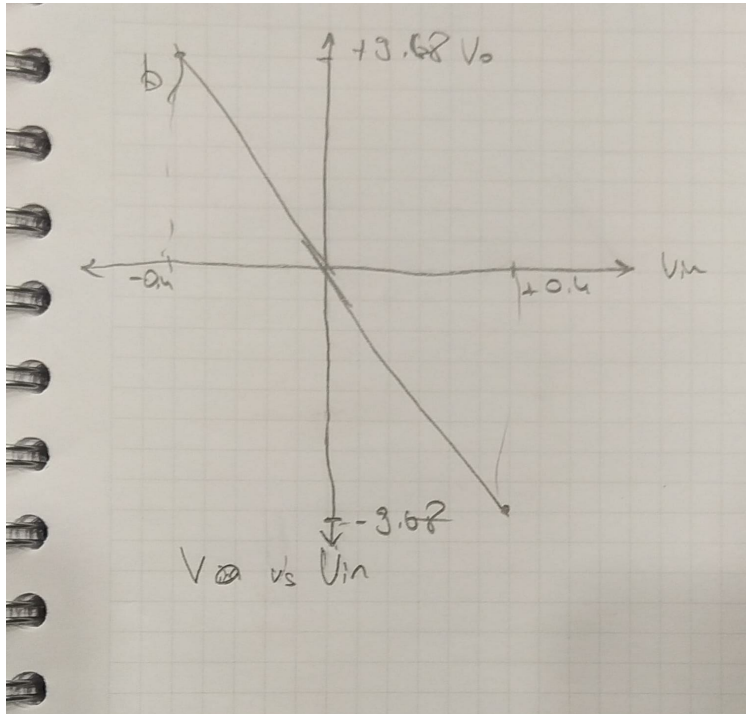


Figure 4: $V_o(t)$ vs V_{in} sketch

3 Step 2

For this step circuit given in Figure 5 is taken as the reference.

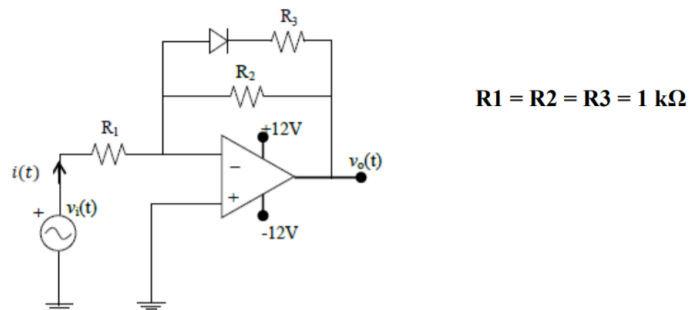


Figure 5: Circuit for Step 2

Then V_o vs V_{in} is plotted given in Figure 6 with its calculations.

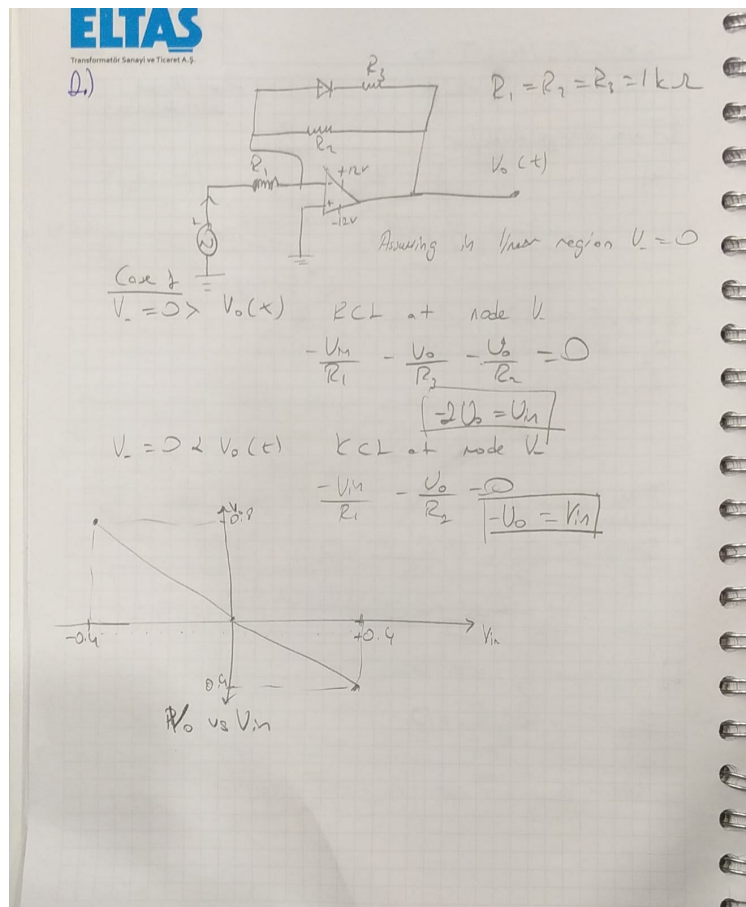


Figure 6: $V_o(t)$ vs V_{in} sketch

In order to measure this characteristic using a DSO, the voltage difference between V_-

and V_o should be increased so that non-ideal diode (e.g. 1N007) react this difference properly. This can be done by increasing the V_{in} and/or decreasing the R_1 value. So, when the first channel of the DSO connected to the V_o node and the channel to the V_{in} node, measurement can be made.

4 Step 3

4.1 a) Darkness Sensor

The circuit given in Figure 7 is taken as the reference.

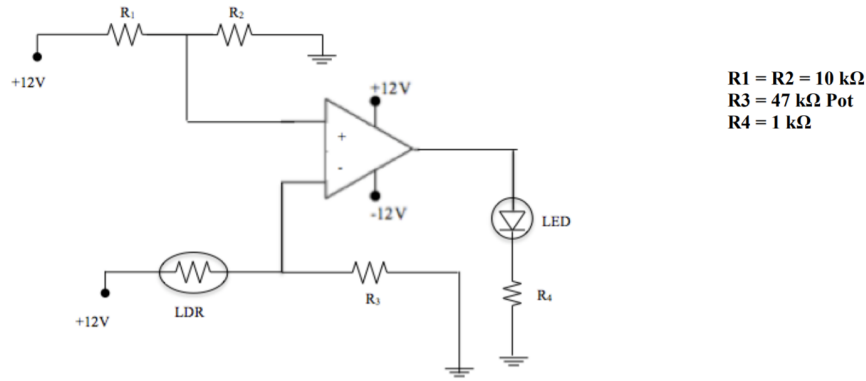


Figure 7: Darkness sensor circuit for the Step 3

The relation that express $V_o(t)$ vs R_{LDR} can be derived using voltage divider equations as follows.

$$V_+ = 6V \text{olts}$$

$$V_- = 12 \frac{R_3}{R_3 + R_{LDR}}$$

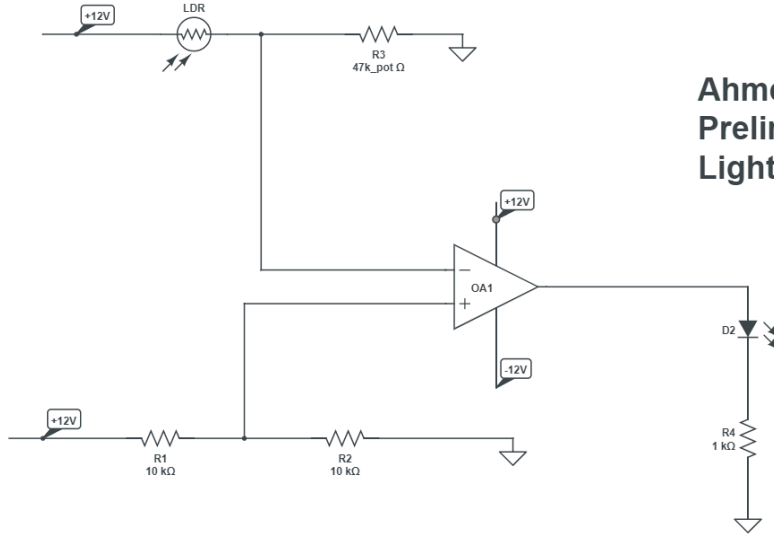
so;

$$\text{if } (6 - 12 \frac{R_3}{R_3 + R_{LDR}} > 0, V_o = +12V)$$

$$\text{if } (6 - 12 \frac{R_3}{R_3 + R_{LDR}} < 0, V_o = -12V)$$

4.2 b) Lightness Sensor

The lightness sensor can be designed via swapping the inverting and non-inverting terminals of Op-Amp in the circuit given in Figure 6. So the resulting circuit is given in the Figure 7.



Ahmet Akman Experiment 6 Preliminary Work Lightness Sensor Design

Figure 8: Lightness sensor circuit for the Step 3

5 Step 4

The circuit in the Figure 1 is constructed in LTSpice environment, given in Figure 8.

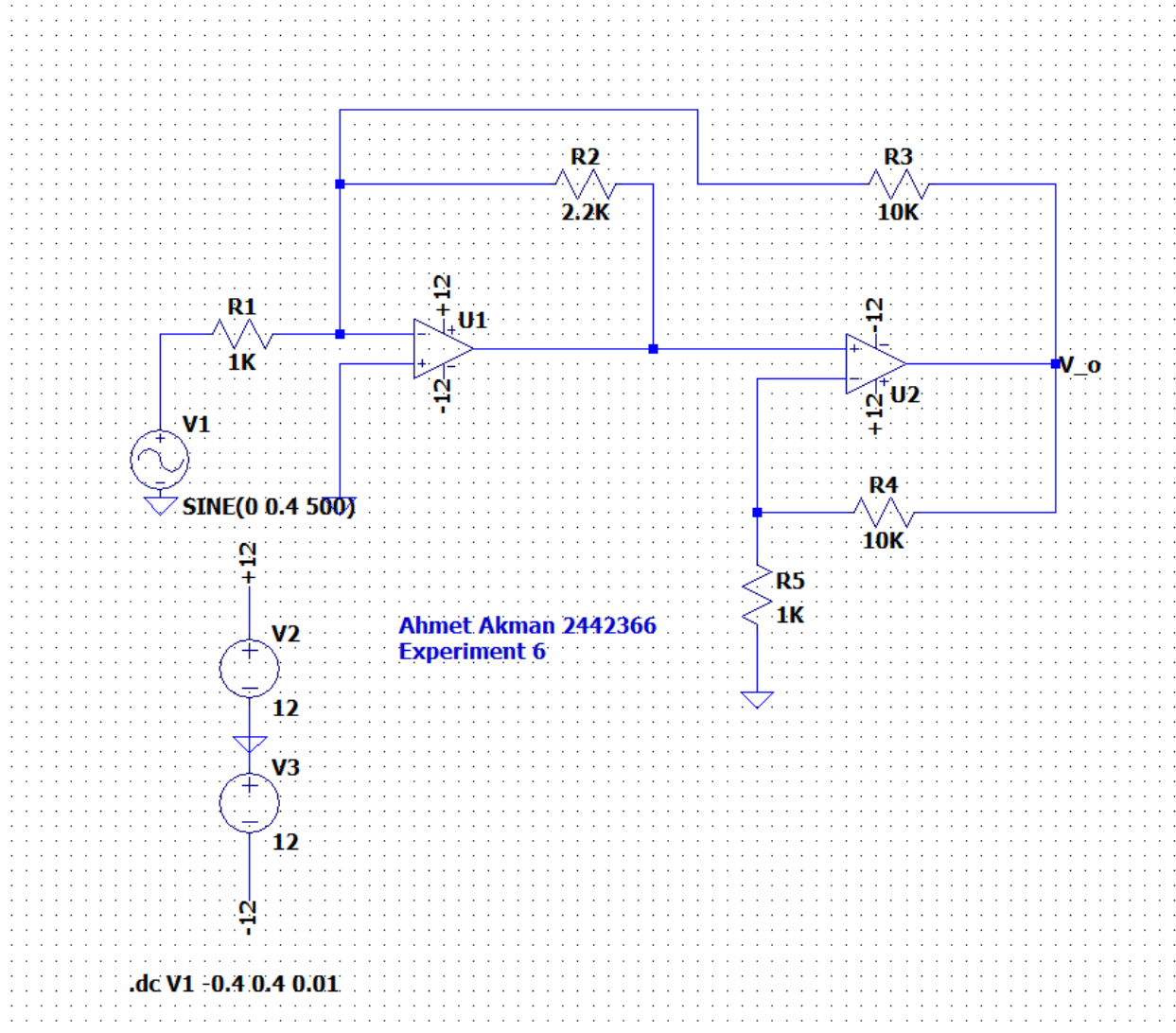


Figure 9: LTSpice schematic for two stage amplifier

Then the plot, V_o vs V_{in} is obtained and illustrated in Figure 9.

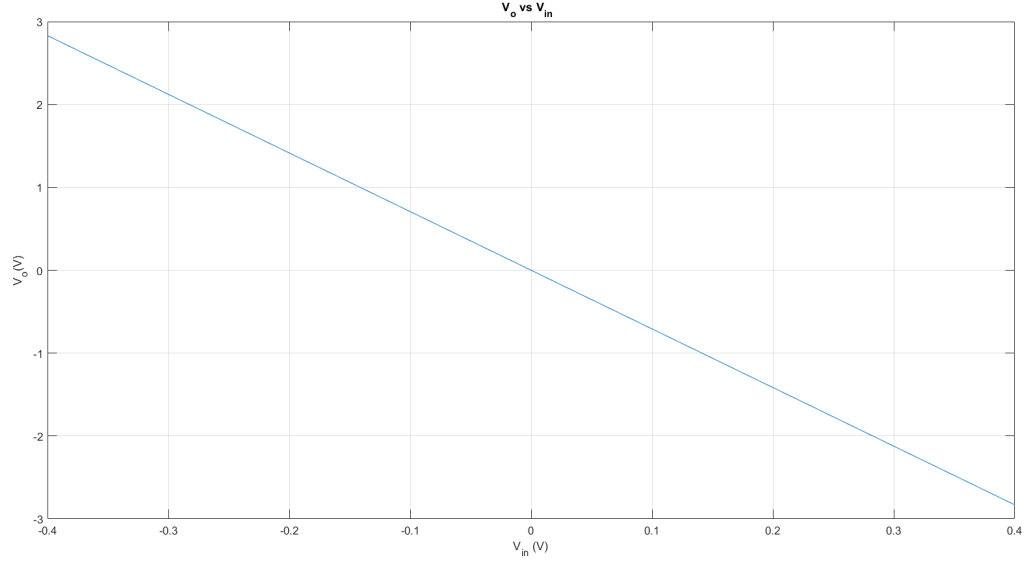


Figure 10: V_o vs V_{in}

for the part b) of the Step 1 plot given in Figure 10 is obtained.

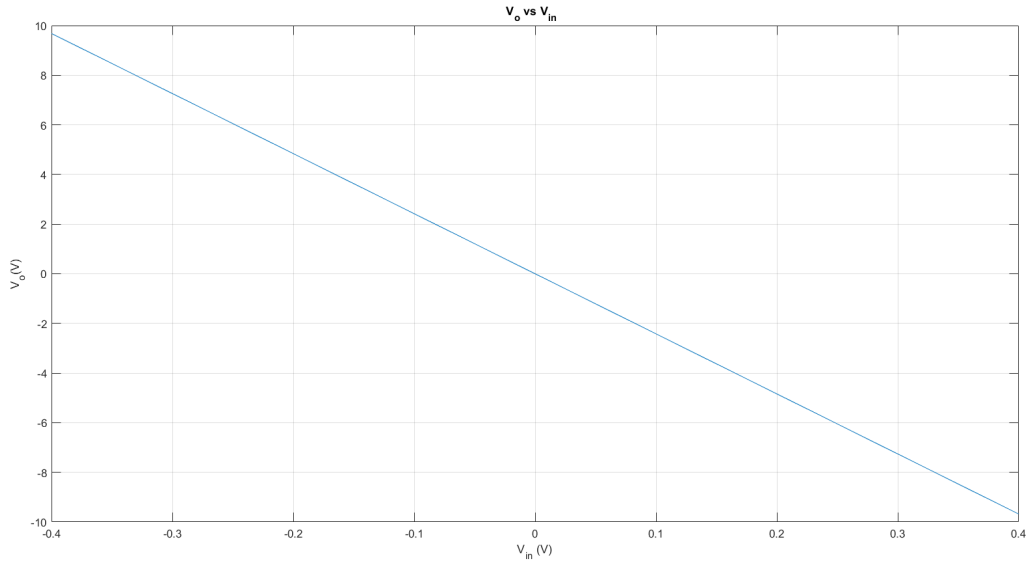


Figure 11: V_o vs V_{in}

By comparing the sketch in the Figure 3, it can be said that simulation result is consistent with our theoretical result.

The circuit in the Figure 5 is constructed in LTSpice environment, given in Figure 12.

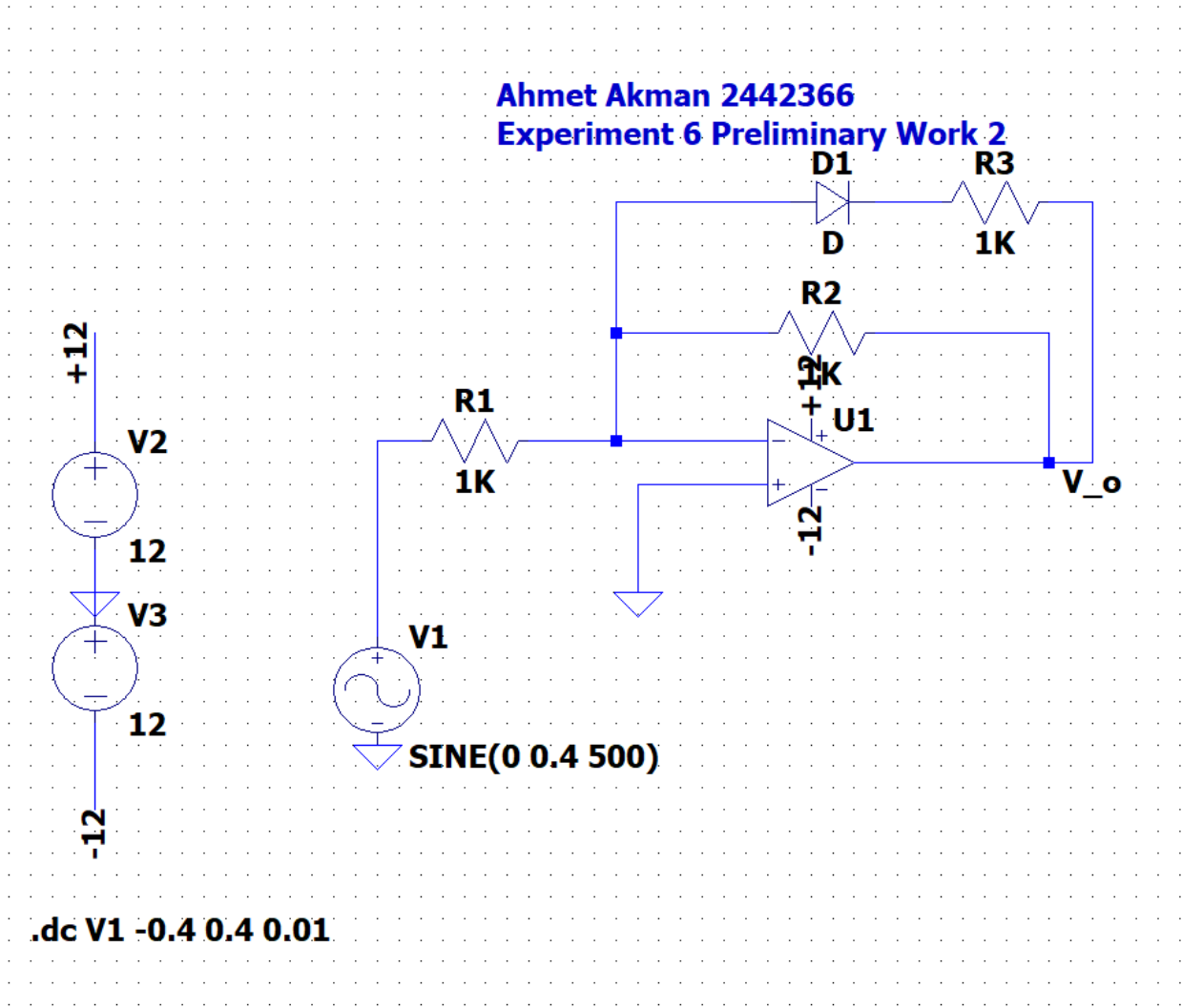


Figure 12: LTSpice schematic for Step 2 circuit

Then the plot, V_o vs V_{in} is obtained and illustrated in Figure 13.

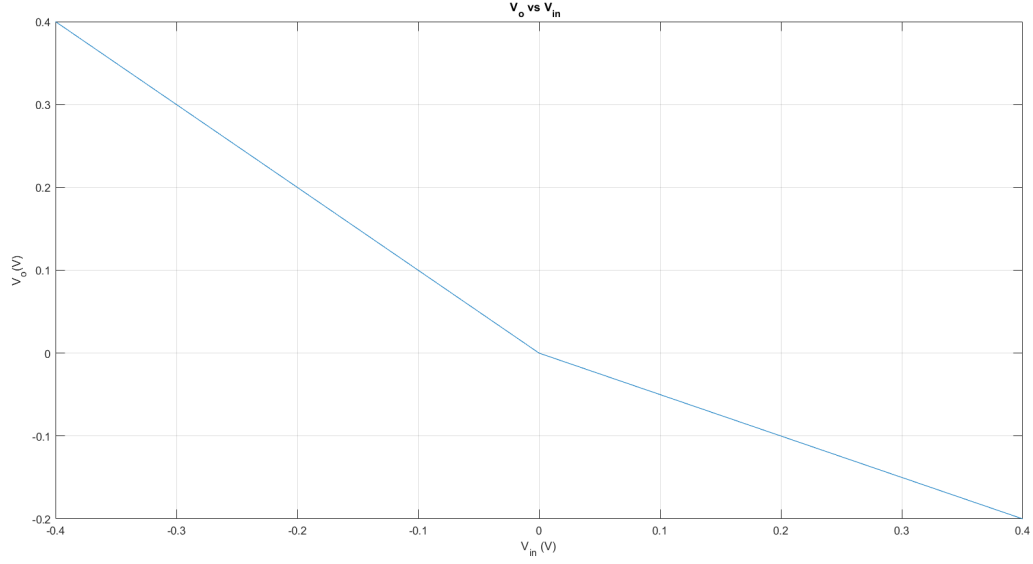


Figure 13: V_o vs V_{in}

By comparing the sketch in the Figure 6, it can be said that simulation result is consistent with our theoretical findings.

6 Conclusion

In conclusion, in preliminary work of experiment 6, "Operational Amplifiers-II" needed the expressions for the amplifier circuits are obtained and necessary data are plotted. Then and simulations are made and compared with theoretical results.