DENEY RAPORU

Deney Adı	Linear Applications of Operational Amplifiers
Deneyi Yaptıran Ar. Gör.	Ozan Güleç
Raporu Hazırlayan **(İsim / Numara / Bölüm)**	Ömer Malik Kalembaşı / 150180112 / Computer Engineering
Grup Numarası ve **Deney Tarihi**	C3/ March 31, 2021

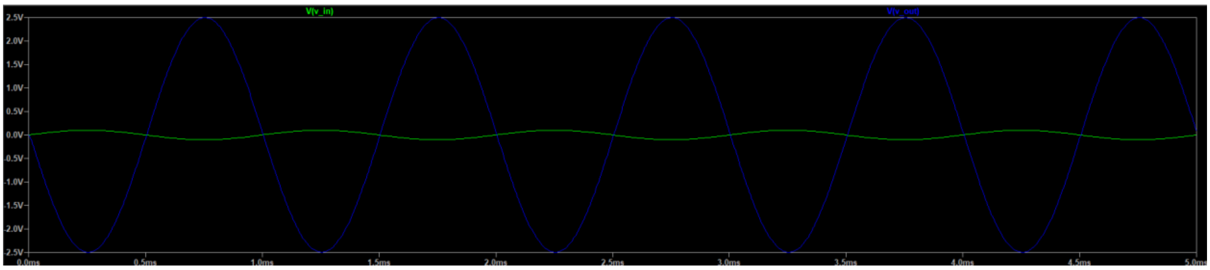
Rapor Notu	Teslim Edildiği Tarih	Teslim Alındığı Tarih
	March 31, 2021	

Note: In this experiment you can use LT1001 from LTSpice OPAMP library instead of 741 as you don't have the model for that in LTSpice. The results are not going to change; thus you can be comfortable with using LT1001. Use 15V for V_{CC} and -15V for $-V_{EE}$.

Experiment 4.1.

An inverting amplifier circuit shown in Figure-1. Apply a sinusoidal signal for V_{in} with 100 mV amplitude and 1 kHz frequency. Instead of variable resistor R_2 in Figure-1, use normal resistor for simulation purpose. You are free to choose your resistor values but you have to obtain a gain larger than 10.

a) Show your transient simulation results for V_{in} and V_{out} during 5 ms.



b) Explain the circuit and simulation result.

   It is inverting amplifier circuit example. It amplifies 25 times (R2/R1) in this example.

c) What is the maximum input voltage amplitude for your amplifier without any clipping at the output?

   In practice, above 560mV.

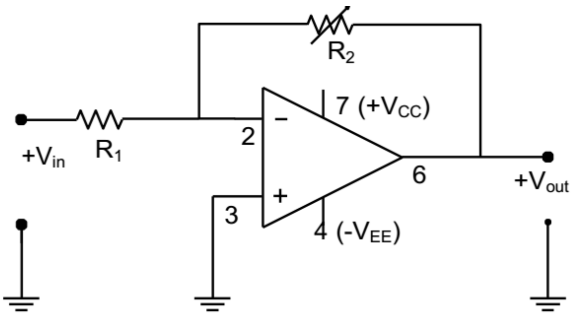


Figure 1: Inverting Amplifier

Experiment 4.2.

Repeat the exact same things (for the same input amplitude, frequency etc.) for the non-inverting amplifier which given in Figure-2. Again use a normal resistor, instead of variable resistor R_2. Explain the difference between the amplifiers in Figure-1 and Figure-2 based on your simulation results.

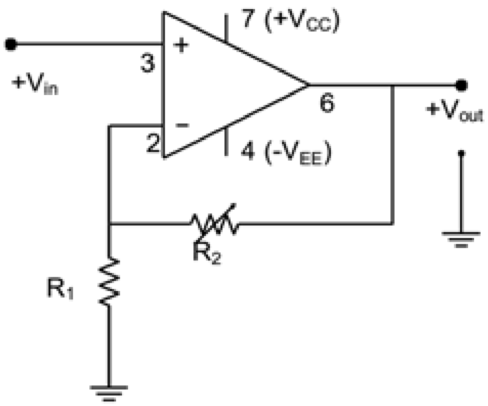
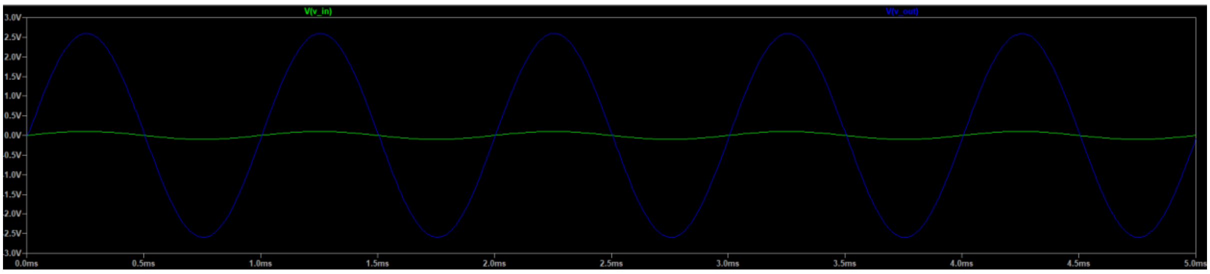


Figure 2: Non-Inverting Amplifier

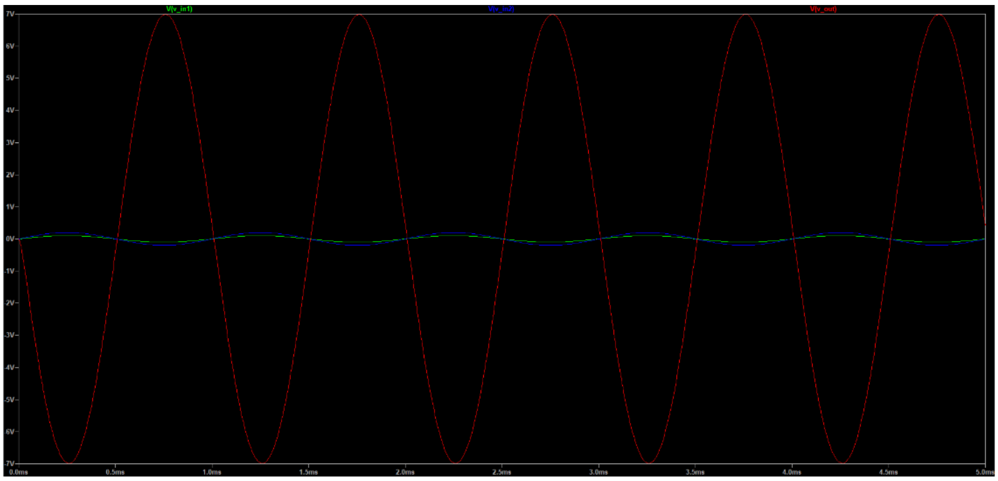


It is non-inverting amplifier. Difference between 4.1 is the phase difference between V_in and V_out. In this section V_in and V_out make positive and negative peaks together.

Experiment 4.3.

For the summing amplifier circuit in Figure-3, implement the function $V_{out}= -(aV_1+bV_2)$. You are free the choose a and b (using appropriate resistor ratios, you can easily set a and b). V_1 and V_2 are the sinusoidal signals and have the amplitudes 100 mV and 200 mV, respectively. Set the both frequency to 1 kHz.

a) how your transient simulation results for $V_{in1,}$ V_{in2} and V_{out} during 5 ms.



b) Explain the circuit and simulation result.

It is summing amplifier circuit. V_{out}= -(aV_1+bV_2). R3=60k, R2=3k, R1=2k.
V_in1 * (R3/R1) = 0.1 * 30 = 3V
V_in2 * (R3/R2) = 0.2 * 20 = 4V
V_in1 + Vin2 = 7V

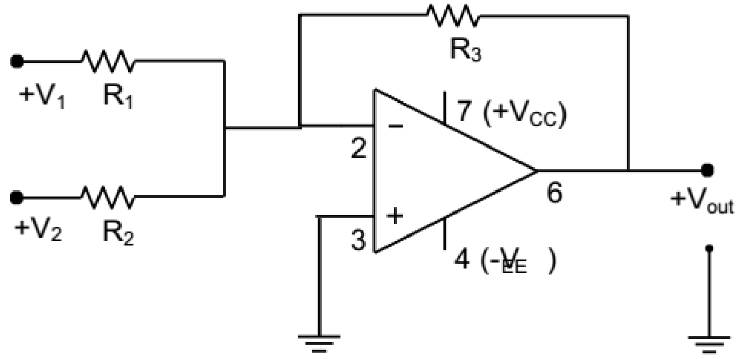
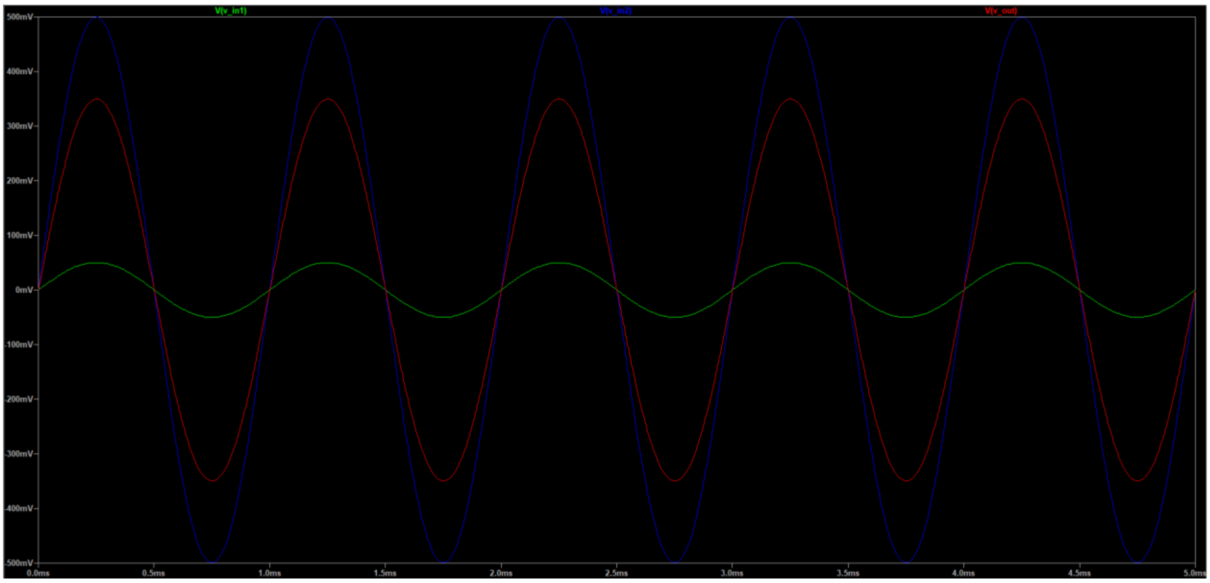


Figure 3: Summing Amplifier

Experiment 4.4.

For the difference amplifier circuit in Figure-4, implement the function V_{out}= (aV_2-bV_1). You are free the choose a and b (using appropriate resistor ratios, you can easily set a and b). V_1 and V_2 are the sinusoidal signals and have the amplitudes 100 mV and 200 mV, respectively. Set the both frequency to 1 kHz.

a) Show your transient simulation results for $V_{in1,}$ V_{in2} and V_{out} during 5 ms.



b) Explain the circuit and simulation result.

It is difference amplifier circuit.

V_in2 – V_in1 = V_out according to subtraction.

Voltage gain formula = - (R1/R3) * (V2-V1)

R1 = 20k, R3 = 60k, V2 = 500mV, V1 = 50mV.

-(20k/60k) * (450mV) = -150mV

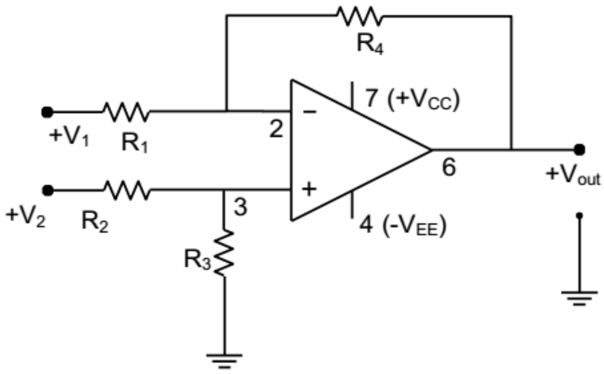


Figure 4: Difference Amplifier

Experiment 4.5.

For the integrator circuit in Figure 5, and differentiator circuit in Figure 6, C=10 nF, R_1=R_{eq}=10k, R_2=100k values are given.

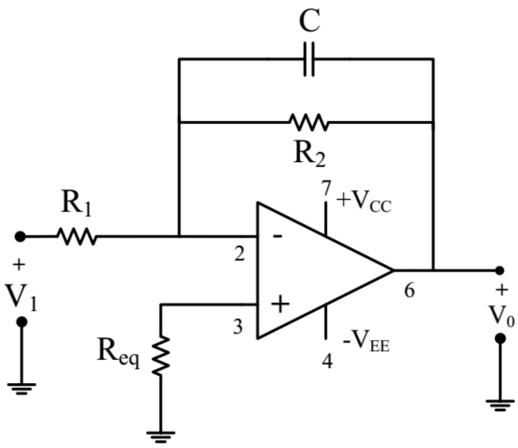


Figure 5: Integrator

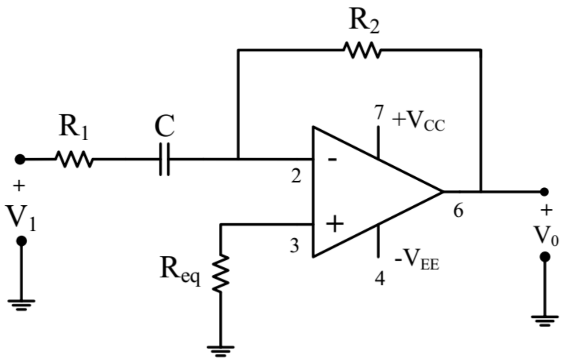
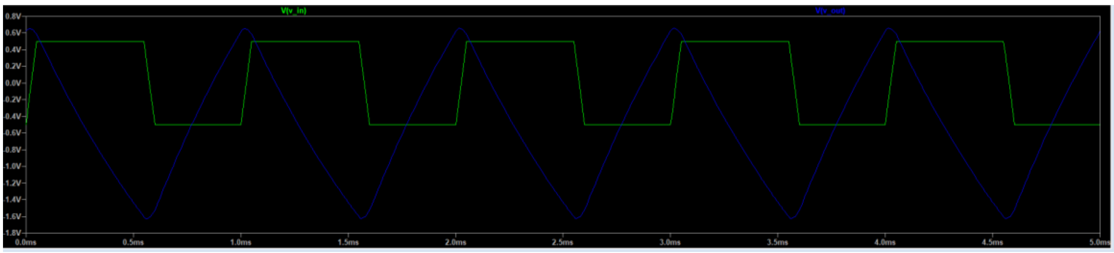


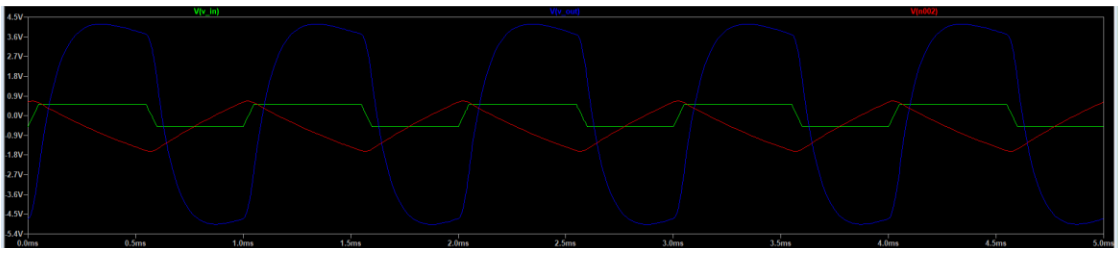
Figure 6: Differentiator

a) Apply square pulse with 500 mV amplitude and 1 kHz frequency for integrator circuit. Do the transient simulation during 5 ms. Show V_i and $V_{o.}$ Discuss if the circuit operates as an integrator.



Triangular shapes (V_out) are formed by the integral of the V_in which is square shapes.

b) Connect the output of the integrator to the input of differentiator. Repeat the transient simulation, do not change the input signal that you use in a. Show the output of differentiator. Explain your result and discuss if the circuit operates as a differentiator.



V(n002) is V_out of section a. Squares have not exact square shapes but theoretically we take them as squares. Main idea does not change. Curvy shapes are derivative of V_out of section a.

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