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 $-V_{EE}$. The datasheet for LT1001 is readily available online.

Experiment 2.1

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) Observe your V_{in} and V_{out} and copy them onto your protocol paper.
b) Explain the circuit.
c) What is the maximum input voltage amplitude for your amplifier without any clipping at the output?

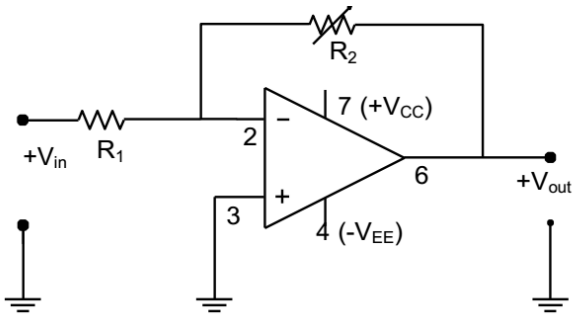

Figure 1: Inverting Amplifier

Experiment 2.2

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.

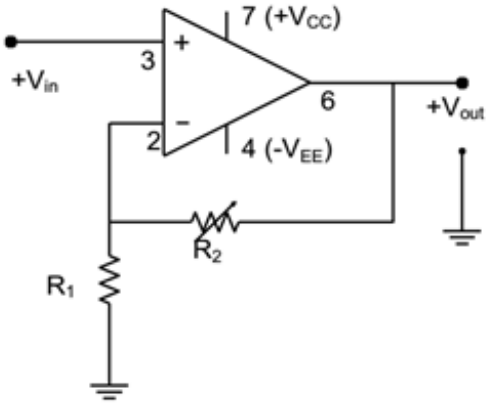

Figure 2: Non-Inverting Amplifier

Experiment 2.3

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) Observe $V_{in1,}$ V_{in2} and V_{out} with the oscilloscope and copy them onto your protocol paper.
b) Explain the circuit.

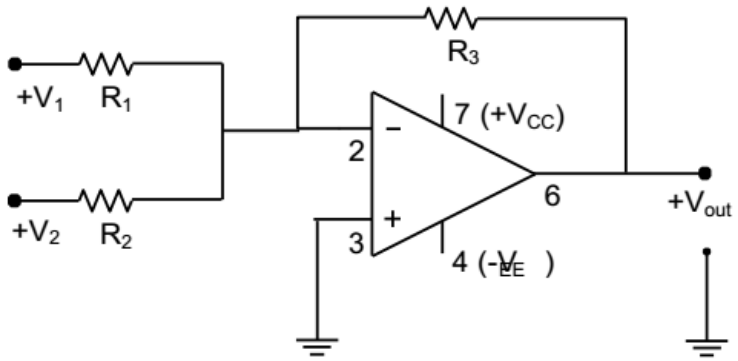

Figure 3: Summing Amplifier

Experiment 2.4

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) Observe $V_{in1,}$ V_{in2} and V_{out} with the oscilloscope and copy them onto your protocol paper.
b) Explain the circuit.

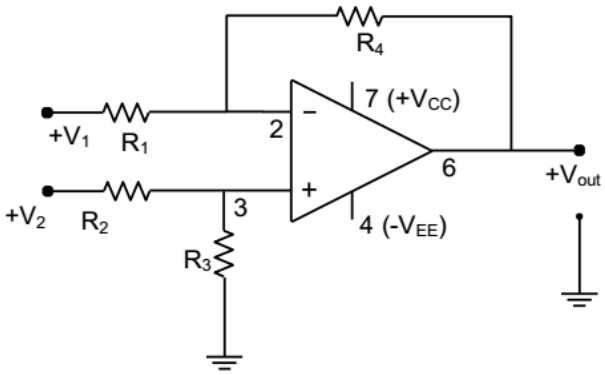

Figure 4: Difference Amplifier

Experiment 2.5

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

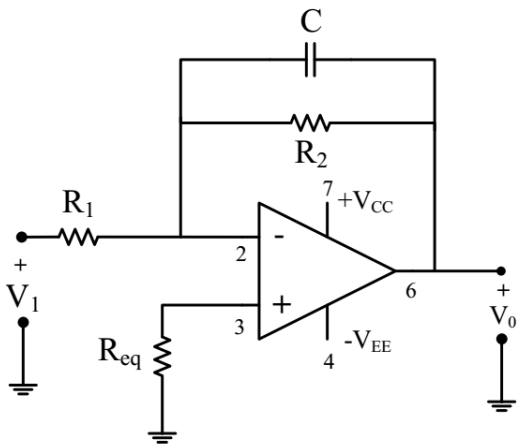

Figure 5: Integrator

Apply square pulse with 500 mV amplitude and 1 kHz frequency for integrator circuit. Observe and note V_i and V_o. Discuss if the circuit operates as an integrator.