Aim
To study the inverting, non-inverting, and summing amplifier

Introduction
The operational amplifier (abbreviated as op-amp) denoted by the number 741 as shown in Fig. 1 (schematic), Fig. 2 (actual chip), and Fig. 3 (pin numbers), is among the most basic linear integrated circuits frequently employed in diverse low frequency applications. The actual chip has four pins on each side, with a dot (or an indent) just above pin no. 1 (Fig. 2).

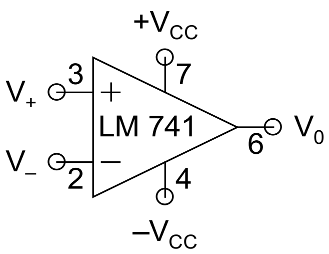

Figure 1

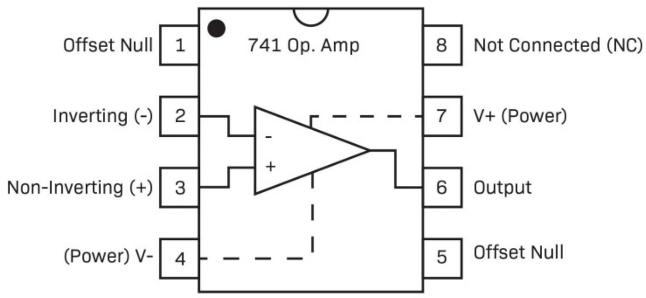

Figure 2

Referring to Figs. 1 and 2, the op-amp has two inputs, viz., inverting (V^-: pin no. 2) and non-inverting (V^+: pin no. 3), and one output (V_0: pin no. 6). Pin numbers 7 and 4 are used for the power supplies ($+V_{CC}$ and $-V_{CC}$ respectively). Pin numbers 1 and 5 will not be used in this experiment (keep them open). The input-output relationship of an op-amp is given by $V_0 = A(V^+ - V^-)$, where the differentia1 voltage gain A is very large. For an ideal op-amp: (i) A is infinite, (ii) the input impedance is infinite, and (iii) the output impedance is zero, making it practically an ideal controlled voltage source. However, in a practical op-amp, A is typically in the range of 10^4 to 10^6 over the frequency range of interest and for different IC types.

CARE

- Connect the op-amp on Falstad such that its pin 1 is on your left side, as shown in Fig. 2.
- Be doubly sure that the +15 V (pin 7) and –15 V (pin 4) supplies are connected properly to the op-amp. If you interchange these connections or connect them to some other pins, the op-amp will get damaged instantly. This is the most common reason for op-amp damage.
- Make sure to turn the power supply on after all the connections are made, and turn it off after the measurements are done.
- It is a good practice to keep the DSO and FG in ON condition. Connect the FG output to the left side of the breadboard and use a jumper to connect it to your circuit as required. Note that the FG signal should appear at the op-amp circuit input only after it receives DC power.

1. Inverting Amplifier

(i) Wire the circuit of Fig. 3 on the Falstad Simulator. Choose R_2 = 51 kΩ. Adjust the FG output to produce $V_i = 0.1 \sin(\omega t)$ (f = 1 kHz).

(ii) Observe and sketch the V_i and V_0 waveforms.

(iii) Measure the voltage gain $A_v \equiv V_0/V_i$ and compare with the theoretical value.

(iv) Repeat this experiment on Tinkercad using a DC input voltage source of 1 V.

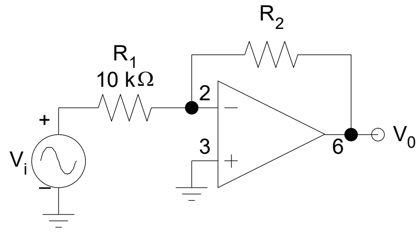

Figure 3

2. Non-Inverting Amplifier

(i) Wire the circuit of Fig. 4 on the Falstad Simulator. Choose R_2 = 51 kΩ. Adjust the FG output to produce $V_i = 0.1 \sin(\omega t)$ (f = 1 kHz).

(ii) Observe and sketch V_i and V_0 waveforms.

(iii) Measure the voltage gain $A_v \equiv V_0/V_i$ and compare with the theoretical value.

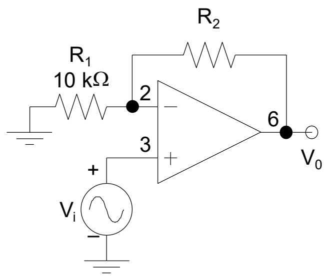

Figure 4

(iv) Repeat this experiment on Tinkercad using a DC input voltage source of 1 V.

3. Summing Amplifier

Design a circuit using opamps that simply adds three inputs voltages.

4. Refer to example of the Schmitt Trigger in Falstad and explain the observation in details.