Study of Basic OPAMP Configurations and Simple Mathematical Operations

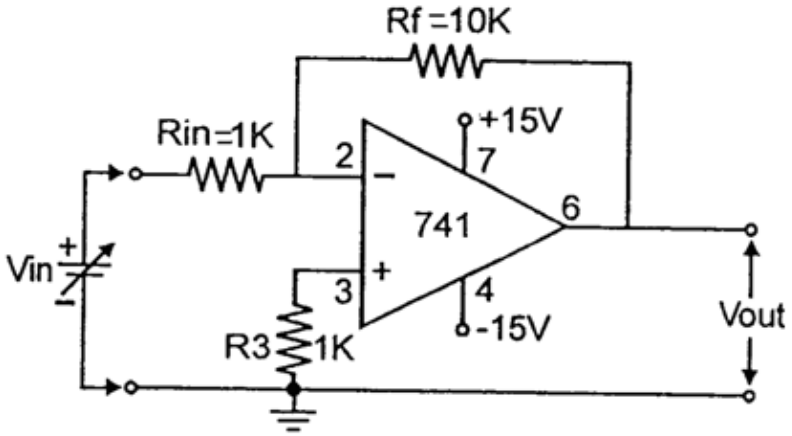
Objectives:

(I) Study of the inverting amplifier configuration and to find its gain
(II) Study of the non-inverting amplifier configuration and to find its gain
(III) Study simple mathematical operation and design an averaging amplifier

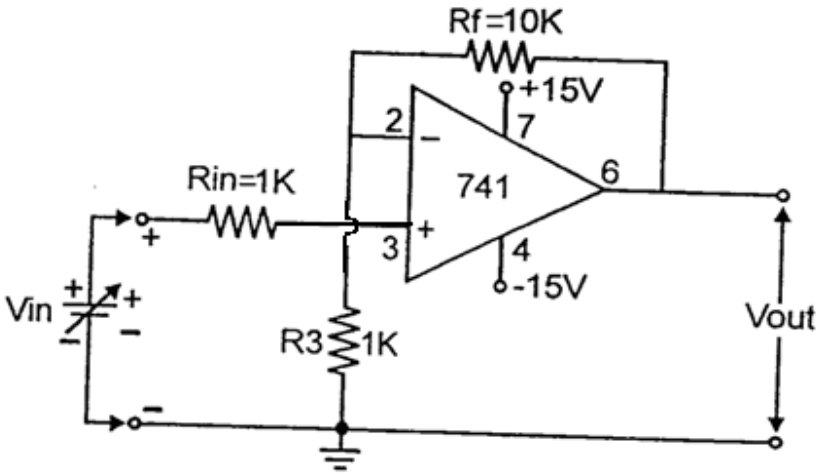
Components: OPAMP 741 chip, Resistors, Oscilloscope, DC voltage source, Bread board

Theory: Please refer the supplementary note.

Circuit Diagram:



Inverting amplifier



Non-inverting amplifier

Procedure:

(I) Inverting amplifier

1. Configure the circuit as shown in the circuit diagram. Connect the pins 7 and 4 of the IC to the ±15V output terminals of the D.C. power supply. Connect the 0V terminal to ground. Choose R_{in} = 1KΩ and R_f = 10KΩ. Measure the resistance values with multimeter and calculate gain, -(R_f/R_{in}). Connect a resistor R_3 (= $R_{in} \| R_f \approx R_{in}$) as shown in the circuit diagram so as to minimize offset due to input bias current.
2. Connect one of the output terminals of the D.C. power supply (0-30V) at the **inverting input (pin no. 2).**
3. Switch on the power supply and apply different voltages in the range 0- 1.5V (why?) in steps of 0.2 V at the inverting terminal. Measure this input using a digital multimeter.
4. Measure the corresponding output voltages with the multimeter and calculate gain V_o/V_{in}. Note the sign of the output voltage.
5. Now, replace R_f by 50KΩ. Measure the resistance value with multimeter and calculate gain, -(R_f/R_{in}).
6. Apply different voltages in the range 0- 0.5V in steps of 0.1 V at the inverting terminal. Measure this input using a digital multimeter.
7. Measure the corresponding output voltages with the multimeter and calculate gain V_o/V_{in}.
8. Plot graphs for $V_{in} \sim V_o$ for both the values of R_F.
9. You may also use a function generator to give a sinusoidal input and notice the output waveform using an oscilloscope.

(II) Non-inverting amplifier

1. Configure the circuit as shown in the circuit diagram with R_{in} = 1KΩ and R_f = 10KΩ. using the measured value of resistance calculate gain, 1+ (R_f/R_{in}).
2. Connect one of the output terminals of the D.C. power supply (0-30V) at the **non-inverting input (pin no. 3).**
3. Repeat steps 3 onwards of procedure (I) with inputs applied at non-inverting terminal.

Observations

Table (I):

Obs. No.	Input (V)	$-\frac{R_f}{R_{in}}$ = ------			$-\frac{R_f}{R_{in}}$ = ------		
		Output (V)	Gain V_o/V_{in}	Average	Output (V)	Gain V_o/V_{in}	Average
	0.2						
	0.4						
	…						

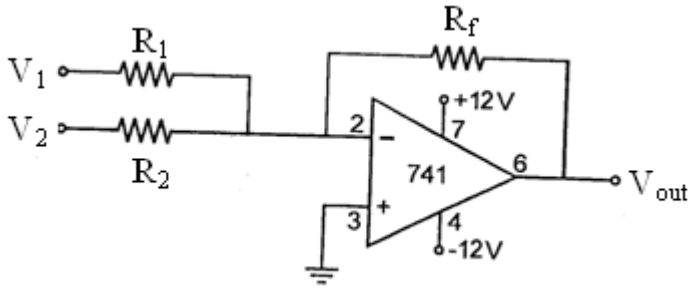
Table (For II):

Obs. No.	Input (V)	$1+\frac{R_f}{R_{in}}$ = ------			$1+\frac{R_f}{R_{in}}$ = ------		
		Output (V)	Gain V_o/V_{in}	Average	Output (V)	Gain V_o/V_{in}	Average
1	0.1						
2	0.2						
..	…						

(III) Simple mathematical operations using OPAMP

a. To study OPAMP as summing amplifier

Circuit Diagram:



Procedure:

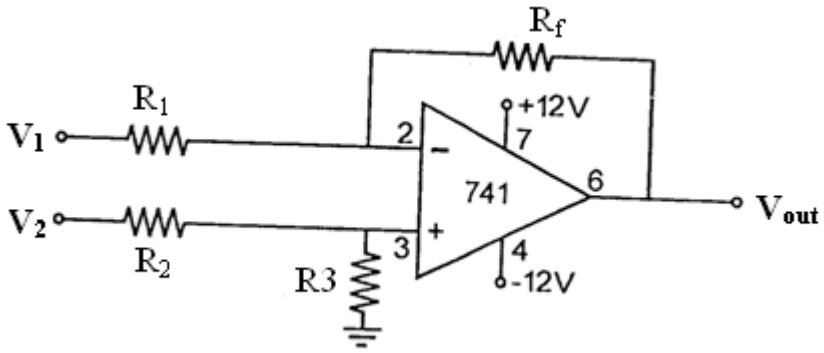
1. Assemble the circuit as shown in circuit diagram choosing R_1, R_2, R_f = 10KΩ each. Use 0-±15V terminal output to provide supply to the IC.
2. Using 0 – 30V and 5V terminals of the power supply, apply two inputs at the inverting terminal. Measure each input with multimeter.
3. Measure the output with multimeter for at least five input combinations.
4. Compare the output with the sum of the two inputs.

Observations:

Obs.No	**V_1 (V)**	**V_2 (V)**	**V_{out} (V)**	**$V_1 + V_2$ (V)**
1				
..				
5				

b. To study OPAMP as difference amplifier

Circuit Diagram:



Procedure:

1. Assemble the circuit as shown in circuit diagram choosing R_1, R_2, R_3, R_f = 10KΩ each. Use 0- ±15V terminal output to provide supply to the IC.
2. Using 0 – 30V and 5V terminals of the power supply, apply two inputs, one at the inverting and the other at the non-inverting terminal. Measure each input with multimeter.
3. Measure output with multimeter for at least five input combinations.
4. Compare the output with the difference of the two inputs.

Observations:

Obs.No	**V_1 (V)**	**V_2 (V)**	**V_{out} (V)**	**$V_2 - V_1$ (V)**
1				
..				
5				

c. Inverting amplifier configuration of OPAMP is nothing but multiplication or division of input voltage with a number equal to Rf/R_1. With the knowledge of division and addition design an averaging amplifier of inputs V_1 and V_2 and tabulate.

Conclusions: