Experiment 3

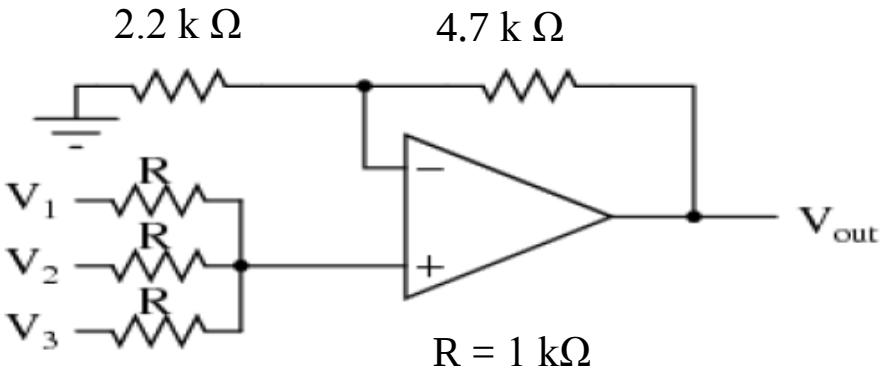
Objective: To realize summing, averaging and difference amplifier using OP-AMP.

Equipment Required: Breadboard, Regulated Power Supply, Function Generator, and CRO.

Components Required: OP-AMP 741 IC, Resistances (1KΩ (3), 2.2KΩ, 4.7KΩ (2)), connecting wires.

- **Summing Amplifier**

This circuit is used to perform arithmetic addition of signals applied to it. The circuit is designed such that the final expression of output voltage is sum of all the signals applied to it.



$V_{out} = V_1 + V_2 + V_3$

Procedure to build Summing Amplifier:

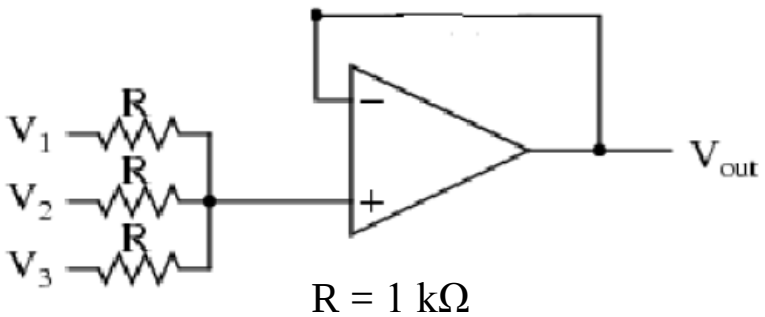
1. Connect the circuit as shown in circuit diagram above.
2. Measure input and output voltages on CRO.
3. Try the same experiment for different set of voltages.

S. No	V_1	V_2	V_3	V_{out} (peak)
1	0	0	0	
2	0	0	1 V (peak)	
3	0	1 V (peak)	0	
4	0	1 V (peak)	1 V (peak)	
5	1 V (peak)	0	0	
6	1 V (peak)	0	1 V (peak)	
7	1 V (peak)	1 V (peak)	1 V (peak)	
8	1 V (peak)	1 V (peak)	1 V (peak)	

- **Averaging Amplifier**

This circuit is used to perform arithmetic averaging of signals applied to it. The circuit is designed such that the final expression of output voltage is average of all the signals applied to it.

$$V_{out} = (V_1 + V_2 + V_3)/3$$



R = 1 kΩ

Procedure to build Averaging Amplifier:

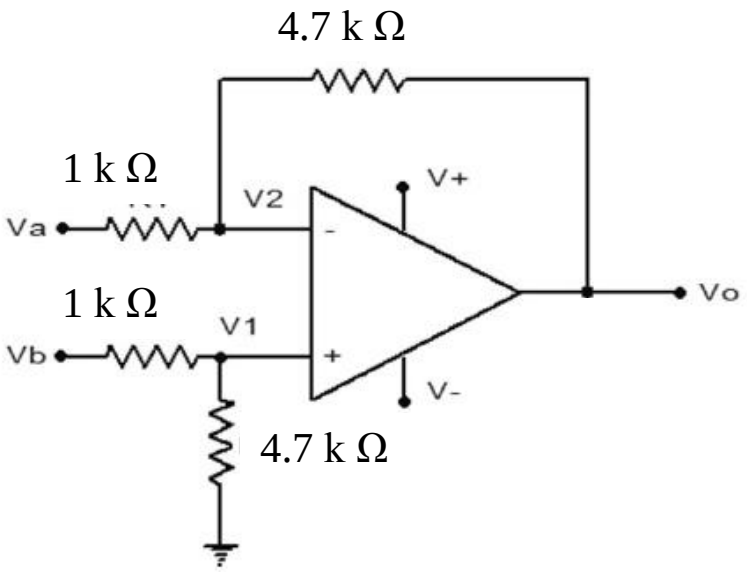
1. Connect the circuit as shown in circuit diagram above.
2. Measure input and output voltages on CRO.
3. Try the same experiment for different set of voltages.

S. No	V_1	V_2	V_3	V_{out} (peak)
1	0	0	0	
2	1 V (peak)	0	0	
3	0	1 V (peak)	0	
4	0	0	1 V (peak)	
5	1 V (peak)	1 V (peak)	0	
6	1 V (peak)	0	1 V (peak)	
7	0	1 V (peak)	1 V (peak)	
8	1 V (peak)	1 V (peak)	1 V (peak)	

- **Difference Amplifier**

This circuit is used to difference of signals applied to it. Amplification factor is 4.7.

$V_{out} = 4.7 (V_b - V_a)$



Procedure to build Difference Amplifier:

1. Connect the circuit shown in circuit diagram above.
2. Measure input and output voltages on CRO.
3. Try the same experiment for different set of voltages.

S. No	V_a	V_b	V_o (peak)
1	0	0	
2	1 V (peak)	0	
3	0	1 V (peak)	
4	1 V (peak)	1 V (peak)	

Precautions to be taken:

1. Ensure that all the discrete components are working properly.
2. Make sure that all the connections in the circuit are correct before giving supply to circuit.
3. Remove the supply before changing any connections in circuit.
4. Check the amplitude of the supply signal before applying it to the circuit.
5. Ensure that the op-amp does not saturate.