EXPERIMENT NO.4

TITLE: **INVERTING CONFIGURATION OF OP-AMP AS SUMMING & AVERAGING AMPLIFIER.**

OBJECTIVES:

1. To assemble the circuit of summing amplifier using inverting configuration of op-amp & measure its output voltage.
2. To assemble the circuit of averaging amplifier using inverting configuration of op-amp & measure its output voltage.

LAB REQUIREMENTS:

Breadboard, Op-amp IC 741, Resistors(Ra, Rb & Rf), DC regulated Dual power supply (0-30V)-**2Nos**, Multimeter and connecting wires.

CIRCUIT DIAGRAM:

1. **Summing amplifier using inverting configuration of op-amp IC 741:**

2. **Averaging amplifier using inverting configuration of op-amp IC 741:**

THEORY:

a) Summing amplifier using inverting configuration of op-amp IC 741:

The circuit shown in **(1)** is commonly known as two input **Summing amplifier** in an inverting configuration of op-amp IC741. Inverting configuration with 'n' number of input can be used as a summing, scaling or averaging amplifier. In General output voltage of this circuit can be given as-

$$v_o = -\left(\frac{R_F}{R_a}.v_a + \frac{R_F}{R_b}.v_b + \cdots + \frac{R_F}{R_n}.v_n\right)$$

For two input circuit,

$$v_o = -\left(\frac{R_F}{R_a}.v_a + \frac{R_F}{R_b}.v_b\right)$$

If in the circuit $R_a = R_b = R_F$, then above equation of output voltage becomes-

$$v_o = -(v_a + v_b)$$

This means that the output voltage is the negative sum of two inputs voltages hence it is called as summing amplifier.

b) Averaging amplifier using inverting configuration of op-amp IC 741:

The circuit shown in **(2)** is commonly known as an **Averaging amplifier** circuit in which the output voltage is equal to the negative average of all the input voltage applied at inverting terminal of op-amp. This can be accomplished by using input resistance Ra & Rb of equal value and twice that of R_F i.e.

If in the circuit $R_a = R_b = 2R_F$, then above equation of output voltage becomes-

$$v_o = -\frac{(v_a + v_b)}{2}$$

This means that the output voltage is the negative average of two inputs voltages hence it is called as averaging amplifier.

EXPERIMENTAL PROCEDURE:

1. Refer the Pin Diagram of op-amp IC741 & assemble the circuits as per circuit diagram (1) & (2) on the breadboard.
2. Apply V_{CC} & V_{EE} = ±15V from one DC regulated dual power supply.
3. Apply two input voltages of suitable value from another DC regulated dual power supply.
4. Measure the output voltage for summing & averaging amplifier circuit with the help of digital multimeter & note the readings in the observation table.

5. Compare the reading with theoretical values of output voltage & interpret the result.

OBSERVATION TABLE:

A) Summing amplifier using inverting configuration of op-amp IC 741:

Sr. No.	Input Voltage (Va)	Input Voltage (Vb)	Ra	Rb	R_F	Output Voltage	
						Theo.	Prac.
1							
2							

B) Averaging amplifier using inverting configuration of op-amp IC 741:

Sr. No.	Input Voltage (Va)	Input Voltage (Vb)	Ra	Rb	R_F	Output Voltage	
						Theo.	Prac.
1							
2							

CALCULATIONS:

RESULT:

1. **For an Summing amplifier using inverting configuration of op-amp IC 741, practical value of output voltage is found to be_____.** This means that _____.

2. **For an Averaging amplifier using inverting configuration of op-amp IC 741, practical value of output voltage is found to be_____.** This means that _____.

EVALUATION (BY TEACHER):

Excellent/Good/Average/Poor