Contents

EXPERIMENT NO -9 TRANSITOR COMMON -BASE CONFIGURATION CHARACTERISTICS

OBJECTIVE: 1.To observes and draw the input and output characteristics of a transistor connected in common base configuration.
2. To find α of the given transistor and also its input and output Resistances.

APPARATUS:
Transistor.
Regulated power supply (0-30V).
Voltmeter (0-20V).
Ammeters (0-10mA) .
Resistor, 1KΩ
Bread board
Connecting wires

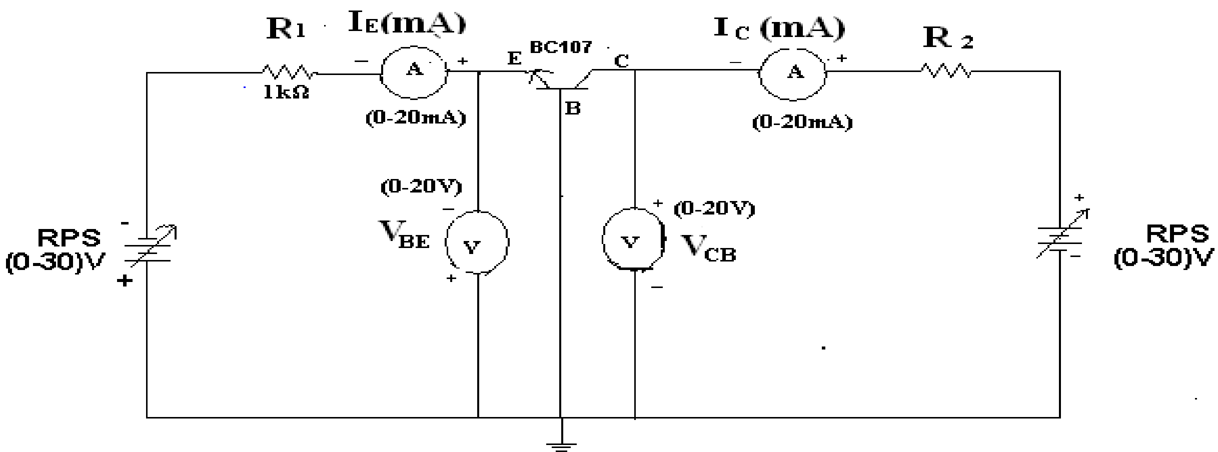
THEORY:
A transistor is a three terminal active device. The terminals are emitter, base, collector. In CB configuration, the base is common to both input (emitter) and output (collector). For normal operation, the E-B junction is forward biased and C-B junction is reverse biased. In CB configuration, IE is +ve, IC is –ve and IB is –ve. So,

$$\mathbf{V_{EB} = F_1 (V_{CB}, I_E) \text{ and}}$$
$$\mathbf{IC = F2 (V_{EB}, I_B)}$$

With an increasing the reverse collector voltage, the space-charge width at the output junction increases and the effective base width „W" decreases. This phenomenon is known as "Early effect". Then, there will be less chance for recombination with in the base region. With increase of charge gradient with in the base region, the current of minority carriers injected across the emitter junction increases. The current amplification factor of CB configuration is given by,

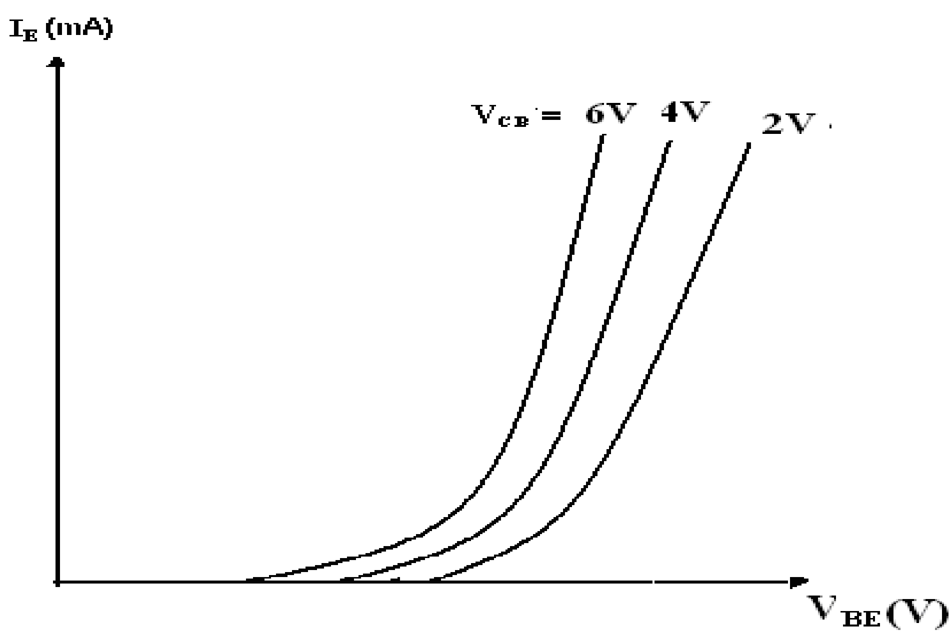
α = ΔIC/ ΔIE
Input Resistance, ri = $\mathbf{\Delta V_{BE} / \Delta I_E}$ at Constant VCB
Output Résistance, ro = $\mathbf{\Delta V_{CB} / \Delta I_C}$ at Constant IE

CIRCUIT DIAGRAM:

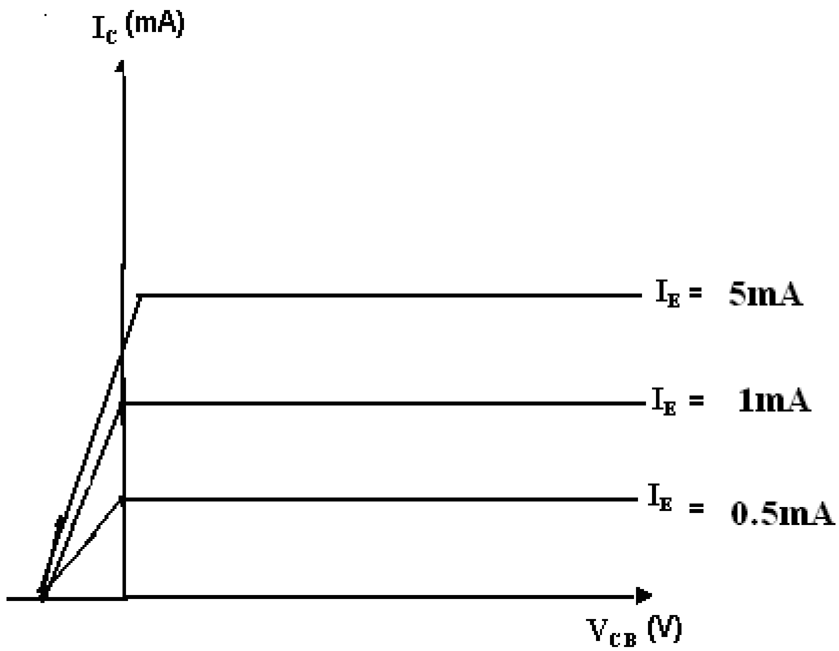


EXPECTED GRAPHS:

A) **INPUT CHARACTERISTICS**



B) OUTPUTCHARACTERISTICS



OBSERVATIONS:

A) INPUT CHARACTERISTICS:

VEE(V)	VCB=1V		VCB=2V		VCB=3V	
	VEB(V)	IE(mA)	VEB(V)	IE(mA)	VEB(V)	IE(mA)

B) OUTPUT CHARACTERISTICS:

Vcc(V)	IE=10mA		IE=20mA		IE=30mA	
	VCB(V)	IC(mA)	VCB(V)	IC(mA)	VCB(V)	IC(mA)

PROCEDURE:

A) INPUT CHARACTERISTICS:

1. Connections are made as per the circuit diagram.
2. For plotting the input characteristics, the output voltage VCE is kept constant at 0V and for different values of VEE ,note down the values of IE and VBE
3. Repeat the above step keeping VCB at 2V, 4V, and 6V and all the readings are tabulated.
4. A graph is drawn between VEB and IE for constant VCB.

B) OUTPUT CHARACTERISTICS:

1. Connections are made as per the circuit diagram.
2. For plotting the output characteristics, the input IE is kept constant at 0.5mA and for different values of VCC, note down the values of IC and VCB.
3. Repeat the above step for the values of IE at 1mA, 5mA and all the readings are tabulated.
4. A graph is drawn between VCB and Ic for constant IE

RESULT: The Current gain of the Transistor in CB is **______** , the input Resistance is _____ and the output Resistance is **______**.

VIVA QUESTIONS:

1. What is the range of α for the transistor?
2. Draw the input and output characteristics of the transistor in CB configuration.
3. Identify various regions in output characteristics.
4. What is the relation between α and β?
5. What are the applications of CB configuration?
6. What are the input and output impedances of CB configuration?
7. Define α (alpha).
8. What is early effect?
9. Draw Circuit diagram of CB configuration for PNP transistor.
10. What is the power gain of CB configuration?

EXPERIMENT NO -10. FET CHARACTERISTICS

OBJECTIVE: a).To draw the drain and transfer characteristics of a given FET. b).To find the drain resistance ($r_{d.}$) amplification factor (μ) and Trans Conductance (g_m) of the given FET.

APPARATUS:

FET
Regulated power supply (0-30V) -1No.
Voltmeter (0-20V) -2No.
Ammeter (0-20mA) -1No.
Bread board
Connecting wires

THEORY:

A FET is a three terminal device, in which current conduction is by majority carriers only. The flow of current is controlled by means of an Electric field. The three terminals of FET are Gate, Drain and Source. It is having the characteristics of high input impedance and less noise, the Gate to Source junction of the FETs always reverse biased. In response to small applied voltage from drain to source, the n-type bar acts as sample resistor, and the drain current increases linearly with $V_{DS.}$ With increase in I_D the ohmic voltage drop between the source and the channel region reverse biases the junction and the conducting position of the channel begins to remain constant. The V_{DS} at this instant is called "pinch of voltage". If the gate to source voltage (V_{GS}) is applied in the direction to provide additional reverse bias, the pinch off voltage ill is decreased. In amplifier application, the FET is always used in the region beyond the pinch-off.

FET parameters:

AC Drain Resistance, $r_d = \Delta V_{DS} / \Delta I_D$ at constant V_{GS}
Tran conductance, $g_m = \Delta I_D / \Delta V_{GS}$ at constant V_{DS}
Amplification, $\mu = \Delta V_{DS}/\Delta V_{GS}$ at constant I_D
Relation between above parameters
$\mu = rd * g_m$

The drain current is given by
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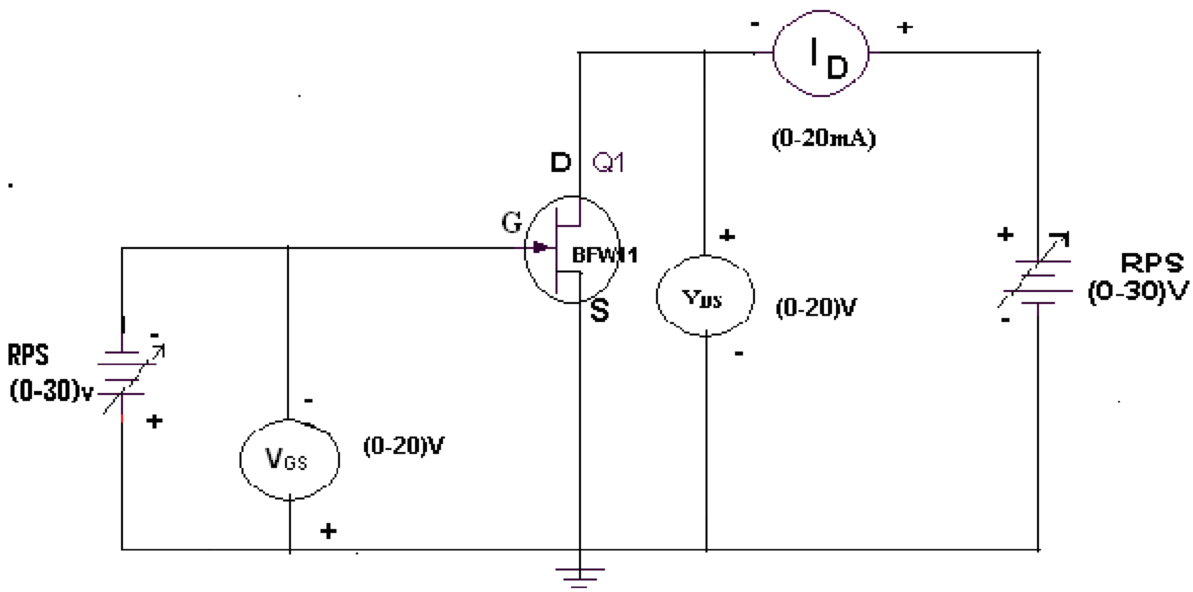
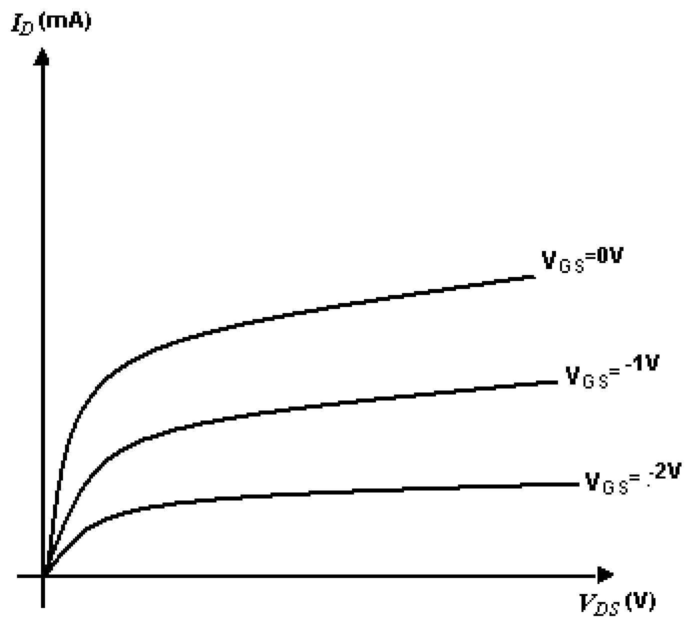
$$I_D = I_{DSS} (1 - V_{GS}/V_P)^2$$

CIRCUIT DIAGRAM:

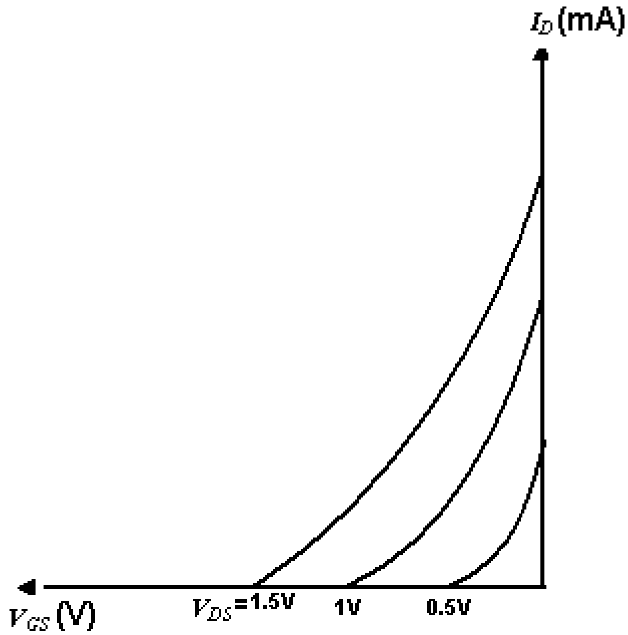


EXPECTED GRAPH:

A) DRAIN CHARCTERISTICS:



B) TRANSFER CHARACTERISTICS:



OBSERVATIONS:

A) DRAIN CHARACTERISTICS:

Sl. No	V_{GS} (V) = 5		V_{GS} (V) = 10		V_{GS} (V) = 15	
	V_{DS}(v)	I_D(mA)	V_{DS}(v)	I_D(mA)	V_{DS}(v)	I_D(mA)

C) TRANSFER CHARACTERISTICS:

Sl. No	V_{DS}(v)= 5		V_{DS}(v)= 10		V_{DS}(v)= 15	
	V_{GS} (V)	I_D(mA)	V_{GS} (V)	I_D(mA)	V_{GS} (V)	I_D(mA)

PROCEDURE:

1. All the connections are made as per the circuit diagram.
2. To plot the drain characteristics, keep V_{GS} constant at 0V.
3. Vary the V_{DD} and observe the values of V_{DS} and I_D.
4. Repeat the above steps 2, 3 for different values of V_{GS} at 0.1V and 0.2V.
5. All the readings are tabulated.
6. To plot the transfer characteristics, keep V_{DS} constant at 1V.
7. Vary V_{GG} and observe the values of V_{GS} and I_D.
8. Repeat steps 6 and 7 for different values of V_{DS} at 1.5 V and 2V.
9. The readings are tabulated.
10. From drain characteristics, calculate the values of dynamic resistance (r_d.)
11. From transfer characteristics, calculate the value of transconductace (g_m)
12. And also calculate Amplification factor (μ).

PRECAUTIONS:
1. The three terminals of the FET must be carefully identified
2. Practically FET contains four terminals, which are called source, drain, Gate, substrate.
3. Source and case should be short circuited.
4. Voltages exceeding the ratings of the FET should not be applied.

RESULT: The drain resistance (r_d.) is ____, the amplification factor (μ) is ______and the Trans conductance (g_m) of the given FET.

VIVA QUESTIONS:

1. What are the advantages of FET?

2. What is the difference between FET and BJT?

3. Explain different regions of V-I characteristics of FET.

4. What are the applications of FET?

5. What are the types of FET?

Experiment # 11 Non-inverting amplifier

Objective: To understand the behavior of opamp in the case of using inverting & non inverting pins .

Theory:

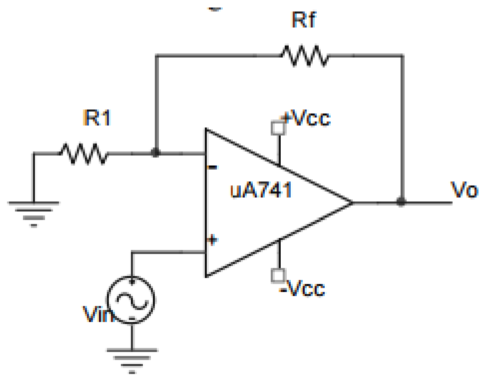
The input signal is applied to the non-inverting (+) input. The output is applied back to the inverting (-) input through the feedback circuit (closed loop) formed by the input resistor R1 and the feedback resistor Rf. This creates –ve feedback as follows. Resistors R1 and Rf form a voltage-divider circuit, which reduces VO and connects the reduced voltage Vf to the inverting input. The feedback is expressed as

$$V_f = (\frac{R_1}{R_1 + R_f})Vo$$

The difference of the input voltage, Vin and the feedback voltage, Vf is the differential input of the opamp. This differential voltage is amplified by the gain of the op-amp and produces an output voltage expressed as

$$Vo = \left(1 + \frac{R_f}{R_1}\right)V_{in}$$

Circuit diagram:



Non-inverting amplifier configuration of op-amp

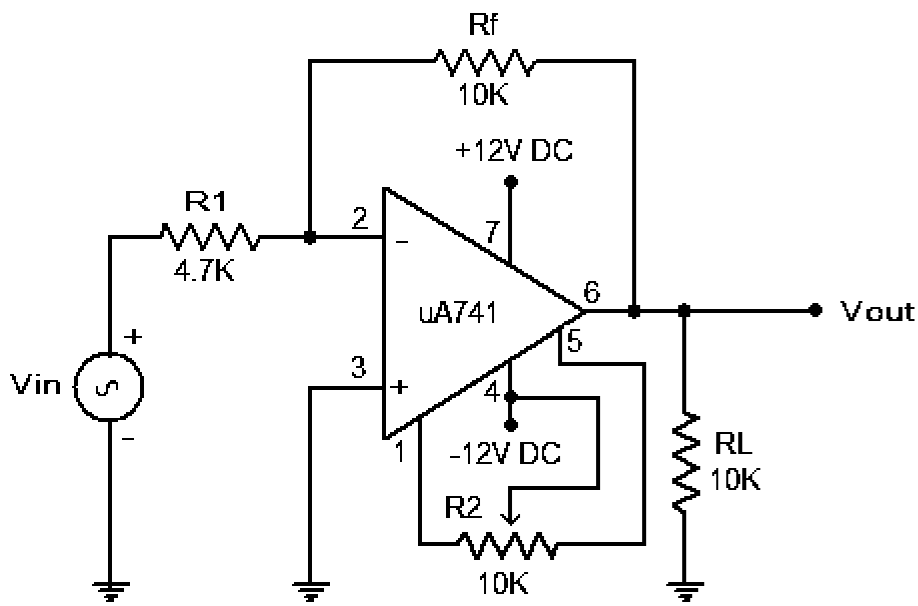
Calculations:

V_{IN}(v)	V_{OUT}(v) measured	V_{OUT}(v) calculated

Experiment #11(B) Inverting amplifier

Theory:

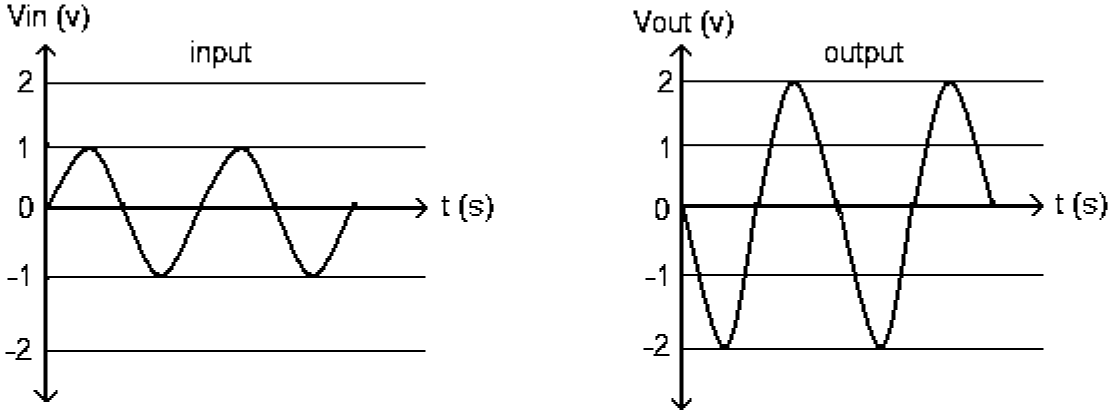
An inverting amplifier using opamp is a type of amplifier using opamp where the output waveform will be phase opposite to the input waveform. The input waveform will be amplifier by the factor Av (voltage gain of the amplifier) in magnitude and its phase will be inverted. In the inverting amplifier circuit the signal to be amplified is applied to the inverting input of the opamp through the input resistance R1. Rf is the feedback resistor. Rf and Rin together determines the gain of the amplifier. Inverting operational amplifier gain can be expressed using the equation Av = – Rf/R1. Negative sign implies that the output signal is negated. The circuit diagram of a basic inverting amplifier using opamp is shown below.



opamp inverting amplifier

Signal to be amplified is applied to the inverting pi (pin2) of the IC. Non inverting pin (pin3) is connected to ground. R1 is the input resistor and Rf is the feedback resistor. Rf and R1 together sets the gain of the amplifier. With the used values of R1 and Rf the gain will be 10 (Av = -Rf/R1 = 10K/1K = 10). RL is the load resistor and the amplified signal will be available across it. POT R2 can be used for nullifying the output offset voltage. If you are planning to assemble the circuit, the power supply must be well regulated and filtered. Noise from the power supply can adversely affect the performance of the circuit.

Input and output waveforms of an opamp inverting amplifier (gain assumed to be 2)



Calculations:

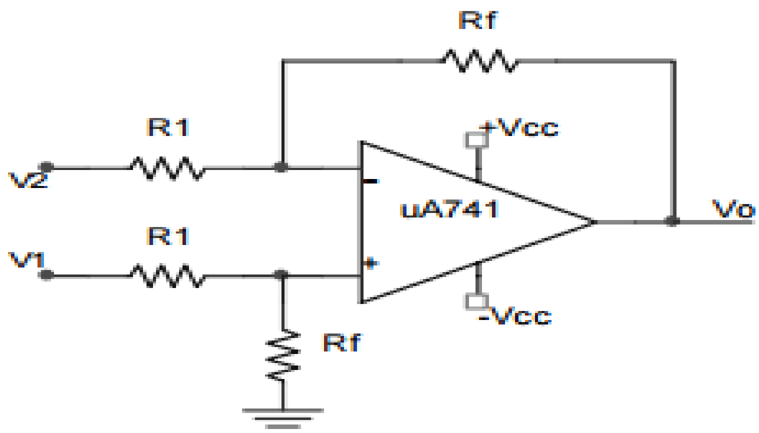
$V_{IN}(v)$	$V_{OUT}(v)$ measured	$V_{OUT}(v)$ calculated

Experiment # 12(a) Subtractor or Differential amplifier

Objective: to understand the behavior of opamp when use as a differential amplifier.

Theory:

The function of a subtractor is to provide an output proportional to or equal to the difference of two input signals. A basic differential amplifier or a subtractor circuit is shown in fig.



The output voltage of the differential amplifier can be expressed as

$$Vo = \frac{R_f}{R_1}(V_1 - V_2)$$

Thus it can be seen that the output voltage depends on the difference of the input voltages. (V1-V2) can be suitably amplified choosing the values of Rf/R1. The circuit also behaves as a subtractor if Rf=R1.

Calculations:

V_{IN1}(v)	V_{IN2}(v)	V_{OUT}(v)

Experiment # 12(B) Summing amplifier using Op Amp

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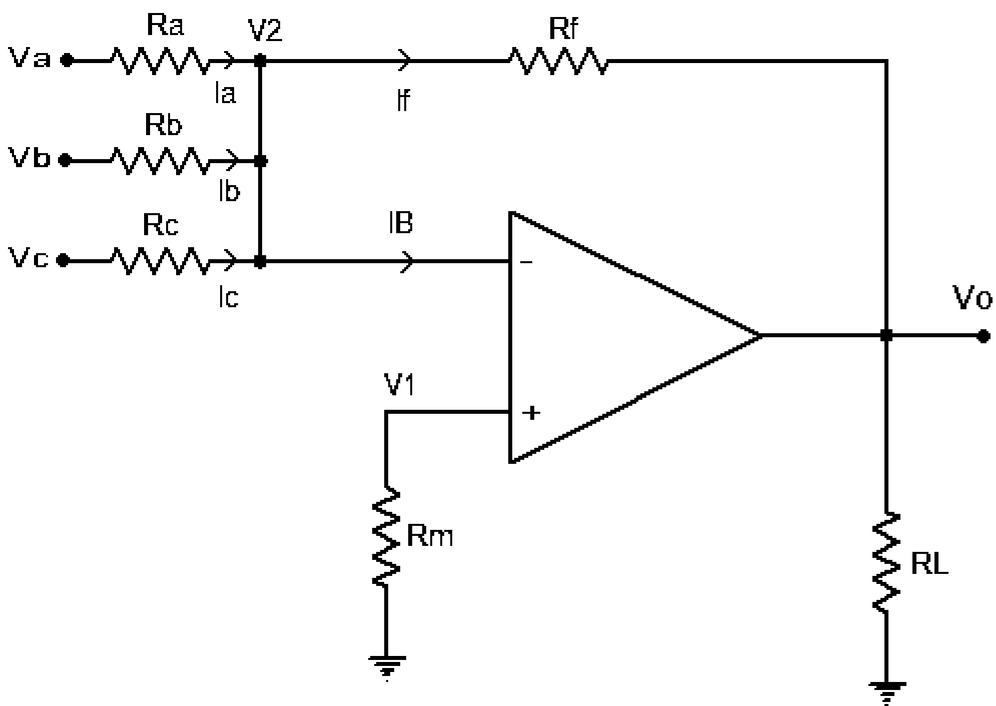
Objective: To understand the opamp use as summing amplifier.

Theory:

Summing amplifier is a type operational amplifier circuit which can be used to sum signals. The sum of the input signal is amplified by a certain factor and made available at the output .Any number of input signal can be summed using an opamp. The circuit shown below is a three input summing amplifier in the inverting mode.



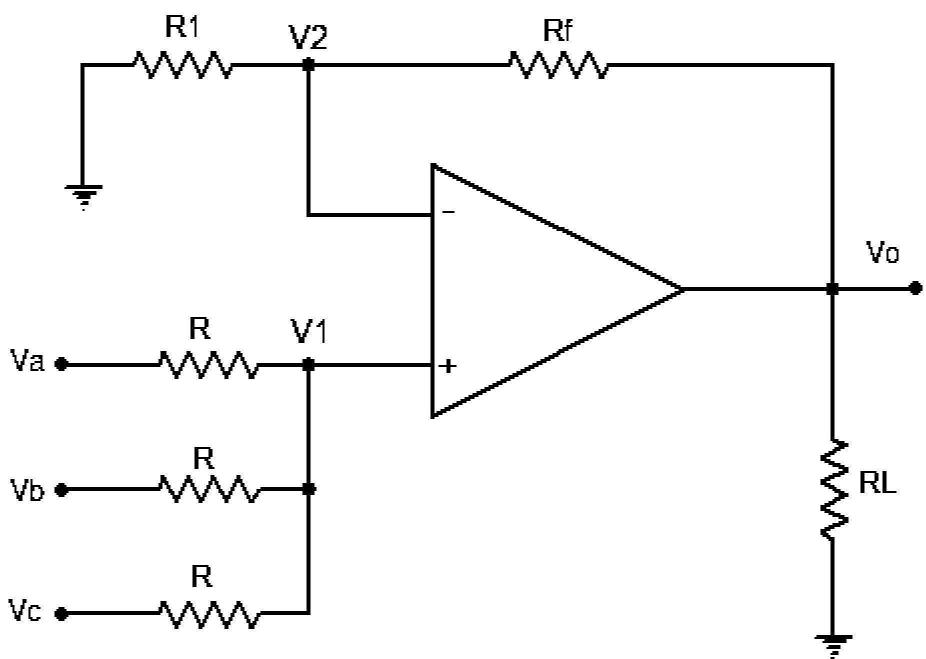
Summing amplifier

In the circuit, the input signals Va, Vb, Vc are applied to the inverting input of the opamp through input resistors Ra, Rb, Rc. Any number of input signals can be applied to the inverting input in the above manner. Rf is the feedback resistor. On inverting input of the opamp is grounded using resistor Rm. RL is the load resistor.

$$V_o = -((R_f/R_a)V_a + (R_f/R_b)V_b + (R_f/R_c)V_c)$$

$$V_o = -(R_f/R) \times (V_a + V_b + V_c) \quad \text{(When } R_a=R_b=R_c\text{)}$$

Summing amplifier in non inverting configuration.



Summing amplifier non inverting configuration

A non inverting summing amplifier circuit with three inputs are shown above. The voltage inputs Va, Vb and Vc are applied to non-inverting input of the opamp. Rf is the feedback resistor. The output voltage of the circuit is governed by the equation;

Vo = (1+ (Rf/R1)) ((Va+Vb+Vc)/3)

Draw the table and fill it.