Department of Electrical Engineering
Assignment
Date: 14/04/2020

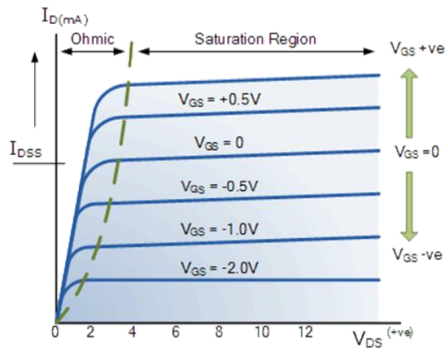
Course Details

Course Title: Electronic Circuit Design **Module:** 04

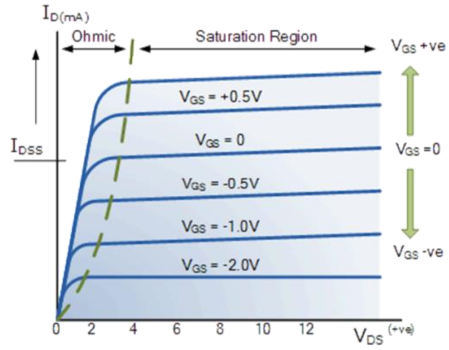
Instructor: Enger.sir mujtab ihsan **Total Marks:** 30

Student Details

Name: Farhan shah **Student ID:** 13180

Q1.	(a)	**Explain** the drain characteristic curve of D-MOSFET given below. 	Marks 07 CLO 1
	(b)	**Sketch** the hybrid model and write equations for the transistor in common emitter configuration.	Marks 06 CLO 1
Q2.		A certain operational amplifier has a common mode gain of 0.6 and an open loop differential voltage gain of 400,000. **Evaluate** the CMRR & express it in decibels.	Marks 05 CLO 2
Q3.	(a)	**Explain** the concept behind negative feedback in operational amplifiers.	Marks 06 CLO 2
	(b)	**State** the following statement as **True** or **False** and also give the reason for your answer: "The output of a summing amplifier is positive"	Marks 06 CLO 2

Q1. (a) Explain the drain characteristic curve of D-MOSFET given below.



<u>Answer:</u>

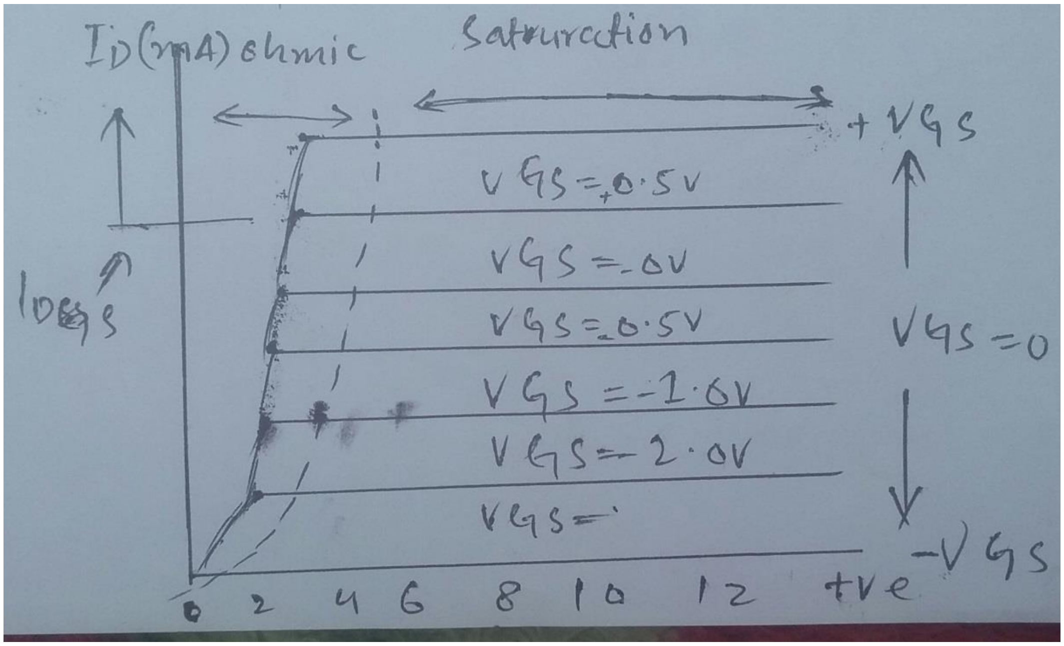
<u>D.MOSFET:</u>

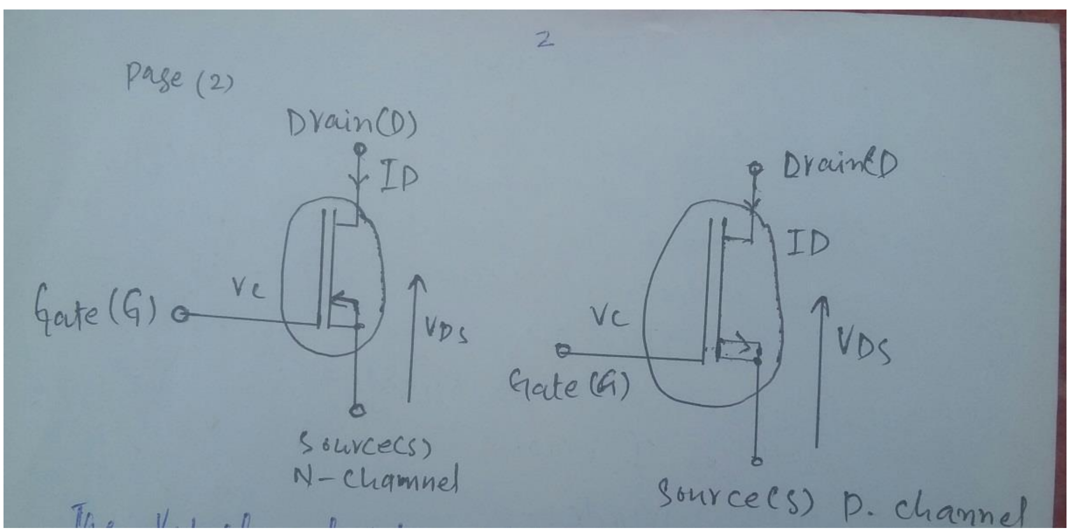
A D.mosfet is a depletion mosfet meaning that the threshold voltage negative instead of positive (positive is the usual case). its is on at agate source voltage of zero.

<u>Depletion Mode:</u>

The depletion mode mosfet are generally known as switched ON devices because these transistors are generally closed when there is no bias voltage at the gate terminal. if the gate voltage increase in positive then the channel width increase in depletion mode.

As a result the drain current (Id) through the channel increases If the applied gate voltage more negative. Then the width is very less and mosfet may enter into the cutoff region. The depletion mode mosfet is rarely used type of transistor in the electronic circuit.


ID(mA) ohmic
Saturaction
+VGS
VGS = +0.5V
VGS = 0V
VGS = 0.5V
VGS = -1.0V
VGS = -2.0V
VGS = 0
-VGS
0 2 4 6 8 10 12 +ve


2
Page (2)
Drain(D)
ID
Gate (G)
Vc
VDS
Source(S)
N-Channel
Drain(D)
ID
Vc
Gate (G)
VDS
Source(S) P. channel

(b) Sketch the hybrid model and write equations for the transistor in common emitter configuration.

Answer:

Transistor Hybrid Model:

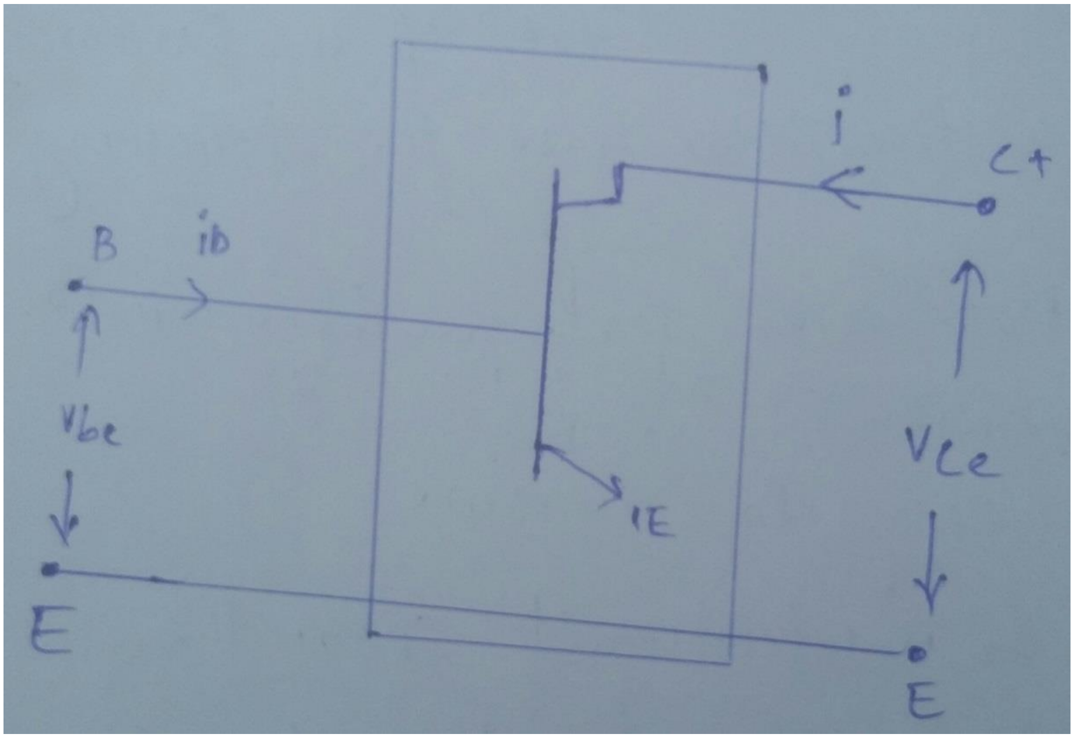
- Use of h – parameters to describe a transistor have the following advantages:
- h – Parameters are real numbers up to radio frequencies.
- They are easy to measure
- They can be determined from the transistor static characteristics curves.
- They are convenient to use in circuit analysis and design.
- Easily convertible from one configuration to the other.
- Readily supplied by many factories

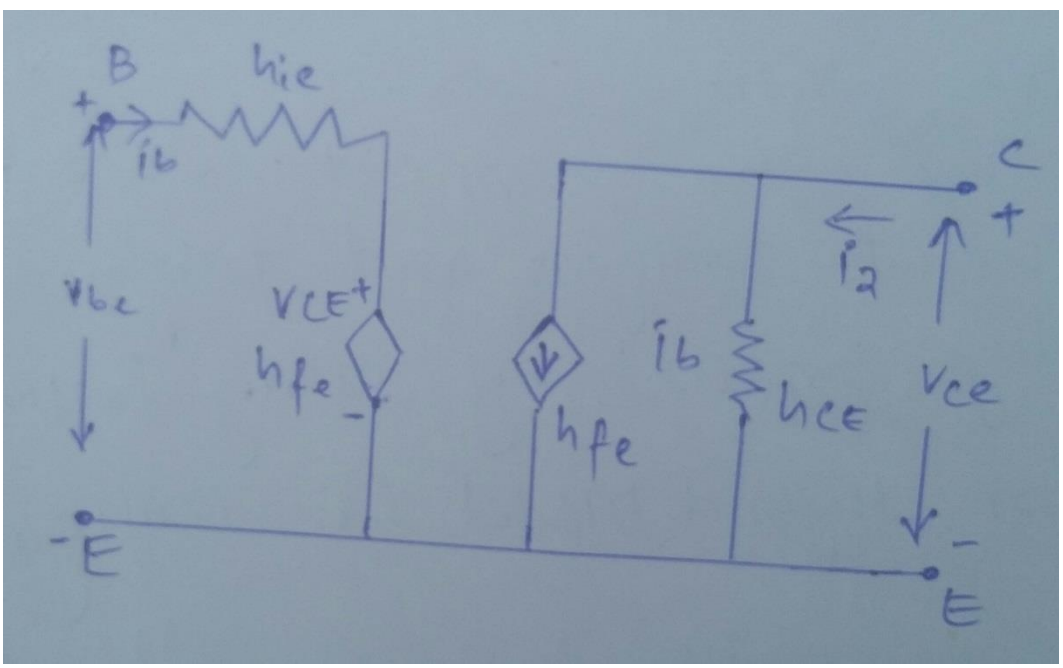
➢ **Transistor Hybrid Model CE Configuration:**

In common emitter transistor configuration, the input signal is applied between the base and emitter terminals of the transistor and output appears between the collector and emitter terminals. The input voltage (Vbe) and the output current (i.e.) are given by the following equations:

Vbe = hie.ib + hre.Vc

i.e. = hfe.ib + hoe.Vc


B
ib
C+
Vbe
Vce
IE
E
E


B
hie
ib
Vbe
VCE+
hfe
hfe
ib
hcE
C
i2
Vce
E
E

Transistor Hybrid Model CE Configuration:

Where $h_{ie} = (\partial f_1/\partial i_B)_{V_c} = (\partial v_B/\partial i_B)_{V_c} = (\Delta v_B / \Delta i_B)_{V_c} = (v_b / i_b)_{V_c}$

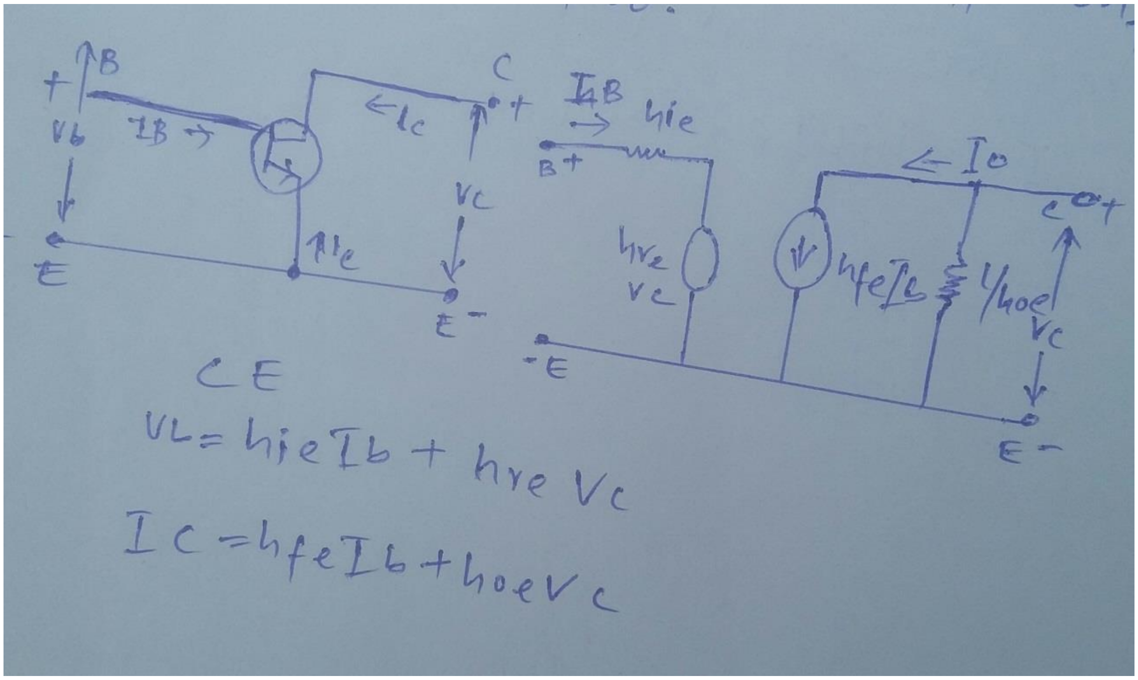
$h_{re} = (\partial f_1/\partial v_c)_{I_B} = (\partial v_B/\partial v_c)_{I_B} = (\Delta v_B / \Delta v_c)_{I_B} = (v_b / v_c)_{I_B}$

$h_{fe} = (\partial f_2/\partial i_B)_{V_c} = (\partial i_c / \partial i_B)_{V_c} = (\Delta i_c / \Delta i_B)_{V_c} = (i_c / i_b)_{V_c}$

$h_{oe} = (\partial f_2/\partial v_c)_{I_B} = (\partial i_c / \partial v_c)_{I_B} = (\Delta i_c / \Delta v_c)_{I_B} = (i_c / v_c)_{I_B}$

The same theory is extended to other configurations including CB and CC.

Hybrid Model and Equations for the transistor in three different configurations are given below:



Q2. A certain operational amplifier has a common mode gain of 0.6 and an open loop differential voltage gain of 400,000. Evaluate the CMRR & express it in decibels.

<u>Given Data:</u>

Aol= Open Loop differential voltage gain= 400,000

Acm= Common mode gain= 0.6

<u>Required:</u>

CMRR=?

<u>Solution:</u>

Formula: As CMRR=Aol/Acm

CMRR= 400,000/0.6

= 666,666.66

CMRR in decibels:

Formula:

CMRR=20log(Aol/Acm)

=20log (666, 66.66) = 116.478

Q3. (a) Explain the concept behind negative feedback in operational amplifiers.

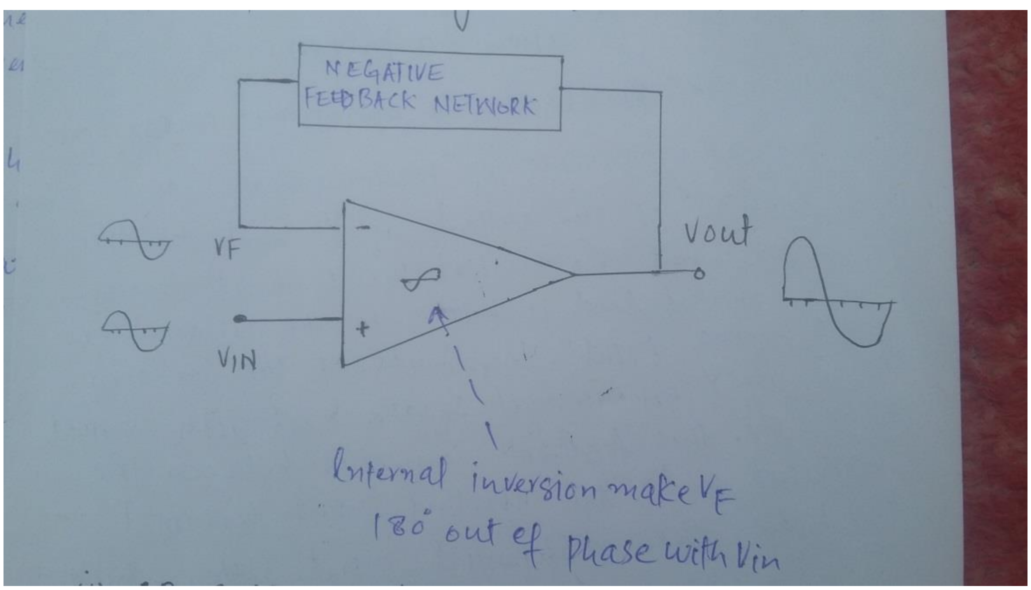
<u>Answer:</u>

<u>Negative feedback:</u>

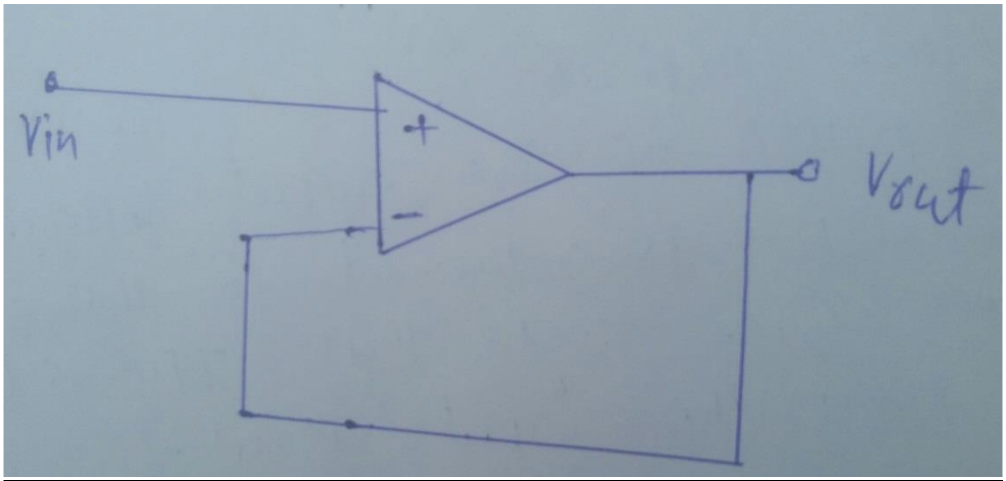
Negative feedback is the process whereby a portion of the output voltage of an amplifier is returned to the input with a phase angle that opposes (or subtracts from) the input signal"

Inverting (-) input effectively makes the feedback signal 180' out of phase with the input signal

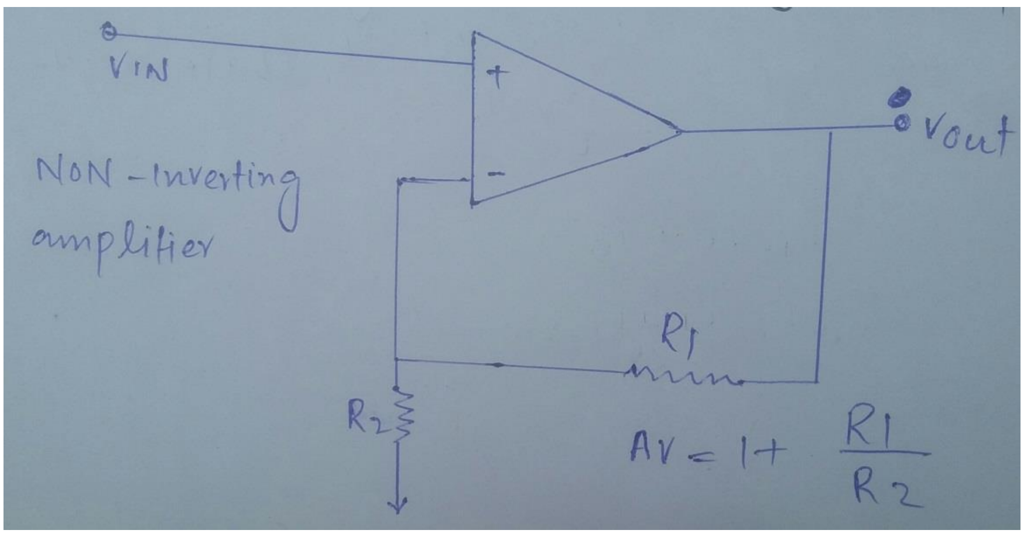
<u>Op-Amps with negative Feedback</u>:



1.Op-amp as Buffer:



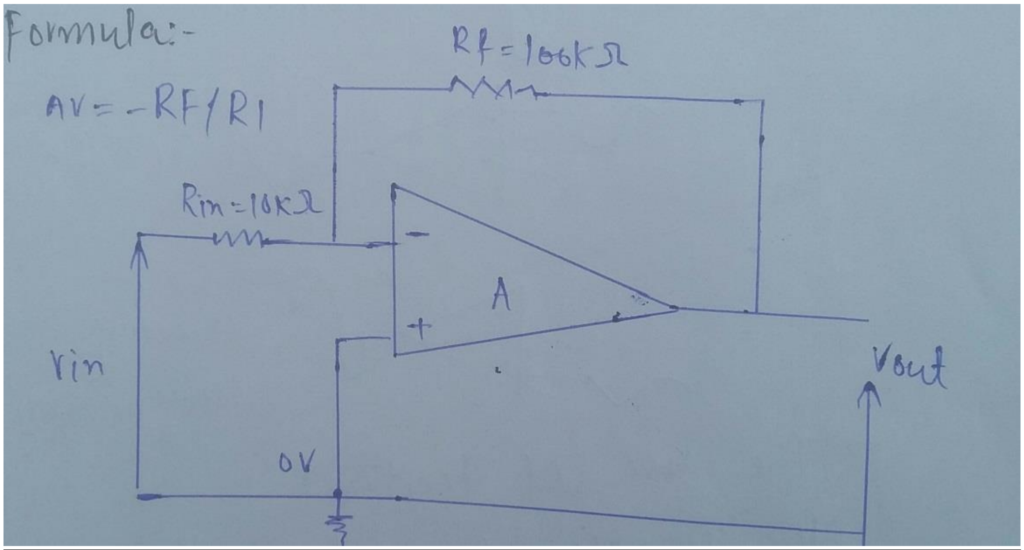
2. Op-amp as Non Inverting Amplifier:



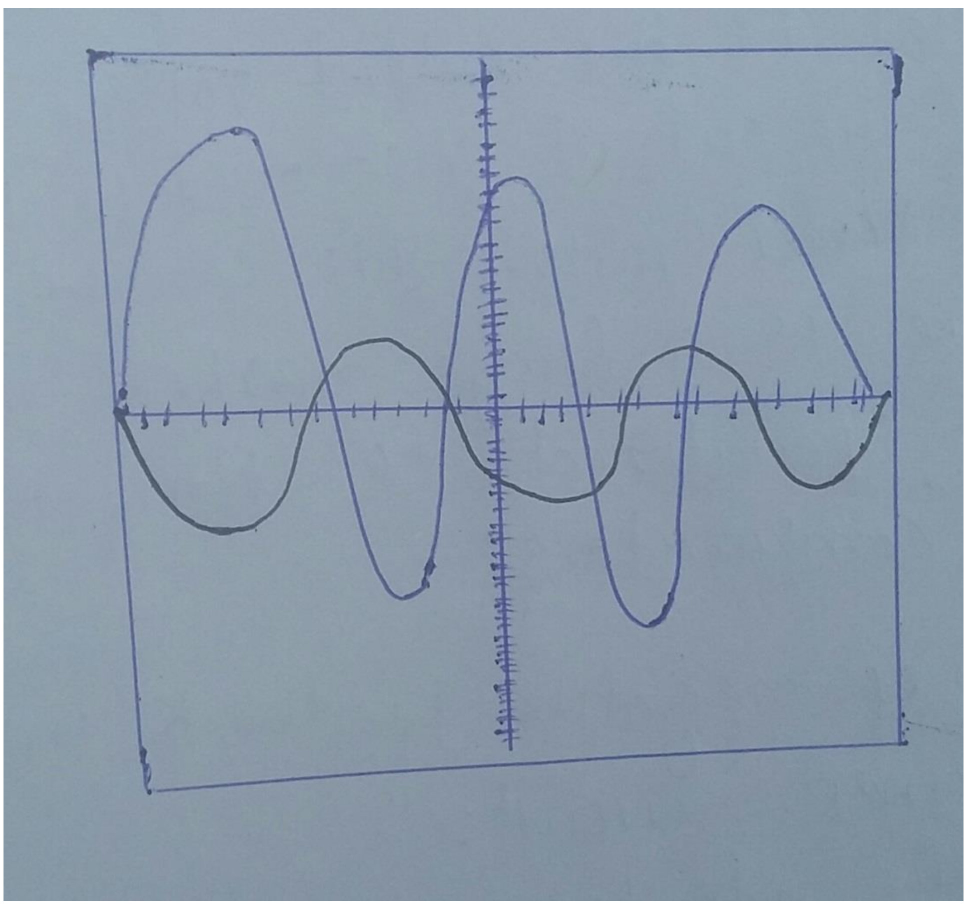
3.Op-amp as Inverting Amplifier:

Formula:

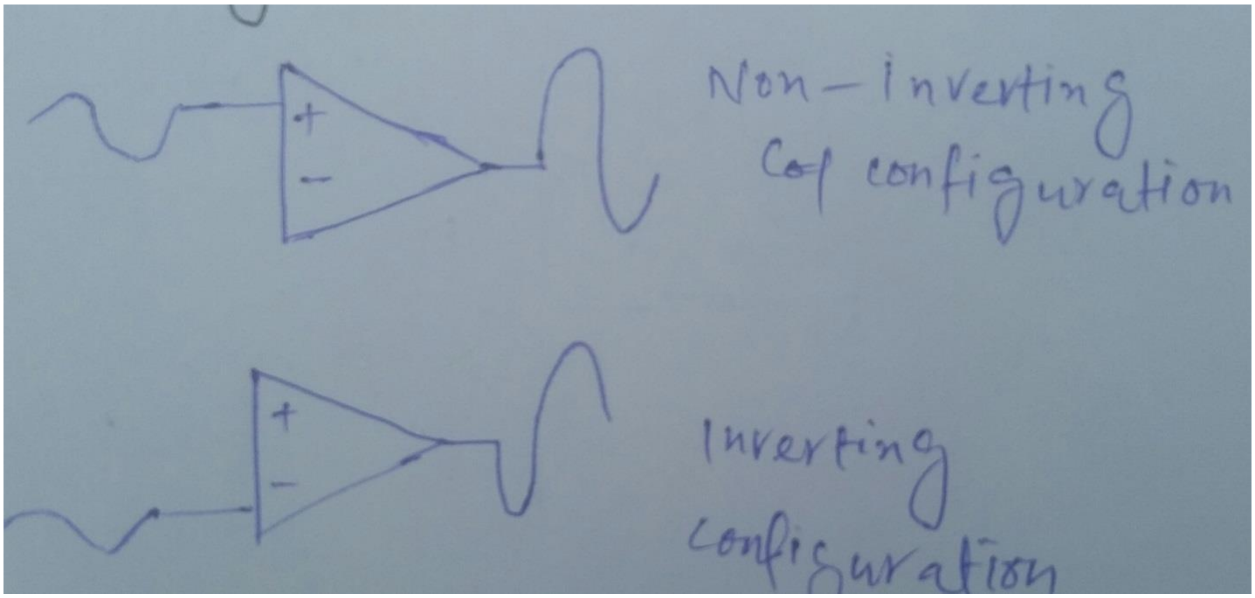
Av= -RF/ R1



Op-amp Input & Output Signals:



Input and output of inverting and non-inverting amplifier:



Benefit of negative feedback in an op-amp circuit:

There are many advantages to using feedback within a system design but the main advantages of using negative feedback in amplifier circuits to greatly improve their stability. Better tolerance to component variations stabilization against Dc drift as well increasing the amplifier bandwidth.

(b) State the following statement as True or False and also give the reason for your answer:

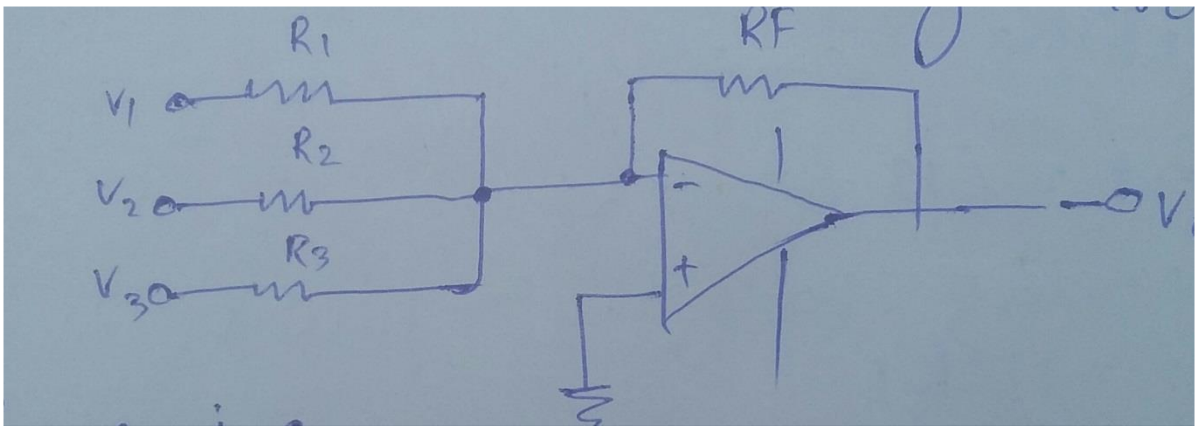
"The output of a summing amplifier is positive"

Answer:

This is false the reason is below.

Reason:

- The output of summing amplifier is positive. Its statement is not correct because summing amplifier is an application of an inverting operational amplifier configuration which has more than one input and its output will be negative.
- Summing amplifier is a type of 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 signals can be summed using an op-amp. The circuit shown below is a three input summing amplifier in the inverting mode.

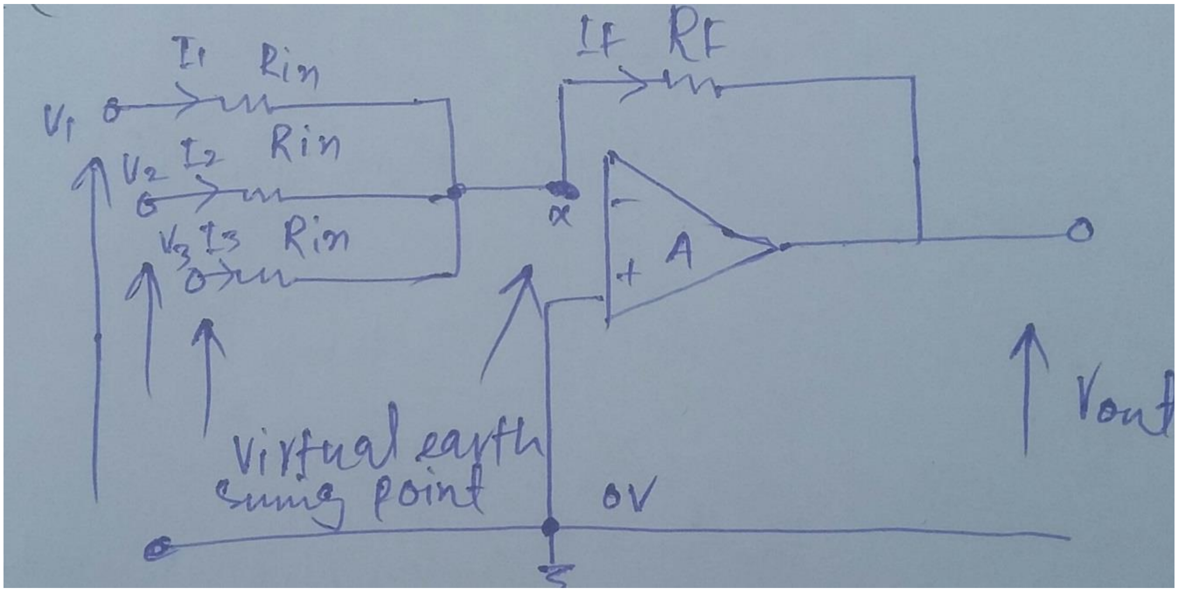


Summing amplifier is an application of inverting op-amp configuration that has two or more inputs and its output voltage is proportional to the negative of the algebraic sum of its input voltages

Important Concepts:

1. Infinite input impedance

2. Virtual ground



Derivation of Vout Formula:

According to KVL:

IT= I1 + I2…………………….eq.1

According to Ohm's Law output voltage will be:

Vout= - IT Rf………………….eq.2

Reason (for negative sign): Summing amplifier is an inverting amplifier.

Putting values of eq.1 in eq.2

Vout=-(I1+I2) x Rf…………..eq.3

According to Ohm's Law V=IR

V1=I1 R1

Therefore

I1=V1/R1

I2=V2/R2

I3=V3/R3

Put these values in eq.3

Vout= - [V1/R1+V2/R2+V3/R3] RF………..eq.4

If the three resistors are equal i.e. R1=R2=R3=Rf=R

Vout= - [V1/R+V2/R+V3/R] R

Vout= - [V1+V2+V3]……………eq.5

Vout= - [V1+V2+V3……….Vn

Summing Amplifier with gain greater than unity:

When Rf is greater than input resistors, the amplifier has a gain of Rf/R, where R is the value of each equal value input resistor.

Vout= - (Rf/R)* [V1+ V2+……….VN]