SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB204 – LINEAR AND DIGITAL CIRCUITS

II YEAR/ III SEMESTER

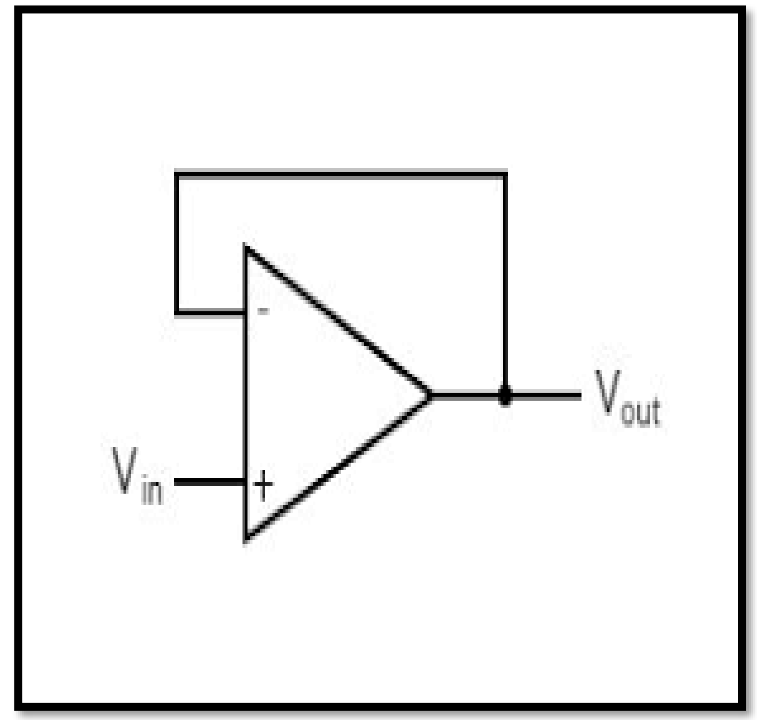
UNIT 1 – **FUNDAMENTALS OF OPAMP**

TOPIC 2 – Feedback in ideal Op-amp

Guess?????

Why?

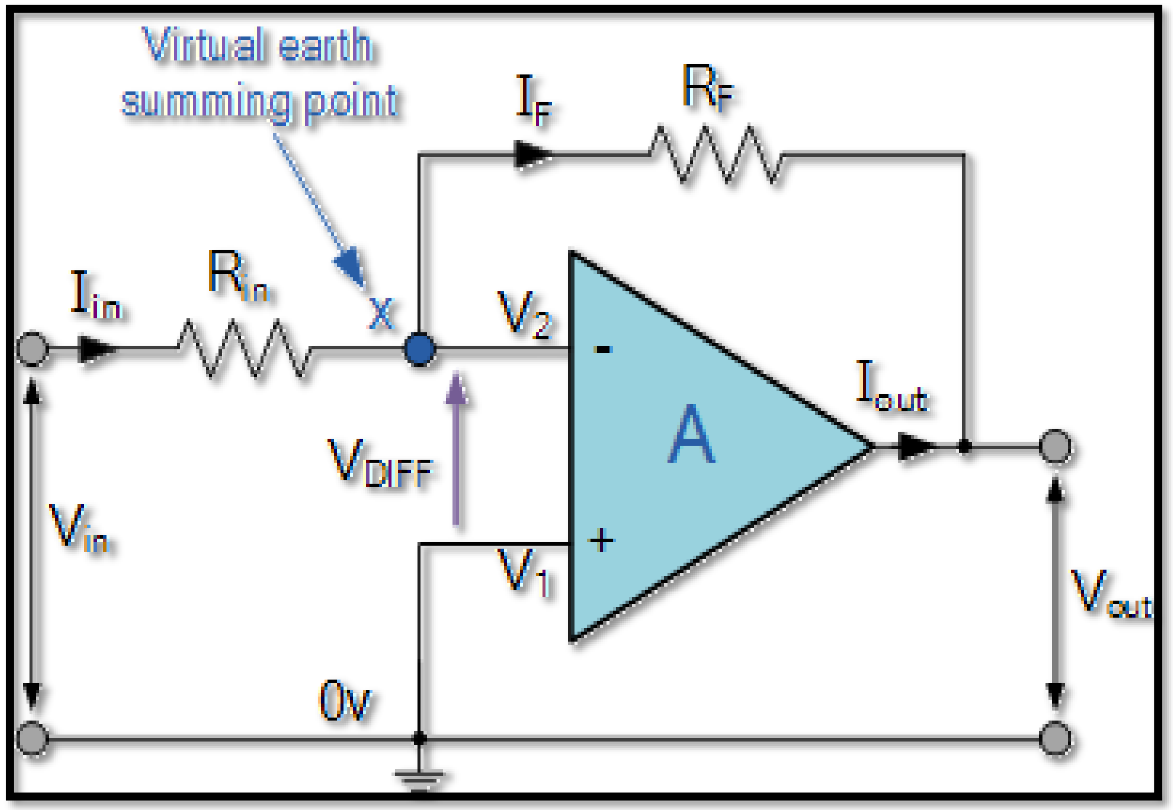
- An ideal op-amp has infinite gain
- It amplifies the difference in voltage between the + and - pins. This gain is not infinite, but still quite large
- The output of the opamp is constrained by the power supply
- If input signals fed into the opamp without feedback it would multiply them by infinity and get a binary output (saturate)
- Using feedback , the gain will be controlled



What?

- Feedback occurs when outputs of a system are routed back as inputs as part of a chain of cause-and-effect that forms a circuit or loop
- The system can then be said to feed back into itself
- This makes reasoning based upon cause and effect tricky, and it is necessary to analyze the system as a whole
- Feedback systems are widely used in amplifier circuits, oscillators, process control systems, and in many other areas

Inverting Op Amp



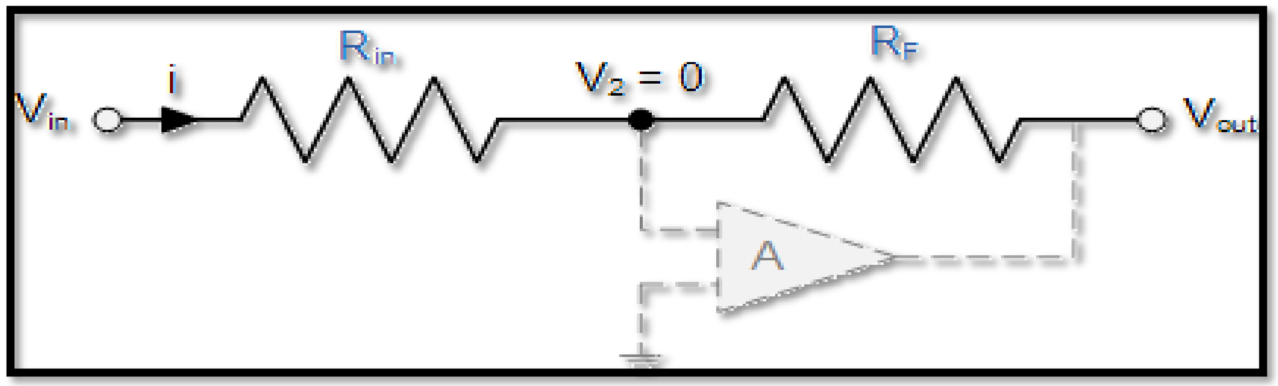
- The operational amplifier is connected with feedback to produce a closed loop operation.

- Two very important rules

- No Current Flows into the Input Terminals
- The Differential Input Voltage is Zero as V1 = V2 = 0 (Virtual Earth)

Inverting Op Amp

Current (i) flows through the resistor network as shown



$$i = \frac{Vin - Vout}{Rin + Rf}$$

$$\text{therefore, } i = \frac{Vin - V2}{Rin} = \frac{V2 - Vout}{Rf}$$

$$i = \frac{Vin}{Rin} - \frac{V2}{Rin} = \frac{V2}{Rf} - \frac{Vout}{Rf}$$

$$\text{so, } \frac{Vin}{Rin} = V2\left[\frac{1}{Rin} + \frac{1}{Rf}\right] - \frac{Vout}{Rf}$$

$$\text{and as, } i = \frac{Vin - 0}{Rin} = \frac{0 - Vout}{Rf} \qquad \frac{Rf}{Rin} = \frac{0 - Vout}{Vin - 0}$$

$$\text{the Closed Loop Gain (Av) is given as, } \frac{Vout}{Vin} = -\frac{Rf}{Rin}$$

Inverting Op Amp

The **Closed-Loop Voltage Gain** of an Inverting Amplifier is given as

$$\text{Gain}(Av) = \frac{V_{out}}{V_{in}} = -\frac{R_f}{R_{in}}$$

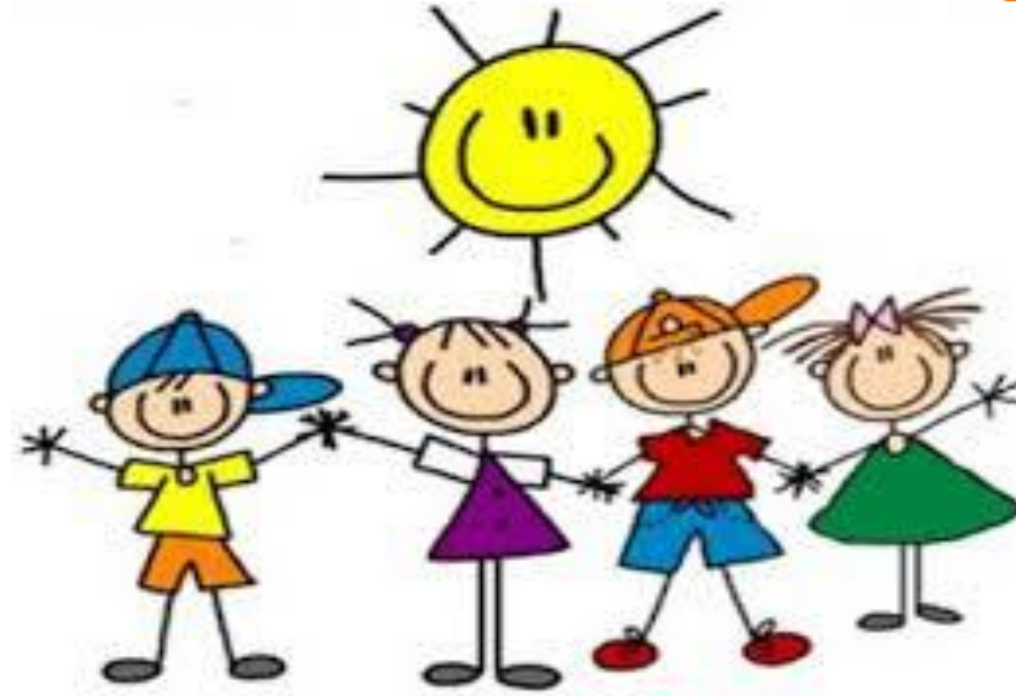
Vout as

$$Vout = -\frac{Rf}{Rin} \times Vin$$

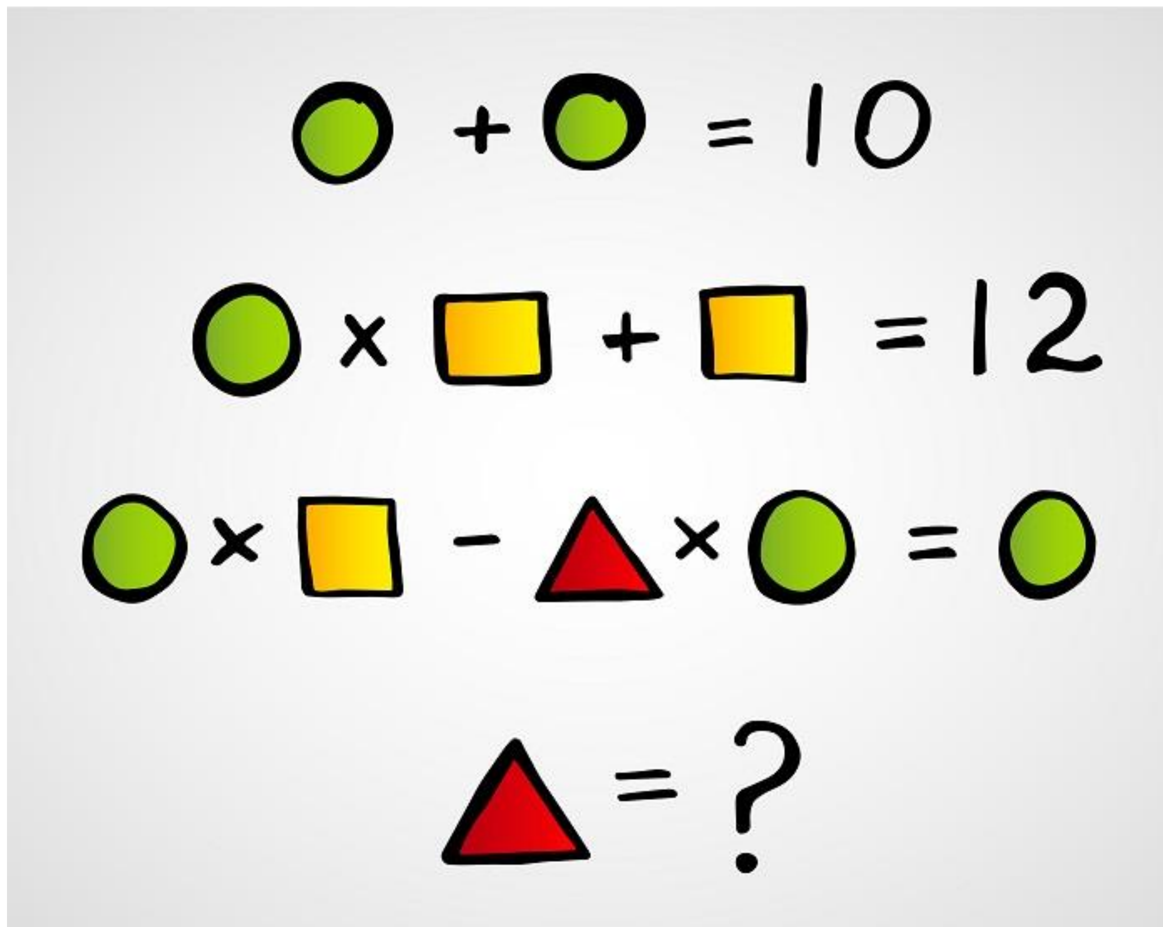
✓The negative sign in the equation indicates an inversion of the output signal with respect to the input as it is 180^{o} out of phase

✓This is due to the feedback being negative in value

Activity

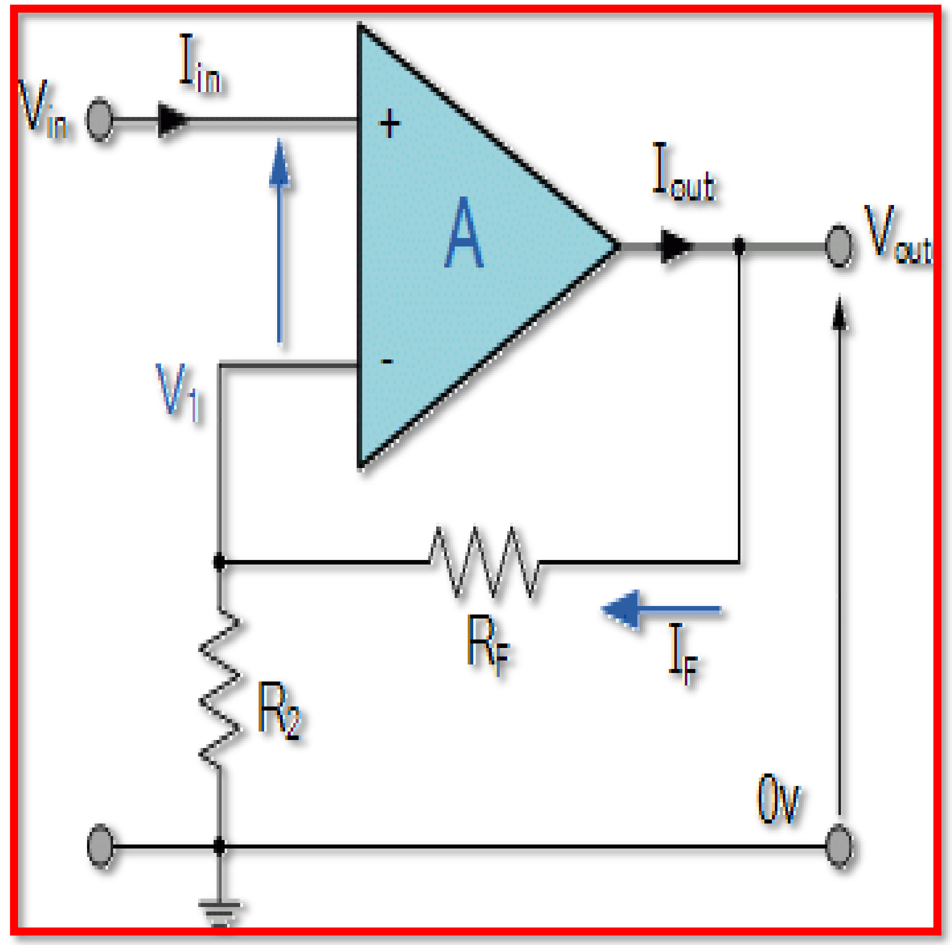


In class activity



Non inverting Op Amp

- In this configuration, the input voltage signal, (V_{IN}) is applied directly to the non-inverting (+) input terminal Infinite input impedance
- The output gain of the amplifier becomes "Positive" in value in contrast to the "Inverting Amplifier" circuit
- The result of this is that the output signal is "in-phase" with the input signal



Non inverting Op Amp

➢Closed-loop voltage gain (A_V) of the **Non-inverting Amplifier** as

$$V_1 = \frac{R_2}{R_2 + R_F} \times V_{OUT}$$

Ideal Summing Point: $V_1 = V_{IN}$

Voltage Gain, $A_{(V)}$ is equal to: $\frac{V_{OUT}}{V_{IN}}$

Then, $A_{(V)} = \frac{V_{OUT}}{V_{IN}} = \frac{R_2 + R_F}{R_2}$

Transpose to give: $A_{(V)} = \frac{V_{OUT}}{V_{IN}} = 1 + \frac{R_F}{R_2}$

Non inverting Op Amp

Closed loop voltage gain of a **Non-inverting Operational Amplifier** will be

$$A_{(v)} = 1 + \frac{R_F}{R_2}$$

- The overall closed-loop gain will always be greater but never less than 1
- It is positive in nature and is determined by the ratio of the values of R_f and R2
- If R_f is zero, the gain of the amplifier will be exactly equal to one (unity)
- If resistor R2 is zero the gain will approach infinity
- But in practice it will be limited to the operational amplifiers open-loop differential gain, (A_O)

Advantages of Negative feedback

- Less frequency distortion
- Less phase distortion
- Increase **stability**
- Increase **bandwidth**
- Decrease noise

These are advantages of negative feedback over positive feedback.

- Low gain is only disadvantage

Assessment

1.Negative Feedback increases gain

A)True   B)False

2.A voltage follower-------------------

3. Define Open Loop Configuration

THANK YOU