SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade (III Cycle)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE CODE & NAME: 23ECB202 LINEAR INTEGRATED CIRCUITS

II YEAR/IV SEMESTER

UNIT 1- OPAMP CHARACTERISTICS

TOPIC 1- INTRODUCTION OF OPERATIONAL AMPLIFIERS (Op-Amps)

OUTLINE

- What is an Op-Amp?
- Why Study Op-Amps?
- Anatomy of an Op-Amp (IC 741)
- Ideal vs. Practical Op-Amp Characteristics
- Op-Amp Configurations
- Applications of Op-Amps
- Real-Life Examples of Op-Amps
- Summary

What is an Op-Amp?

Definition:

- - An Operational Amplifier (Op-Amp) is an integrated circuit (IC) that can amplify weak electrical signals.
- - It has two inputs and one output.

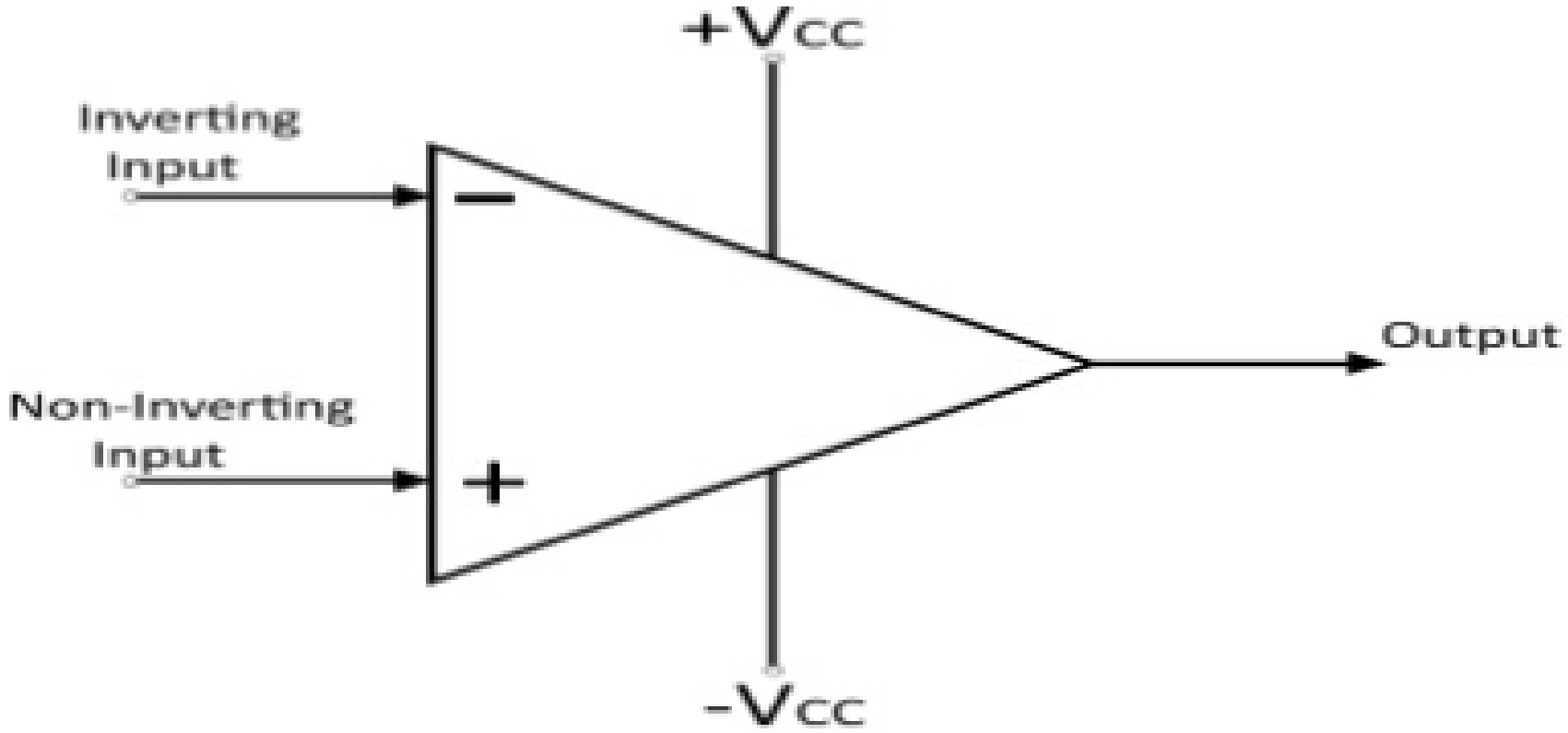
Purpose:

- - Originally designed for mathematical operations like addition, subtraction, integration, and differentiation.

Basic Uses:

- - Amplifiers, filters, oscillators, and comparators.

What is an Op-Amp?



Why Study Op-Amps?

Key Reasons:

- - **Versatility:** Used in nearly all analog electronic devices.
- - **Foundation of Electronics:** Helps understand advanced analog and mixed-signal designs.
- - **Applications:** Found in audio systems, communication devices, and control systems.

Examples:

- - Audio amplifiers, ECG machines, and sensors.

Anatomy of an Op-Amp (IC 741)

Internal Block Diagram of IC 741:

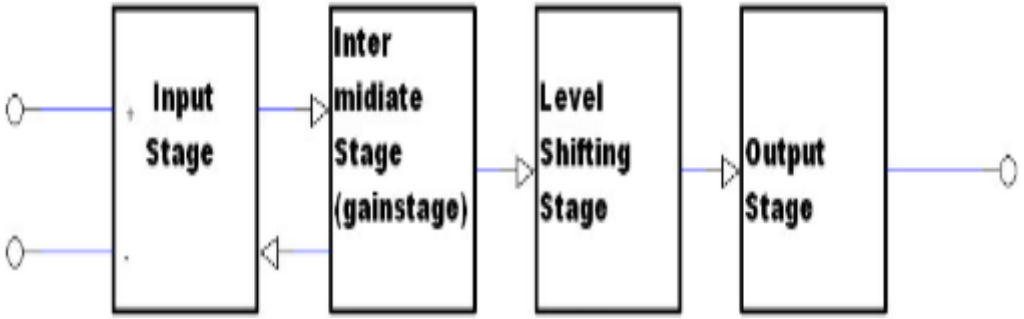
- - Input Stage: Differential amplifier for high input impedance.
- - Gain Stage: Amplifies the signal further.
- - Output Stage: Provides low output impedance to drive loads.

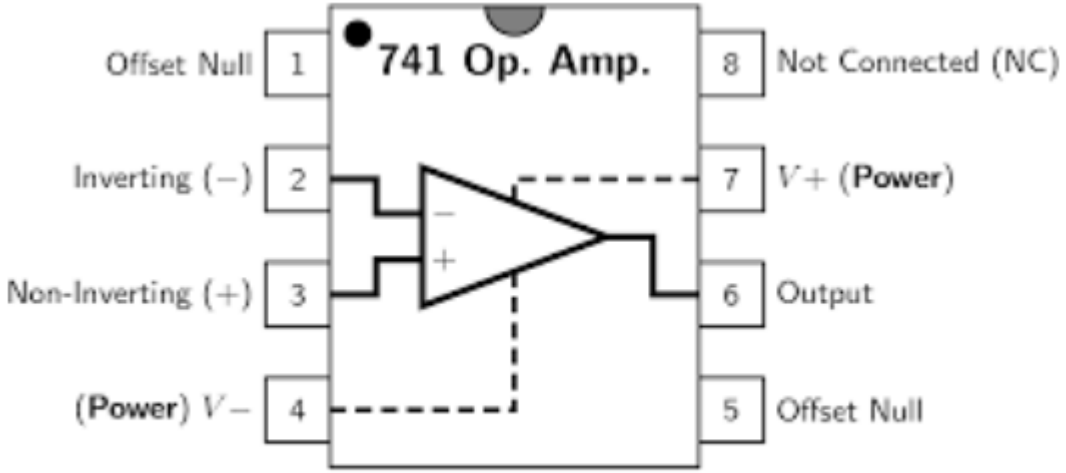
Pin Configuration:

- - Power supply pins (V+ and V-).
- - Input pins (Inverting – and Non-Inverting +).
- - Output pin.

Anatomy of an Op-Amp (IC 741)

Internal Block Diagram of IC 741:





IC 741 Pin Diagram

Ideal vs. Practical Op-Amp Characteristics

Parameter	Ideal Op-Amp	Practical Op-Amp
Input Impedance	Infinite	High (~1 MΩ)
Output Impedance	Zero	Low (~100 Ω)
Open-Loop Gain	Infinite	Finite (100,000-1,000,000)
Bandwidth	Infinite	Limited (1 MHz typical for 741)
Slew Rate	Infinite	Limited (0.5 V/µs for 741)

Op-Amp Configurations

Two Main Configurations:

1. Open-Loop Configuration:

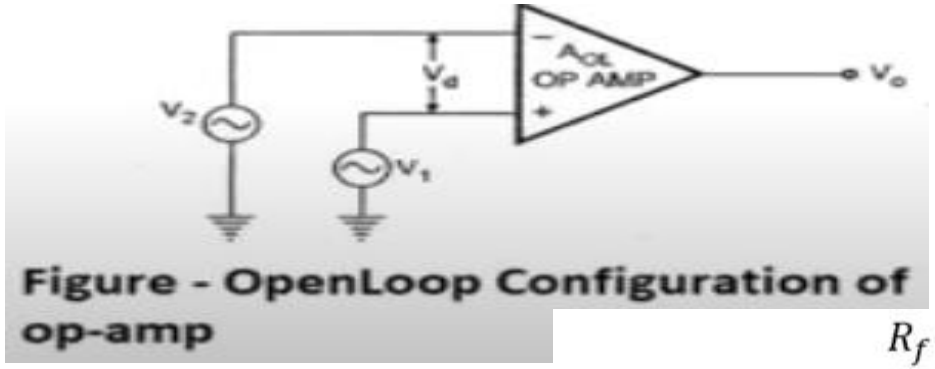
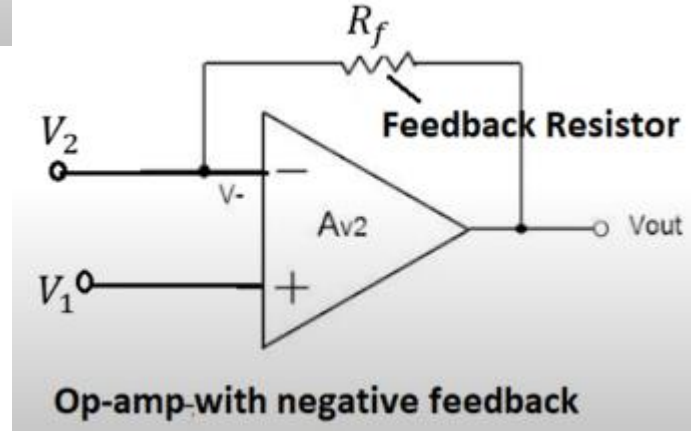


Figure - OpenLoop Configuration of op-amp

- Operates without feedback.

- Used in applications like comparators.

2. Closed-Loop Configuration:

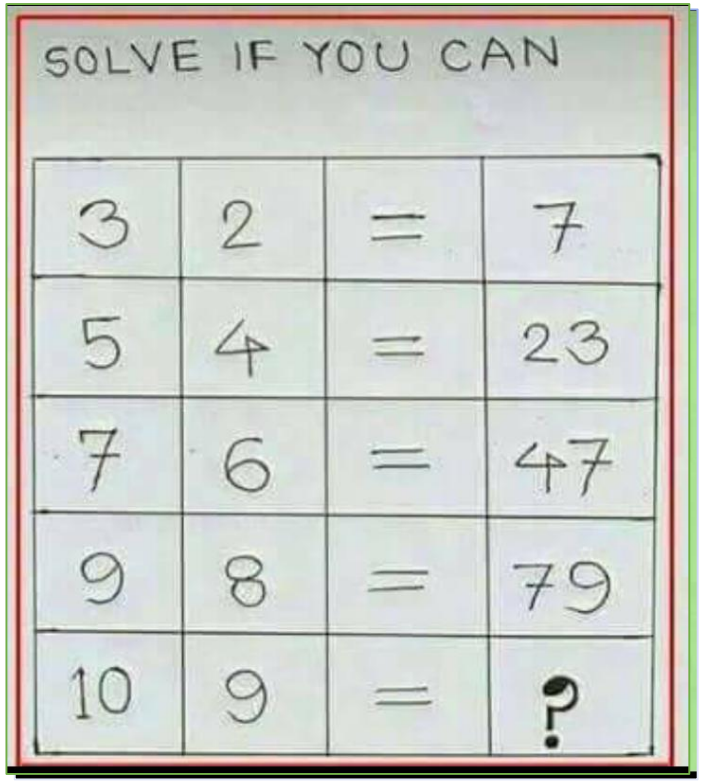


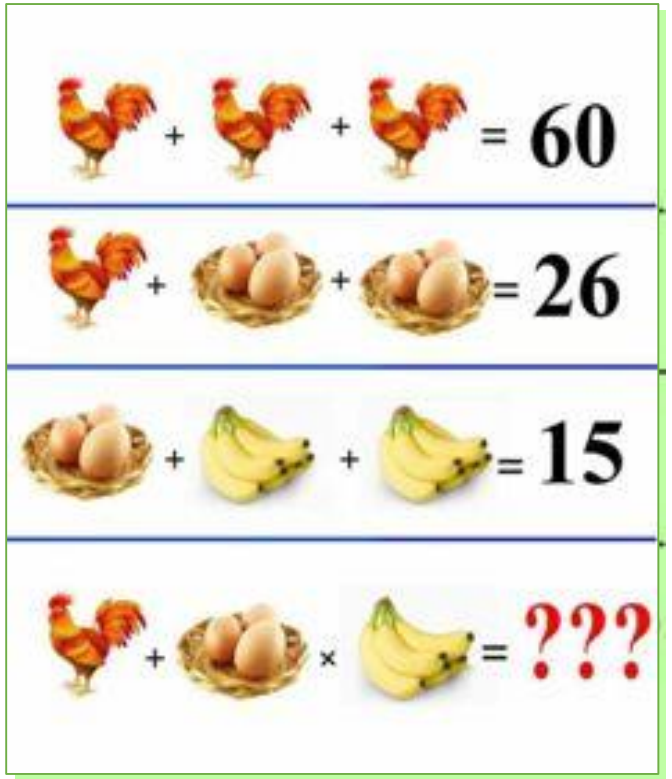
Op-amp with negative feedback

- Feedback is applied to control gain and improve stability.

- Used in amplifiers.

ACTIVITY





Applications of Op-Amps

- Inverting Amplifier:
- - Inverts and amplifies the input signal.
- - Formula: Vout = -(Rf/Rin) * Vin

- Non-Inverting Amplifier:
- - Amplifies the input without inverting it.
- - Formula: Vout = (1 + Rf/R1) * Vin.

Real-Life Examples of Op-Amps

Audio Amplifiers: Amplify microphone signals.

Filters: Remove noise in communication systems.

Voltage Comparators: Used in digital logic circuits.

ASSESSMENT

1. What does an Op-Amp do?
   a) Amplifies signals
   b) Reduces noise
   c) Converts AC to DC
   d) Stores energy

Correct Answer: **a) Amplifies signals**

2. Which of the following is an ideal Op-Amp characteristic?
   a) Infinite gain
   b) Zero output impedance
   c) Infinite input impedance
   d) All of the above

Correct Answer: **d) All of the above**

3. What is the gain formula for a non-inverting amplifier?
   a) Gain = -Rf/R1
   b) Gain = 1 + (Rf/R1)
   c) Gain = Vin/Vout
   d) Gain = 1 - (Rf/R1)

Correct Answer: **b) Gain = 1 + (Rf/R1)**

4. In an Op-Amp, the term 'slew rate' refers to:
   a) The speed at which an Op-Amp operates
   b) The maximum rate of change of the output voltage
   c) The bandwidth of the amplifier
   d) The input impedance of the amplifier

Correct Answer: **b) The maximum rate of change of the output voltage**

5. What is the primary use of the IC 741 Op-Amp?
   a) Digital processing
   b) Signal amplification
   c) Voltage regulation
   d) Signal storage

Correct Answer: **b) Signal amplification**

SUMMARY

THANK YOU...