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 1 – Introduction to Opamp

Guess?????


equipment
bass loudspeaker
concert party
technology panel bass electric object
speaker
concert
retro
power party musical
stereo
rock
modern style
amplifier
guitar
electrical
power button
stereo
string
instrument audio
music
volume
knob
modern
loud
amp
design cabinet
professional
professional
sound
boom
play band
loud
object
string input

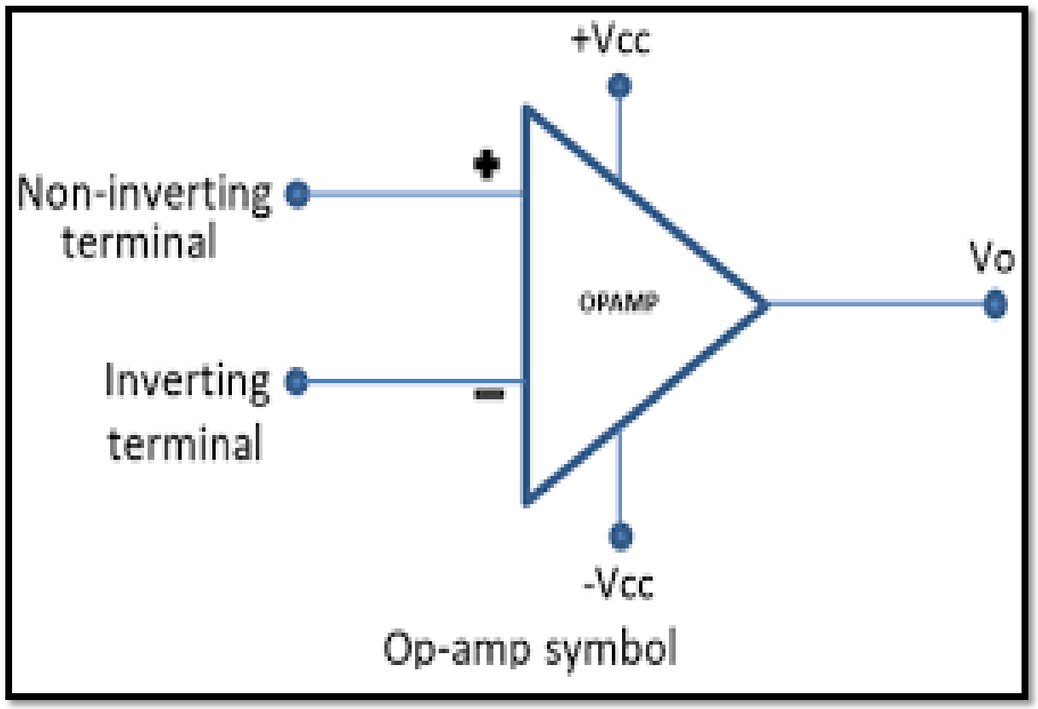
Why?

- Op-amp stands for operational amplifier.
- Op-amps were so named because they were used to model the basic mathematical operations of addition, subtraction, integration, differentiation, etc. in electronic analog computers.
- In this sense a true operational amplifier is an ideal circuit element.
- A circuit that does adding or subtracting depends on a control signal.

What?

- An **operational amplifier** is an integrated circuit that can amplify weak electric signals.
- An **operational amplifier** (often **op amp** or opamp) is a DC-coupled high-gain electronic voltage **amplifier** with a **differential** input and, usually, a single-ended output.
- An **operational amplifier** has two input pins and one output pin. Its basic role is to amplify and output the voltage difference between the two input pins.

Op Amp



Op-amp symbol

➢An *Operational Amplifier* is basically a three-terminal device which consists of two high impedance inputs

➢One of the inputs is called the **Inverting Input**, marked with a negative or “minus” sign, (–)

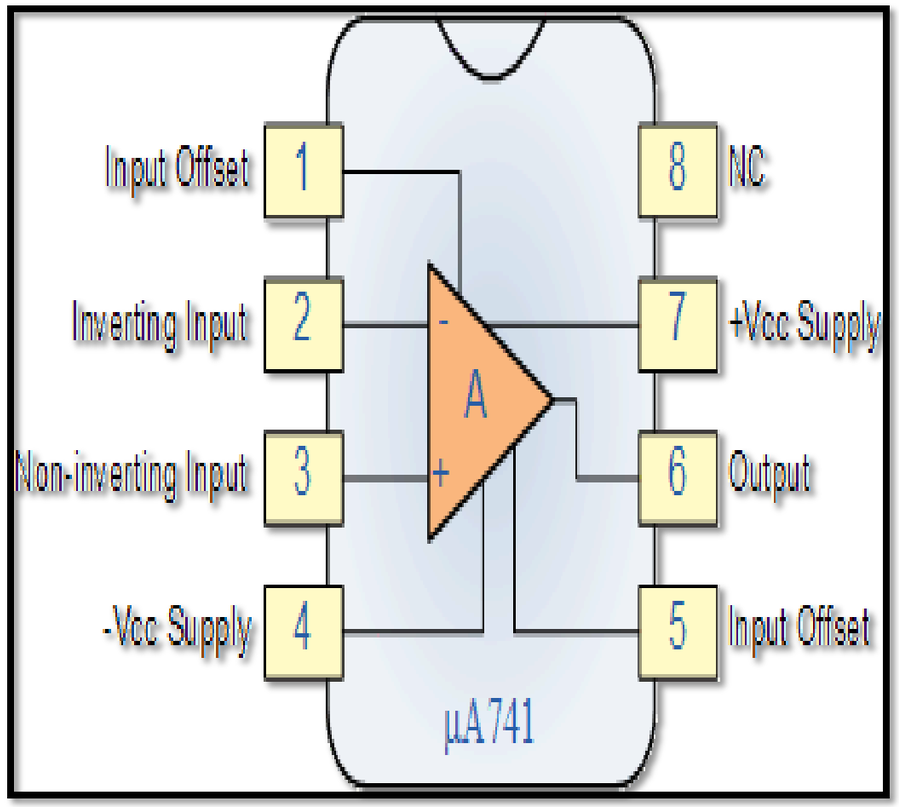
➢ The other input is called the **Non-inverting Input**, marked with a positive or “plus” sign (+)

➢A third terminal represents the operational amplifiers **output port** which can both sink and source either a voltage or a current.

Op Amp Pin diagram

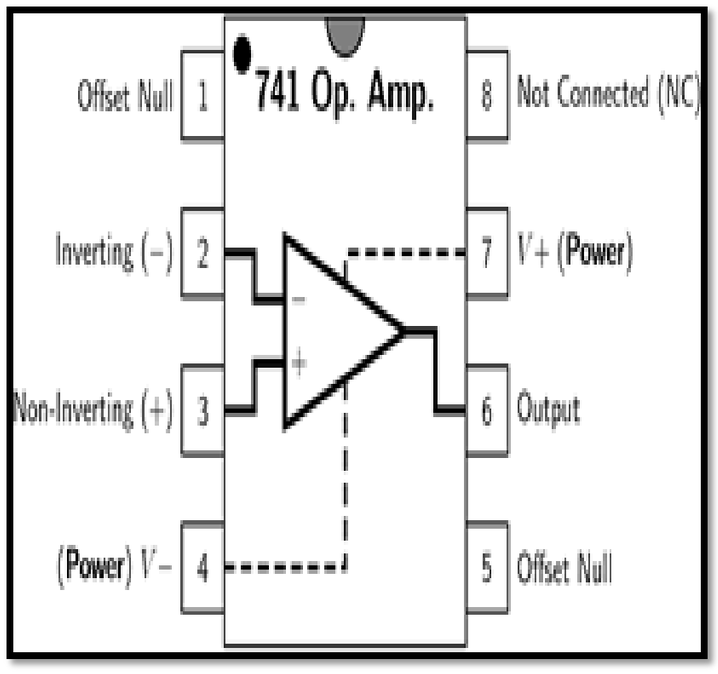
There are 8 pins in a common OP-AMP,

- ✓Pin1: offset null.
- ✓Pin2: inverting input terminal.
- ✓Pin3: non-inverting input terminal.
- ✓Pin4: -VCC(negative supply).
- ✓Pin5: offset null.
- ✓Pin6: output voltage.
- ✓Pin7: +VCC(positive supply).
- ✓Pin8: No connection.



741 IC - Op Amp

- The **741 Op Amp** IC is a monolithic integrated circuit, comprising of a general purpose **Operational Amplifier**



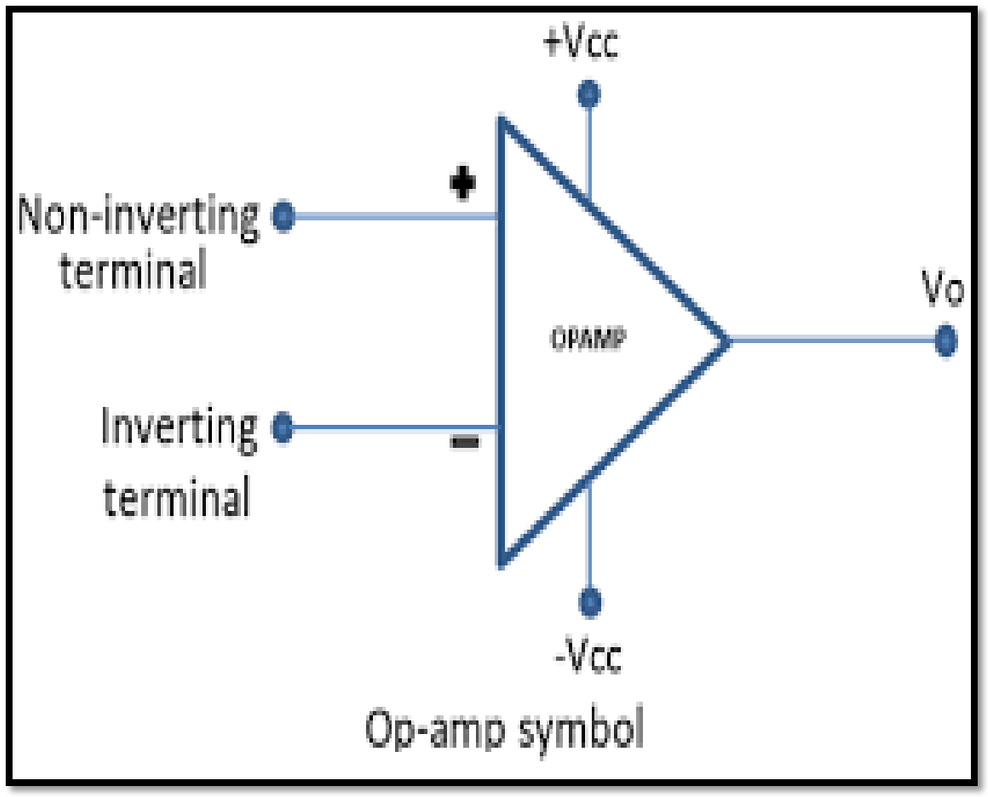
- It was first manufactured by Fairchild semiconductors in the year **1963.**
- The number **741** indicates that this **operational amplifier** IC has 7 functional pins, 4 pins capable of taking input and 1 output pin.

Activity

In class activity

Ideal characteristics of Op Amp

- Infinite open-loop voltage gain
- Infinite input impedance
- Zero output impedance
- Zero noise contribution
- Zero DC output offset
- Infinite bandwidth

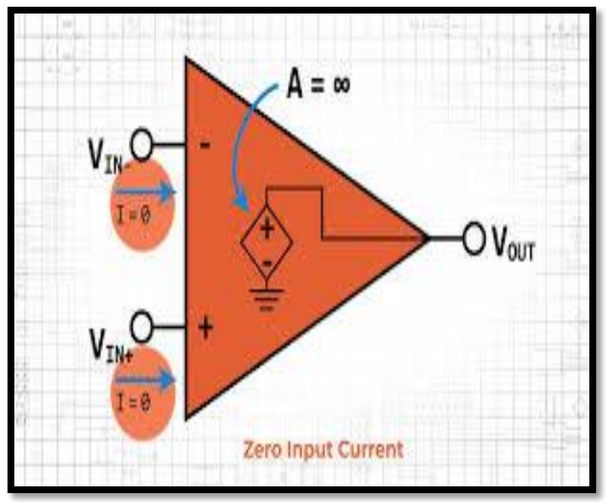


Op-amp symbol

Ideal characteristics of Op Amp

➢An ideal op amp is an op amp that has perfect conditions to allow it to function as an op amp with 100% efficiency.

1. Open-loop voltage gain



- Open-Loop Gain Avol is the gain of the op-amp without positive or negative feedback
- In the ideal op-amp Avol is infinite
- Typical values range from 20,000 to 200,000 in real devices

2. Infinite input impedance

- Input impedance is the ratio of input voltage to input current

$$Z_{in} = \frac{V_{in}}{I_{in}}$$

When Z_{in} is infinite, the input current $I_{in}=0$

- High-grade op-amps can have input impedance in the TΩ range

➢Some low-grade op-amps, on the other hand, can have mA input currents

Ideal characteristics of Op Amp

3. Zero output impedance

➢The ideal op-amp acts as a perfect internal voltage source with no internal resistance

➢This internal resistance is in series with the load, reducing the output voltage available to the load

➢Real op-amps have output-impedance in the 100-20Ω range

4. Zero noise contribution

➢In the ideal op-amp, zero noise voltage is produced internally This is, any noise at the output must have been at the input as well

➢ Practical op-amp are affected by several noise sources, such as resistive and semiconductor noise

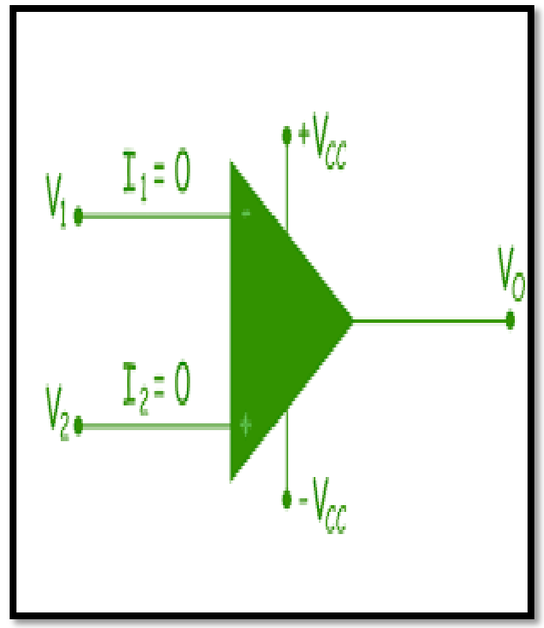
➢ These effects can have considerable effects in low signal-level applications

Ideal characteristics of Op Amp

5. Zero DC output offset

➢The output offset is the output voltage of an amplifier when both inputs are grounded

➢The ideal op-amp has zero output offset, but real op-amps have some amount of output offset voltage



6. Infinite bandwidth

➢The ideal op-amp will amplify all signals from DC to the highest AC frequencies

➢In real op amps, the bandwidth is limited by the Gain-Bandwidth product (GB), which is equal to the frequency where the amplifier gain becomes unity

➢ In the 741 family, have very limited bandwidth of up to a few KHz

Assessment

1.An ideal OP-AMP is an

(a) Current controlled Current source (b).Current controlled Voltage source

(c)Voltage controlled Voltage source (d)Voltage controlled Current source

Answer: (c)Voltage controlled Voltage source

2.A filter that provides a constant output from dc up to a cutoff frequency and passes no signal above that frequency is called a _____ filter.

(a) low pass filter (b) high pass filter

(c) band pass filter (d) band stop filter

Answer: (a) low pass filter

THANK YOU