

## **UNIT-4**

### **1. What is an operational amplifier (Op-Amp)?**

- An operational amplifier (op-amp) is a high-gain DC-coupled voltage amplifier with **differential inputs** and typically a **single output**.
- It is a versatile analog circuit building block used to perform a wide range of functions in electronic circuits.

### **2. What are the ideal characteristics of an Op-Amp?**

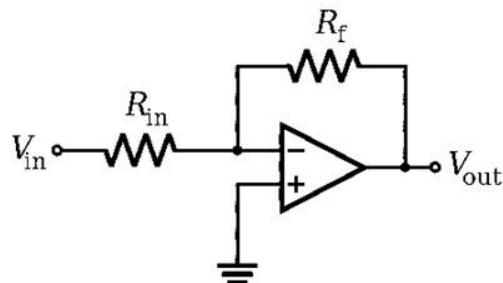
- **Infinite input impedance:** Draws no current from the input signal source.
- **Zero output impedance:** Can deliver any amount of current to the load.
- **Infinite open-loop gain:** Provides very high voltage amplification.
- **Infinite bandwidth:** Can amplify signals of any frequency.
- **Zero offset voltage:** No output voltage when no input is applied.

### **3. What is the difference between the inverting and non-inverting configurations of an Op-Amp?**

- **Inverting Configuration:**
  - The input signal is applied to the inverting input terminal.
  - The output signal is 180 degrees out of phase with the input signal.
  - Gain is determined by the ratio of feedback resistor ( $R_f$ ) to input resistor ( $R_{in}$ ):  
$$\text{Gain} = -R_f/R_{in}$$
- **Non-inverting Configuration:**
  - The input signal is applied to the non-inverting input terminal.
  - The output signal is in phase with the input signal.
  - Gain is determined by  $(1 + R_f/R_{in})$ , where  $R_f$  is the feedback resistor and  $R_{in}$  is the resistor connected to ground.

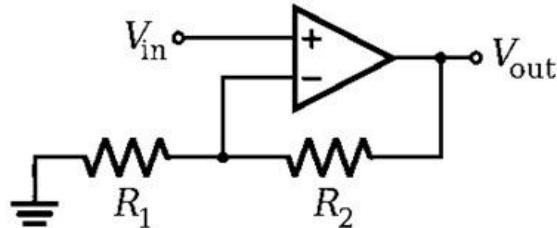
### **4. What is an inverting amplifier?**

- An inverting amplifier is an op-amp circuit configured in the inverting mode.
- It provides a gain that is negative and determined by the ratio of the feedback resistor to the input resistor.



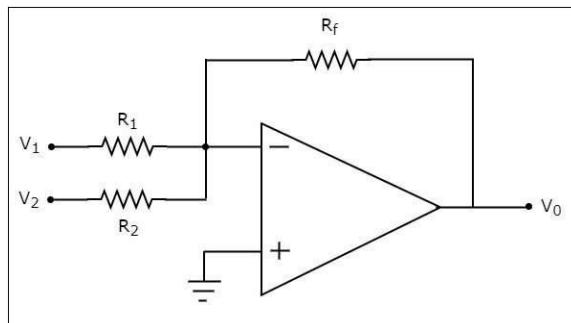
## 5. What is a non-inverting amplifier?

- A non-inverting amplifier is an op-amp circuit configured in the non-inverting mode.
- It provides a gain that is positive and greater than unity.



## 6. How can an Op-Amp be used to implement an adder circuit?

- In an inverting configuration, multiple input resistors can be connected to the inverting input.
- The output voltage will be the weighted sum of the input voltages, with the weights determined by the resistor values.

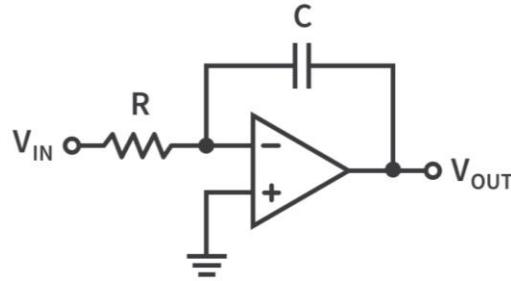


## 7. How can an Op-Amp be used to implement a subtractor circuit?

- By combining an inverting and a non-inverting amplifier, it's possible to create a circuit that subtracts one input voltage from another.

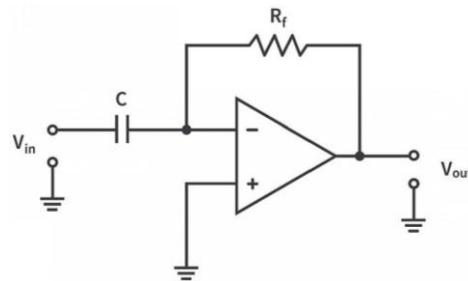
## 8. What is an integrator circuit?

- An integrator circuit is an op-amp circuit that performs mathematical integration.
- It uses a capacitor in the feedback path to integrate the input signal over time.



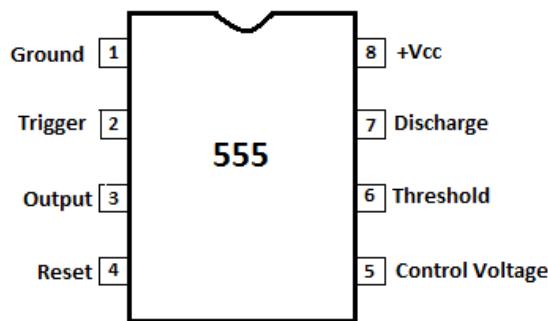
## 9. What is a differentiator circuit?

- A differentiator circuit is an op-amp circuit that performs mathematical differentiation.
- It uses a capacitor at the input to differentiate the input signal with respect to time.



## 10. What is a 555 timer IC?

- The 555 timer is a versatile integrated circuit (IC) widely used in electronics.
- It can be configured to generate various waveforms, such as square waves, triangular waves, and sawtooth waves.
- It can also be used as a pulse generator, delay circuit, and many other applications.

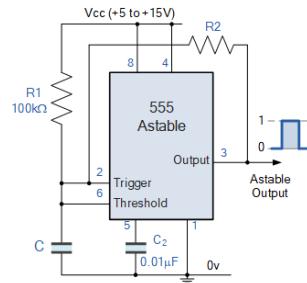


## 11. What are the main applications of a 555 timer?

- **Oscillators:** Generating square waves, triangular waves, sawtooth waves.
- **Pulse generators:** Producing short duration pulses.
- **Timers and delays:** Creating time delays for various applications.
- **Multivibrators:** Generating astable and monostable multivibrator circuits.

## 12. How can a 555 timer be used to generate a square wave?

- In astable mode, the 555 timer can be configured to generate a continuous square wave output.
- The frequency and duty cycle of the square wave can be adjusted by changing the values of external resistors and capacitors.



## 13. How can a 555 timer be used to generate a triangular wave?

- By combining the 555 timer in astable mode with an integrator circuit, it's possible to generate a triangular wave.
- The square wave output from the 555 timer is integrated by the op-amp integrator to produce a triangular waveform.

