TRINITY COLLEGE FOR WOMEN
NAMAKKAL
Department of Physics

LINEAR AND DIGITAL ICs &APPLICATIONS

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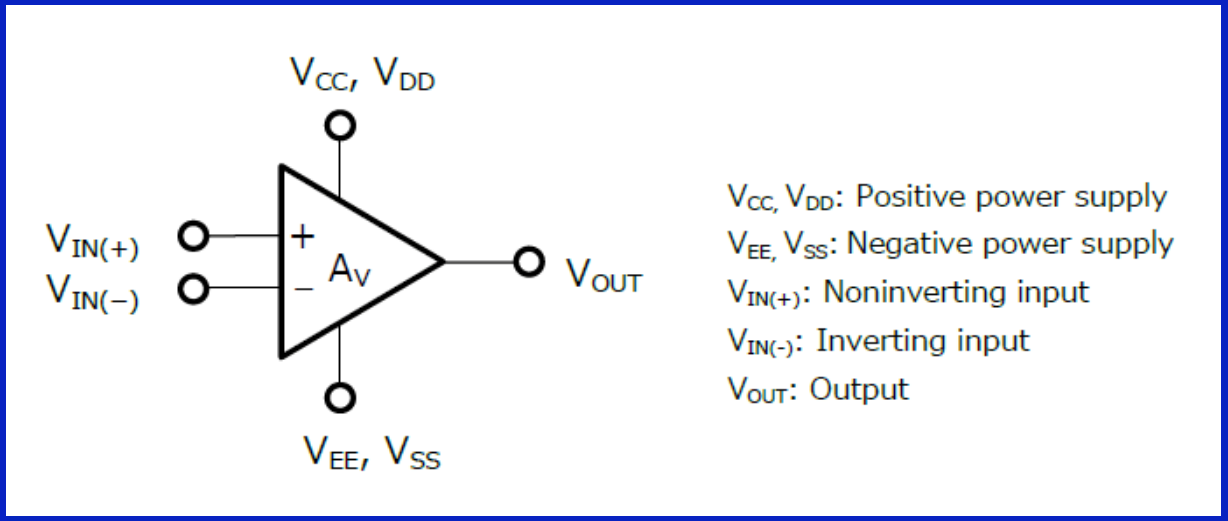
What is Operational Amplifier:

- An oprational amplifier (op –amp) is an integrated circuit (IC) that amplifies and difference in voltage between two inputs

- It’s a building block for analog design and is used in many electric circuits

PRINCIPLE OF OP-AMP :

- An op –amp amplifies the difference in voltage between the noninverting ($_{IN}(+)$ and inverting ($_{IN}(-)$)Inputs.
- Its output voltage is given by Equation 1 which indicates that the output is the same phase as $V_{IN}(+)$ and in opposite phase to $V_{IN}(-)$
- $V_{OUT}=A*(V_{IN}(+) - V_{IN}(-))$ ------(1)



OP –amp characteristics

There are certain important characteristics of an Op-amp, and we will be considering them from the perspective of an ideal case. Since it will simplify the explanation, the results may also be easily seen in approximation with the practical case.

- Open Loop Gain
- Input Impedance
- Output Impedance
- Frequency Response and Bandwidth (BW)
- Gain Bandwidth Product (GBP)

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- Common Mode Rejection Ratio (CMRR)

TYPES OF Op-amp:

- Two possible configurations depending on the terminal where we will provide the input. However, the response and gain can be found similarly using KVL, KCL, and ideal Op-amp assumptions.
- Now that we have gone through the basics of an ideal Op-amp, we can move ahead and classify them into four main ways.
- The major types of Op -amp
- Voltage amplifiers (voltage as input, voltage as output)
- Current amplifiers (current as input, current as output)
- Trans conductance amplifiers (voltage as input, current as output)
- Trans impeadance amplifiers (current as input, voltage as output)

Application of op-amp

- **Voltage Amplification:** Op-amps can be used as voltage amplifiers, increasing the amplitude of an input signal. They provide high gain and are commonly used in audio amplifiers, instrumentation amplifiers, and signal conditioning circuits.

- **Comparator:** Op-amps can compare two input voltage levels and produce a digital output based on the comparison result. This functionality is used in applications like threshold detectors, waveform shaping, and in digital systems for decision-making processes.

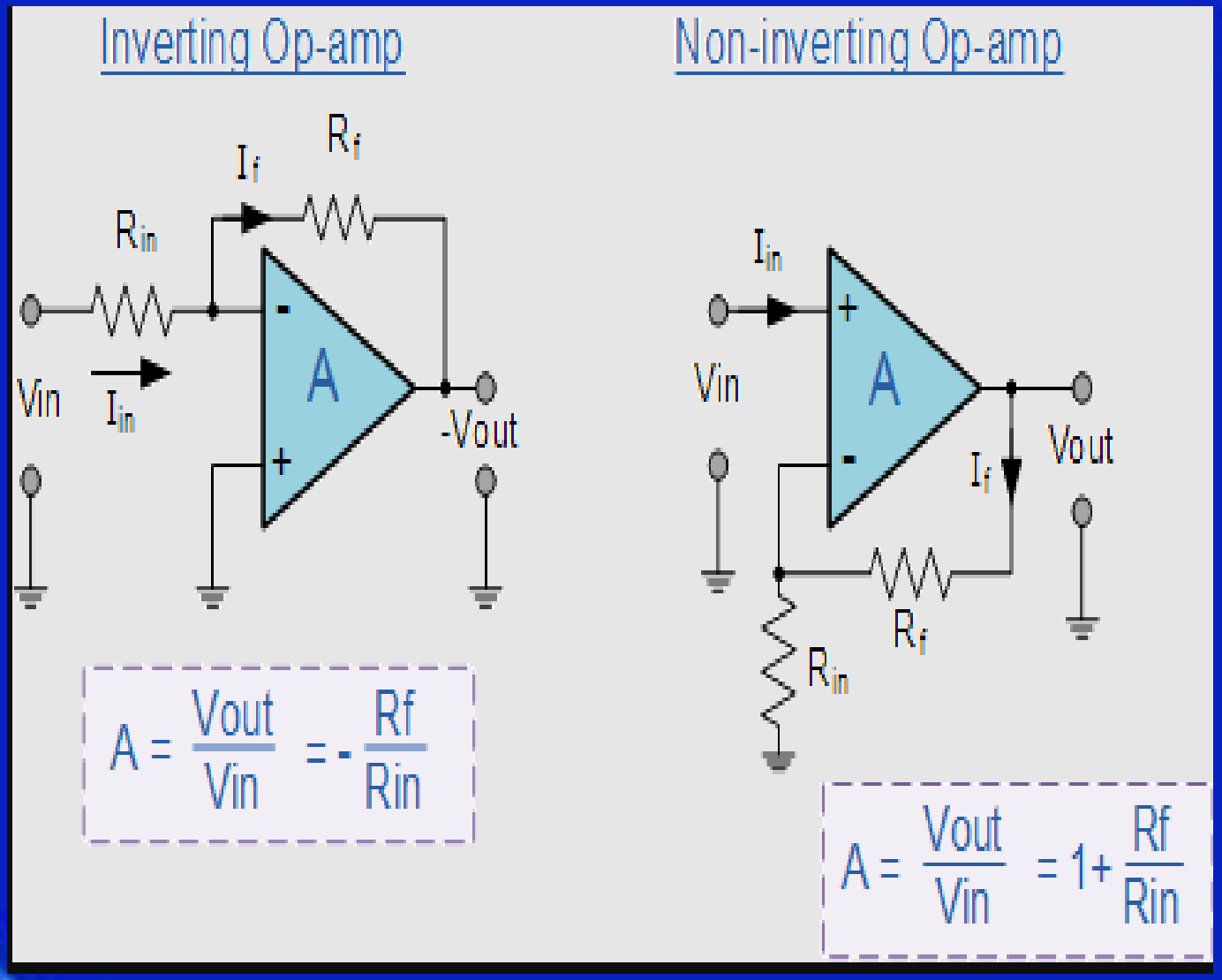
- **Filters:** Op-amps are utilized in various filter configurations (low-pass, high-pass, band-pass, and band-stop filters) to modify or extract specific frequency components from a signal. These filters find applications in audio processing, communication systems, and signal processing.

- **Signal Processing:** Op-amps are crucial in signal processing tasks such as adding, subtracting, integrating, differentiating, and logarithmic/exponential operations. They are used in active filters, oscillators, and function generator circuits.
- **Mathematical Operations:** Op-amps can perform mathematical operations like addition, subtraction, multiplication, division, and taking the absolute value. These operations are widely employed in electronic systems for various computations.
- **Instrumentation:** Op-amps play a significant role in instrumentation systems, such as in precision measurement circuits and sensors. Instrumentation amplifiers, which are built using op-amps, provide high accuracy in measuring small signals and rejecting common-mode noise.
- **Voltage Regulation:** Op-amps are used in voltage regulator circuits to stabilize and regulate output voltage, ensuring a constant supply voltage for sensitive electronic components.

The Two Basic Op-amp Circuits

- For **negative feedback**, were the fed-back voltage is in “anti-phase” to the input the overall gain of the amplifier is reduced.
- For **positive feedback**, were the fed-back voltage is in “Phase” with the input the overall gain of the amplifier is increased.
- By connecting the output directly back to the negative input terminal, 100% feedback is achieved resulting in a **Voltage Follower** (buffer) circuit with a constant gain of 1 (Unity).
- Changing the fixed feedback resistor (Rƒ) for a Potentiometer, the circuit will have Adjustable Gain.

The Two Basic Op-amp Circuits



THANK YOU

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