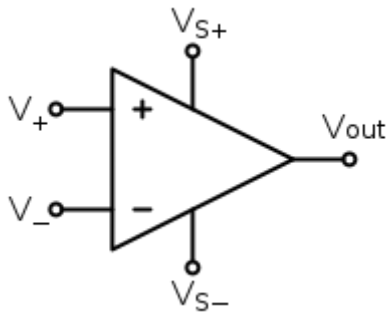
Naman More_ELE_TaskPhase

WEEK 2 – INTRODUCTION TO ELECTRONICS

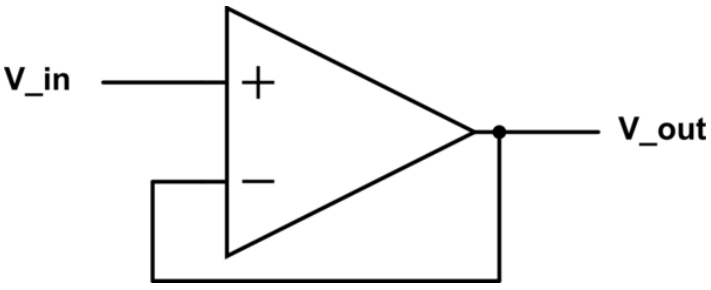
OPERATIONAL AMPLIFIERS

For an Ideal OPAMP, the current in both terminals entering is zero.



TYPES OF OPAMP CIRCUITS AND DERIVATIONS FOR OUTPUT VOLTAGE

- BUFFER CIRCUIT



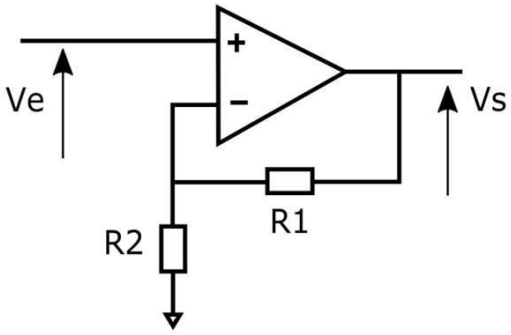
Here, V-out is equal to V-in because it is pretty evident from the circuit connections.
This circuit is useful to generate more *Power* in the output region, as it also has its own internal power source. This is the most basic type of OPAMP, it does not amplify the voltage but it's helpful as it provides almost the same voltage as it takes with a higher power factor. A buffer amplifier (sometimes simply called a buffer) is one that provides electrical impedance transformation from one circuit to another, with the aim of preventing the signal source from being affected by whatever currents (or voltages, for a current buffer) that the load may be produced with.

$V_{out} = V_{in}$

NON-INVERTING AMPLIFIER

The circuits that have the requirement of the high input impedance non-inverting amplifiers are utilized. To isolate the respective cascaded circuits these are used. In the varying gains consideration, these amplifiers are used.

The output voltage is in phase with the Input one. As no current flows in the Terminals, the voltage at the Junction between R1 and R2 Should be same. Hence, using KCL



$$\frac{-V_e}{R_2} = \frac{V_e - V_{out}}{R_1} \Rightarrow \boxed{V_{out} = \frac{R_1+R_2}{R_2} V_e}$$

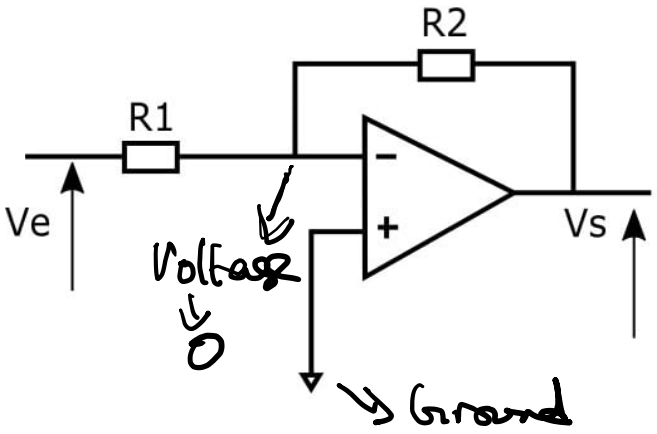
Where, $Gain = \frac{R_1+R_2}{R_2} \therefore V_{out} = GV_e$

INVERTING AMPLIFIER

This type of amplifier amplifies one signal at a time but can be used for multiple by using a summing circuit. The positive terminal is connected to the ground, and no current flows in either of the input terminals, hence the Expression for the Output Voltage is:

(Note : If |Gain| >1 then it is said to be amplified, else if it is said to be attenuated.

Using KCL:-

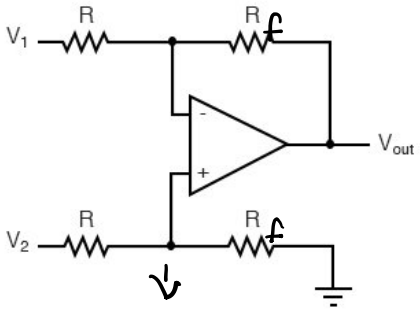


$$\frac{V_e}{R_1} = -\frac{V_s}{R_2}$$

$$V_s = -\frac{R_2}{R_1} V_e$$

DIFFERENCE AMPLIFIER CIRCUIT

This amplifier is used for amplifying the difference between the two input voltages. The differential operational amplifier can be used as an automatic gain control circuit. Some of
the differential operational amplifier can be used for Amplitude modulation.



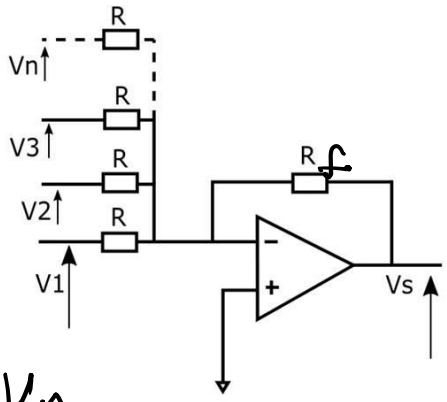
voltage → V_2 (∵ NO current flows)

The expression for the output voltage is:-

$$V_{out} = \frac{R_f}{R}(V_2 - V_1)$$

SUMMING AMPLIFIER CIRCUIT

Summing amplifiers are commonly used to process analog signals. They Are used in audio mixers.
The expression for the output Voltage is:



$$V_{out} = G_1 V_1 + G_2 V_2 + \dots G_n V_n$$

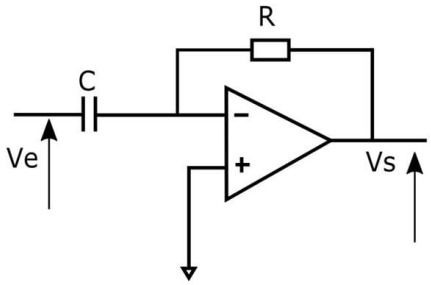
where, $G_n \rightarrow$ Gain

$$\text{Gain} = -\frac{R_f}{R} \quad \text{(we know)}$$

DIFFERENTIATOR AMPLIFIER CIRCUIT

Differentiating amplifiers are most commonly designed to operate on triangular and rectangular signals. Differentiators also find application as wave shaping circuits, to detect high frequency components in the input signals.

The expression for output voltage is:

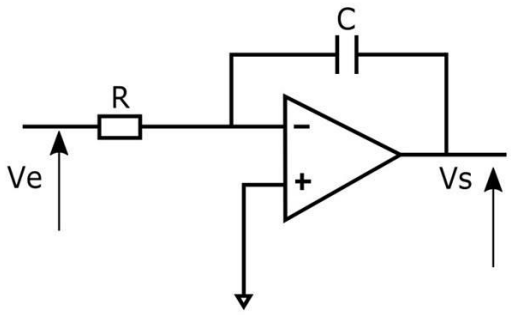


$$V_{out} = -RC\frac{dV_e}{dt}$$ (∵ current across capacitor is $C\frac{dV_c}{dt}$)

INTEGRATOR AMPLIFIER CIRCUIT

The integrator circuit is mostly used in analog computers, analog-to-digital converters and wave-shaping circuits.

The expression for the output voltage is:



$$V_{out} = -\frac{1}{RC}\int_0^t V_e\,dt$$

OTHER TOPICS IN THE COURSE:

DIODES, MOSFETs, BIPOLAR JUNCTION TRANSISTORS

Georgia Institute of Technology

COURSE CERTIFICATE

Apr 6, 2021

Naman More

has successfully completed

Introduction to Electronics

an online non-credit course authorized by Georgia Institute of Technology and offered through Coursera

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