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S. B. Arts and K. C. P. Science College, Vijayapur

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Department of PG Studies in PHYSICS

2022- 2023

Theory Assignment

M. Sc IInd Semester

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UUCMSNo. : PISHM22S103012

Subject: Electronic.

Date of submission:

Assignment Number	Date	Marks Assigned	Marks Obtained	Name and Signature of Faculty	Remarks
			05/05		

characteristics & parameters of operational amplifiers

The characteristics of an ideal operational amplifier are described 1st & the characteristics & performance limitations of a practical operational amplifier are described next. There is a section on classifica of operational amplifiers & some note on how to select an operational amplifier for an application.

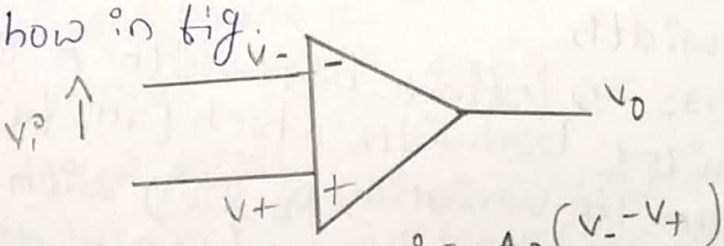
Ideal operational amplifier.

★ Properties of An Ideal Operational amplifier.

The characteristics of the properties of an ideal operational amplifier are

1) Infinite open Loop Gain
2) Infinite Input Impedance
3) Zero O/P Impedance
4) Infinite Bandwidth
5) Zero O/P offset &
6) Zero noise contribution.

The opamp an abbreviation for the operational amplifier is the most imp. linear Ic. The circuit symbol of an opamp show in fig.



$V_o = -A_o V_i = -A_o (V_- - V_+)$

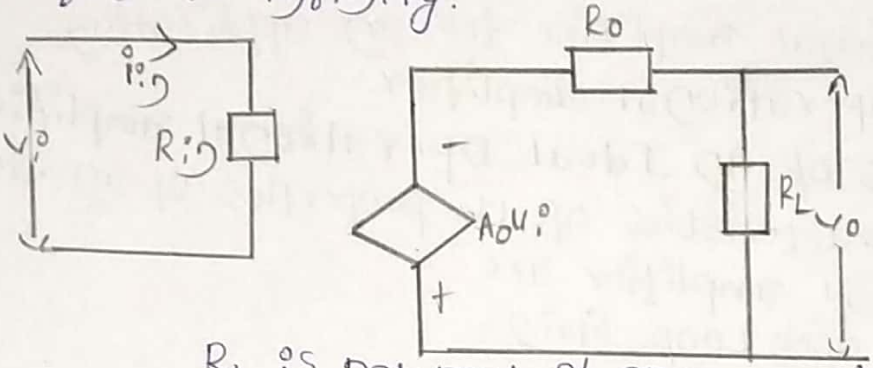
★ Infinite open loop Gain

From fig it is found that $V_o = -A_o \times V_i$ where A_o is known as the open-loop gain of the opamp. Let V_o be -10 volts & A_o be 10^5 Then V_i is 100; V Here the i/p voltage is very small compared to the o/p voltage. If A_o is very large, V_i is -vely small for a finite V_o for the ideal opamp. A_o is taken to be infinite in value. That means for an ideal opamp $V_i = 0$ for a finite V_o. Typically values of A_o range from 20,000 in low-grade consumer audio-range opams to more than 2000,000 in Premium grade opams

The first property of an ideal op amp. is open LOOP Gain A_0 = infinity.

* Infinite I/P Impedance & Zero O/P Impedance.

An ideal Opamp has an infinite i/p impadance & Zero o/p impedance. The sketch in fig is used to illustrate these properties. it can be seen that R_{in} is zero. R_{in} is equal to infinity.



R_L is not part of op amp model

We get that

$$V_0 = -A_0 V_i^* \frac{R_L}{R_0 + R_L}$$

If the o/p resistance R_0 is very small, there is no drop in o/p voltage due to the o/p resistance of an opamp

The 3rd property of an ideal Opamp: $R_0 = 0$

* Infinite Bandwidth

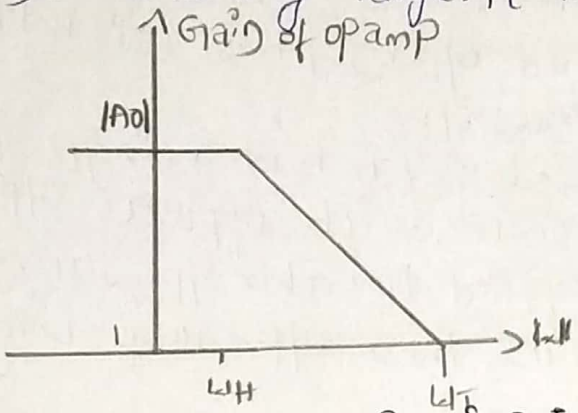
An ideal opamp has an infinite bandwidth. A practical opamp has a limited bandwidth which falls far short of the ideal value. The variation of gain with frequency has been. which is obtained by modeling of the opamp with a single dominant pole, whereas the practical op amp may have more than a single pole.

The asympotic log-magnitude plot in can be expressed by a 1st order eqn shown below

$$A(j\omega) = \frac{A_0}{1 + \frac{j\omega}{\omega_B}}$$

It is seen that two frequencies ω_H & ω_T is to be equal to unity. $A(j\omega_T) = 1 \left| \frac{A_0}{1 + \frac{j\omega_T}{\omega_H}} \right|$

Since A_0 is very large. it means that $\omega_T = A_0 \omega_H$.



★ Zero noise contribution & zero o/p offset.

A practical opamp generates noise signals, like any other device whereas an ideal opamp produces no noise premium opamps are available which contribute very low noise to the rest of circuits. These devices are usually called as premium low-noise type.

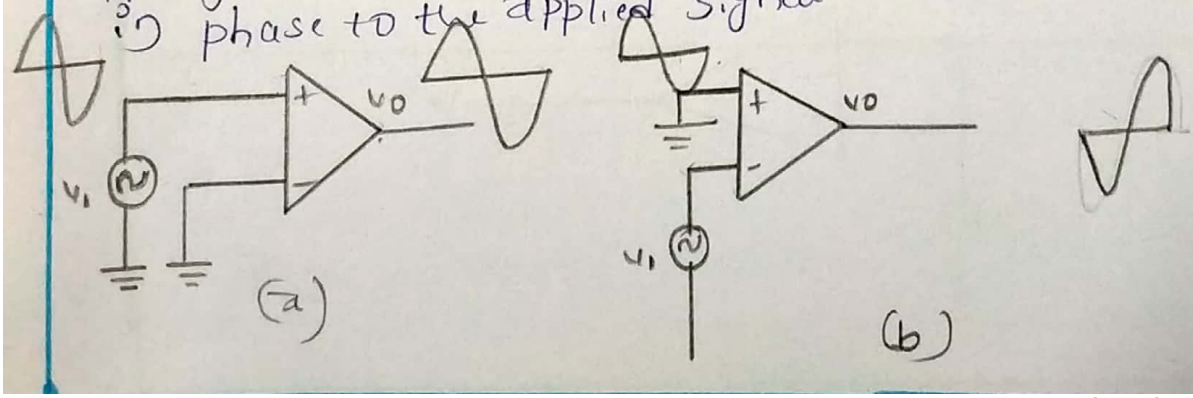
★ Input modes of op-amp.

The differential amplifier exibits 3 modes of operation based on the type of i/p signals

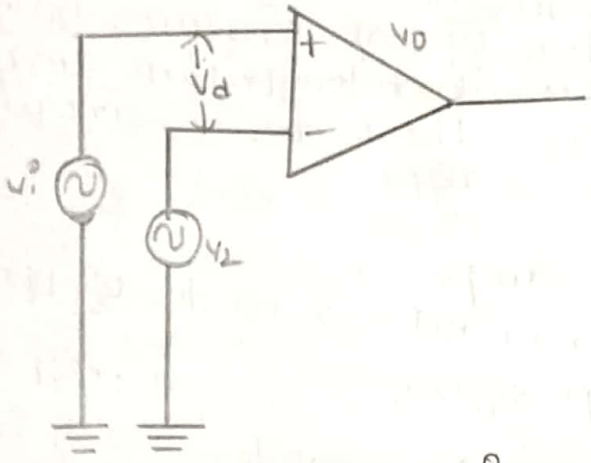
① single ended mode.
② double ended mode or differential mode.
③ common mode.

① single ended mode.

single ended i/p operation results when the i/p signal is connected to one i/p with other i/p connected to ground. Show the signals connected for this operation. The i/p is applied to the plus i/p. which results in an o/p having the same polarity as the applied i/p signal shows as i/p signal applied to the minus i/p the o/p the being opposite in phase to the applied signal.



* Double ended or Differential mode:
In addition to using only one i/p it is possible to apply signals at each i/p this being a bouble-ended operation shown in i/p V_d, applied bet^n the two i/p terminals with the resulting amplified o/p in phase with that applied bet^n the plus & minus i/ps.
While the operation discussed so far had a single o/p the op-amp can also be operator with opposite o/ps as shown in fig. An i/p applied to either i/p will result in o/ps from both terminals these o/p. always being opposite in polarity.



* Common-mode operation
When the same i/p signals are applied to both i/ps common mode operation results as shown in fig.
Ideally the two i/ps are equally amplified & since they results in opposite polarity signals at the o/p these signals cancel resulting in 0-V o/p
Practically a small o/p signal will result.