SEM. IV, paper- CC10

OPAMP

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Lecture-V

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OPAMP

1 FRIDAY 31

5th Week • 031-335

OPAMP :— The Operational amplifier abbreviated as "OPAMP", is a direct coupled high gain, differential input amplifier. The significance of the term "Opreational" is that can perform mathematical operations such as — Summation, Subtration, differentiation and integration.

It is also used in signal amplification, impedance transformation, oscillators, voltage regulator, analog to digital converter and digital to analog converter etc.

✱ Characteristics of an ideal "OPAMP" :—

An ideal OPAMP has following characteristics —

i) Infinite input impedance.
ii) Zero output impedance.
iii) Infinite voltage gain.
iv) Infinite band width
v) Characteristics not ~~diff~~ drifting with temp.r.
vi) perfect balance [i.e when equal voltages are applied to the input terminals then out voltage is Zero.]

Characteristics of a practical OPAMP :—

i) Finite but large input impedance.

ii) Non-zero but small output impedance.

iii) Finite but large voltage gain.

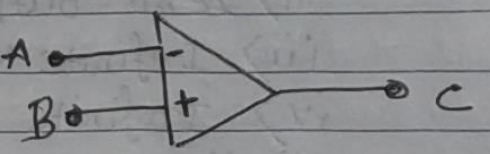
iv) Finite but large band width.

v) characteristics drift with temp=r.

vi) Imperfect balance.

Circuit Symbol Of OPAMP :—

It has two input terminals A,B and one output terminal C.



The terminal "A" is known as inverting terminal, which is labelled by "−". The negetive sign indicates that a signal applied at this terminal, the output becomes reversed polarity.

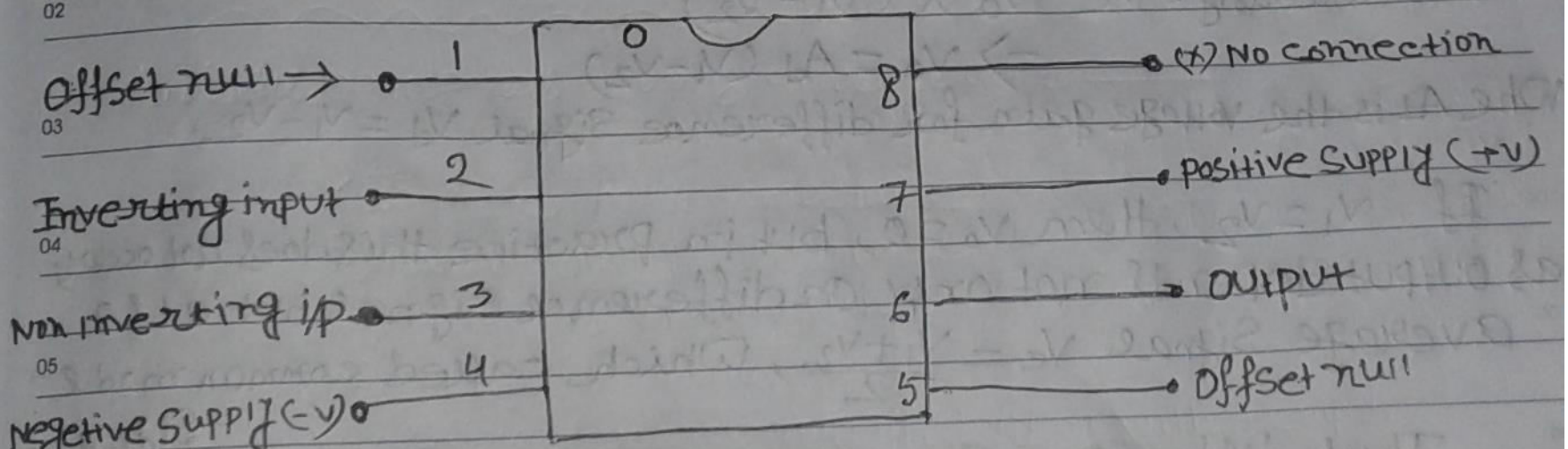
The terminal "B" is known as non-inverting terminal, which is labelled by "+". A signal applied to this terminal appears at the terminal "C" with the same polarity.

The output voltage at C is proportional to the difference of the two signal voltages applied at the two input terminals simultaneously. If V_1 and V_2 are the input signals applied to the non-inverting and inverting terminals respectively, then output voltage of ideal OPAMP is given by, $V_0 \propto (V_1 - V_2)$

$$\Rightarrow V_0 = A(V_1 - V_2)$$

This proportionality constant A is called open loop gain of the OPAMP.

(*) IC form of OPAMP :-



04 TUESDAY 6th Week • 035-331

Common-mode rejection ratio (CMRR)

4 February 2020

CMRR is the abbreviation of common mode rejection ratio, which is defined as the ratio of voltage gain for difference signal (A_d) to the voltage gain for common mode signal (A_c).

i.e. $$CMRR = \left|\frac{A_d}{A_c}\right| = \frac{\text{voltage gain for difference signal}}{\text{voltage gain for common mode signal}}$$

Note:- CMRR is often expressed in dB, as

$$CMRR(\text{in dB}) = 20 \log_{10}\left|\frac{A_d}{A_c}\right|$$

Details :— Differential amplifier :— The output voltage of an OPAMP is proportional to the difference of the two signal voltages applied at the two input terminals simultaneously. i.e $V_o \propto (V_1 - V_2)$

$$\Rightarrow V_o = A_d (V_1 - V_2)$$

Where A_d is the voltage gain for difference signal $V_d = V_1 - V_2$.

If $V_1 = V_2$, then $V_o = 0$, but in practice this does not occur as output depends not only on difference signal but also average signal $V_c = \frac{V_1 + V_2}{2}$, which called common mode signal.

Thus difference signal $V_d = V_1 - V_2$ --- (I)

and common mode signal $V_c = \frac{V_1 + V_2}{2}$ --- (II)

From equation (I) & (II), we get $V_1 = V_c + \frac{1}{2} V_d$ --- (III)

and $V_2 = V_c - \frac{1}{2} V_d$ --- (IV)

If A_1 be the gain when inverting terminal is grounded and A_2 be the gain when non-inverting terminal is grounded