EE539: Analog Integrated Circuit Design;

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1 NEGATIVE FEEDBACK SYSTEMS AND STABILITY

•Parasitic poles introduces phase lag, turns negative feedback to positive feedback and make the system unstable.

•Single dominant pole behavior,extra pole should be beyond the unity gain frequency(of the loop gain).

2 OPERATIONAL AMPLIFIER

In a prctical opamp

•Limiting,
•Nonlinearity(varying slope),
•offset.
So,we have to operate the OPAMP around the slope @ $V_0 = 0$.

Let the external circuit is such that $V_0 = V_{id}a_0$

Loopgain, $= \frac{A_0}{a_0}$

So we can operate the opamp with DC nagative feedback so that to operate in the desired region.

Input referred offset:

V_i to get $V_0 = 0$.

Output referred offset:

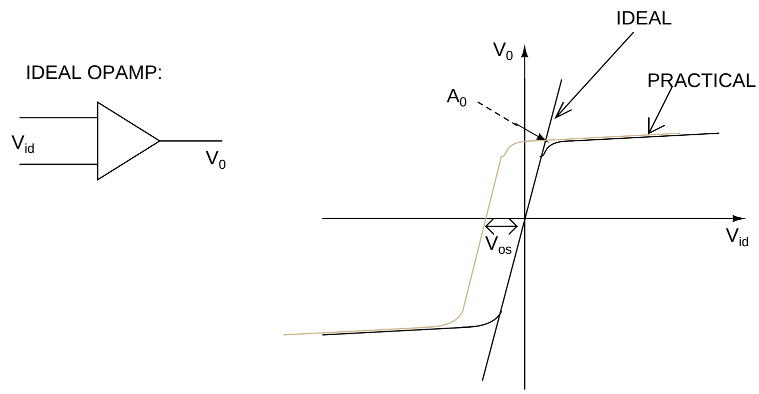

Figure 1: CHARACTERISTICS OF AN OPAMP:

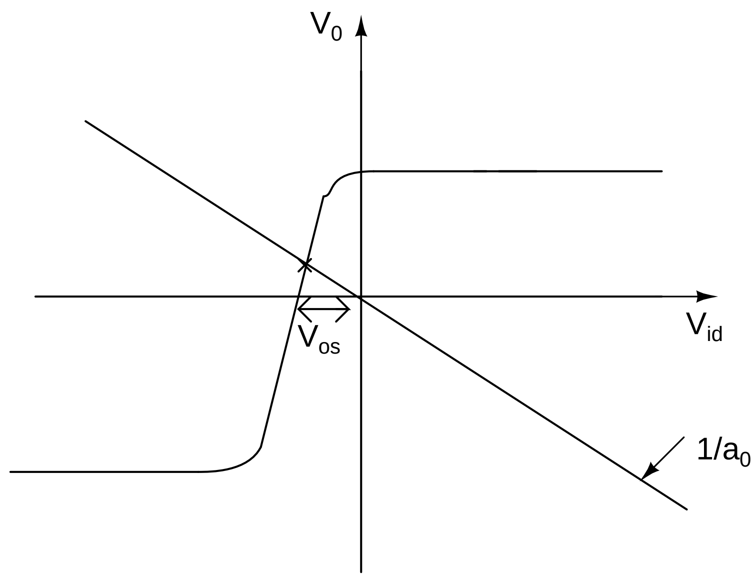

Figure 2: CHARACTERISTICS OF AN OPAMP:

V_0 to get $V_i = 0$.

Let an opamp with dc gain $A_0 = \infty$,input offset V_{os}, and dc nagative feedback.

The operating point under these conditions is,

$V_0 = v_{os} a_0$

$V_{id} = V_{os}$

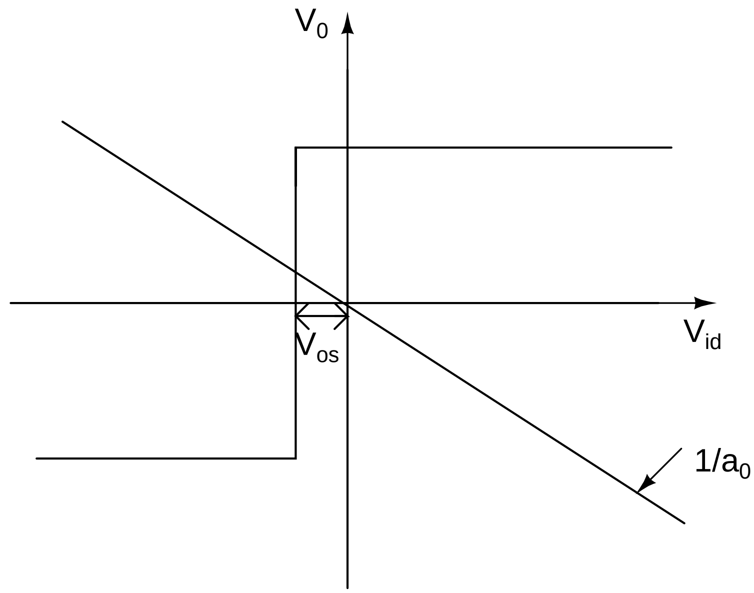

Figure 3: CHARACTERISTICS OF AN OPAMP:

3 SIGNS OF OPAMP TO PROVIDE NEGATIVE FEEDBACK IN A LOOP:

3.1

For an ideal opamp, current flowing through the input terminal is zero;even if $V_{id} = 0$, V_0 can be any value.

For fig(4),$V_0 = \frac{-R_2}{R_1}.V_i$

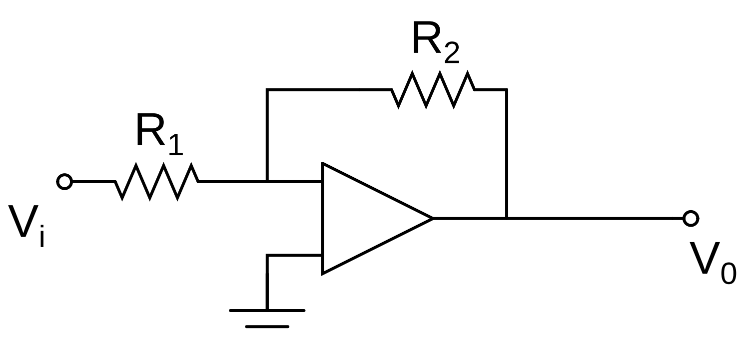

Figure 4: OPAMP circuit diagram

To determine the signs of opamp for negative feedback in the loop, we must write $V_{id} = f(V_0)$ and Vid must have nagative sign. For this, we can make $V_i = 0$, then $V_{id} = V_0.\frac{R_1}{R_1+R_2}$. This is positive ,so we have to connect this to nagative teminal, to provide negative feedback in the loop.

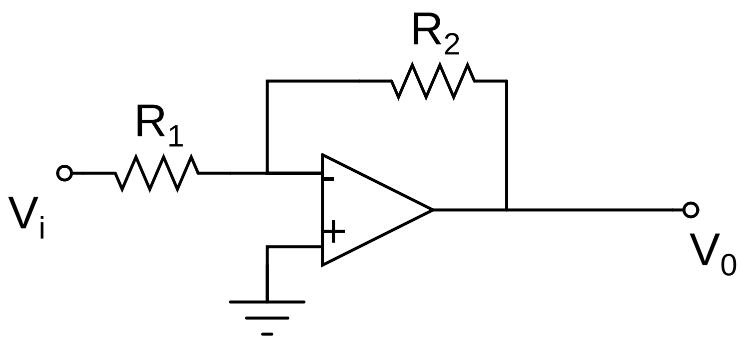

Figure 5: OPAMP circuit diagram

Similarly, we can determine the signs for fig(6),fig(8),fig(10),and fig(12).

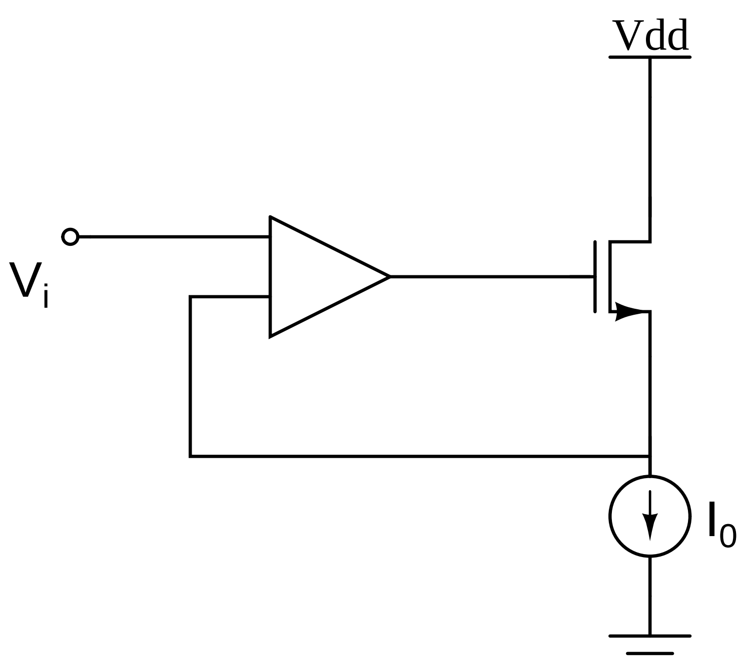

Figure 6: OPAMP circuit diagram

In fig(10),there are two opamps. First we have to determine the signs of one opamp assuming all other opamps are ideal.Let opamp(1),assuming opamp(2) as ideal,then

$V_{id1} = -V_{01}.\frac{R_3}{R_4}\frac{R_1}{R_1+R_2}$

So we connect this to positive terminal. Now we know the signs of opamp(1). To dermine the signs of opamp(2),

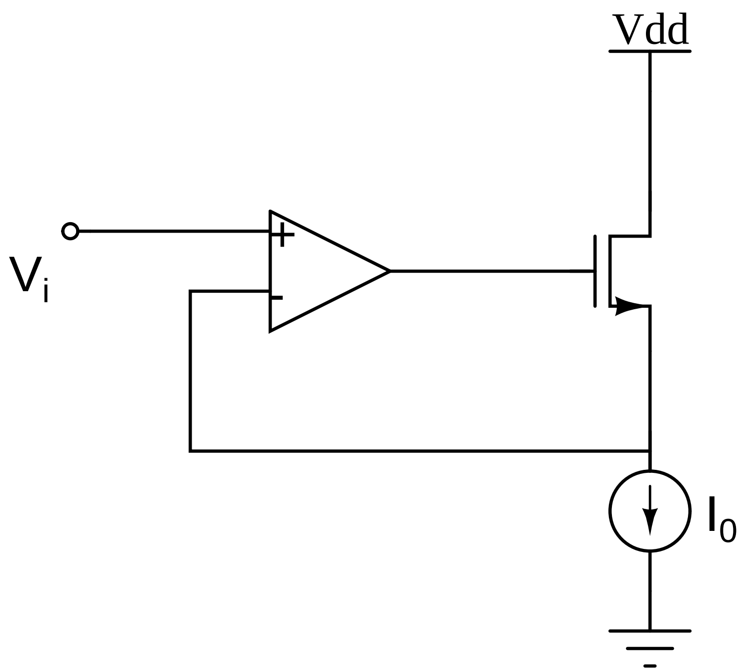

Figure 7: OPAMP circuit diagram

$V_{01} = A_0.V_{o2}\frac{R_1}{R_1+R_2}$

$V_{id,2} = V_{o1}.\frac{R_3}{R_3+R_4} + V02.\frac{R_3}{R_3+R_4}$

So we connect this to negative terminal of the opamp(2).

For fig(12), we can dermine the signs according to the voltages at node a, and node b.And the signs of opamp is shown in the fig(13).

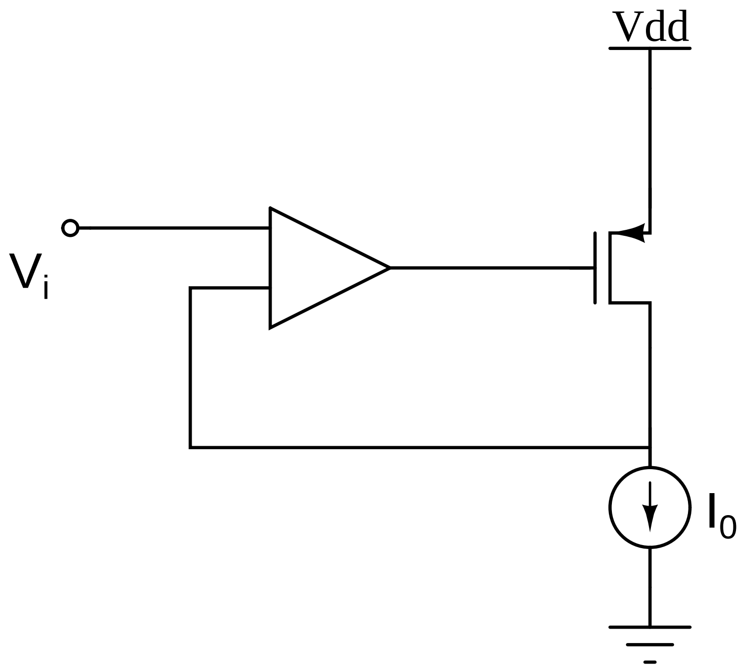

Figure 8: OPAMP circuit diagram

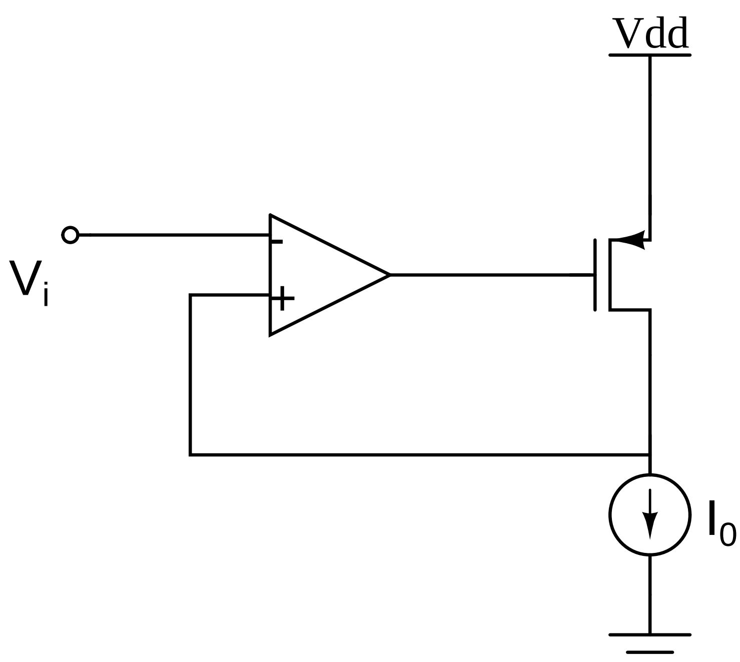

Figure 9: OPAMP circuit diagram

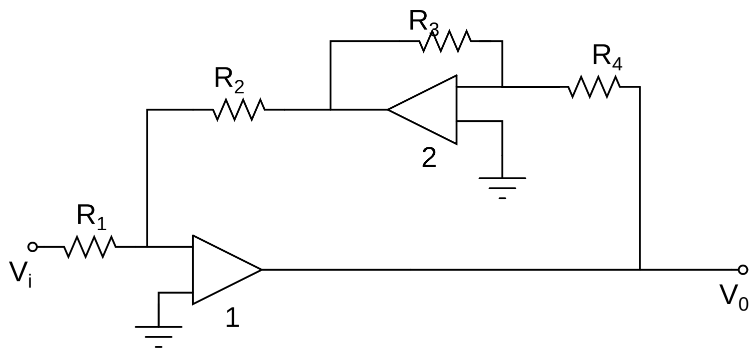

Figure 10: OPAMP circuit diagram

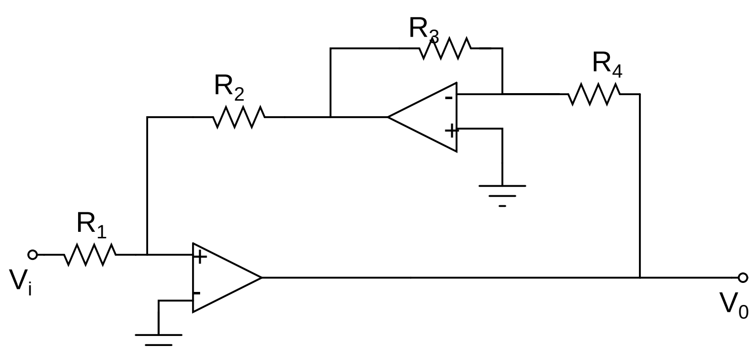

Figure 11: OPAMP circuit diagram

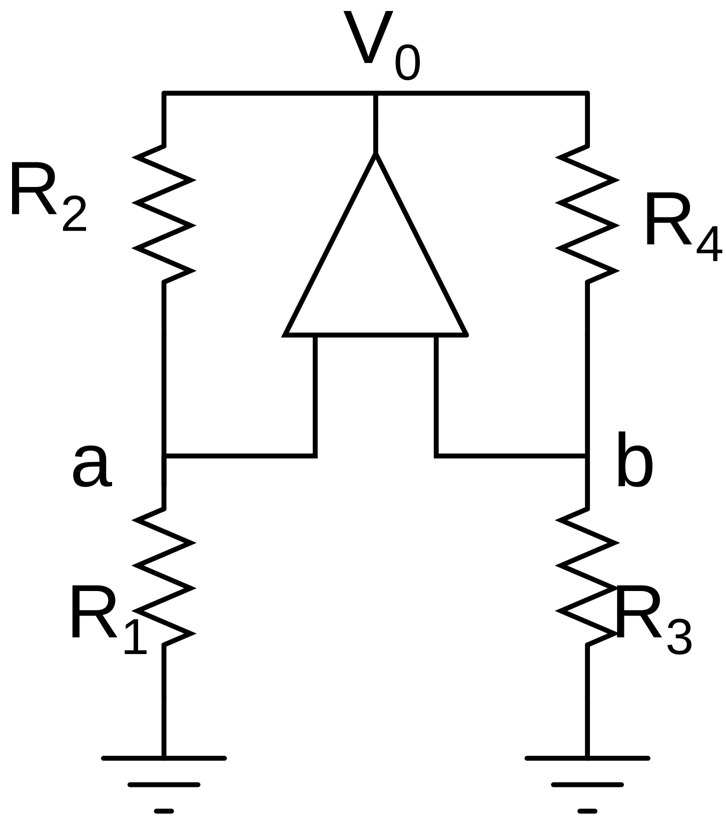

Figure 12: OPAMP circuit diagram

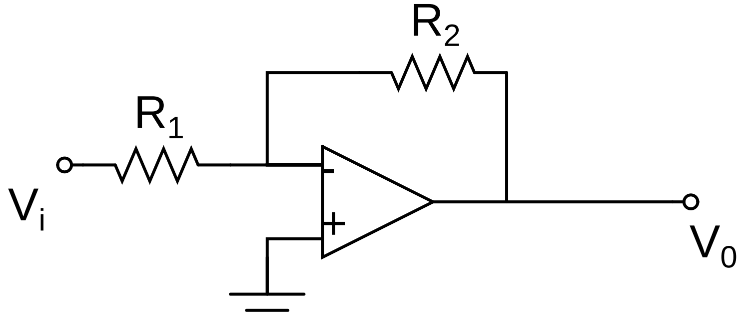

Figure 13: OPAMP circuit diagram