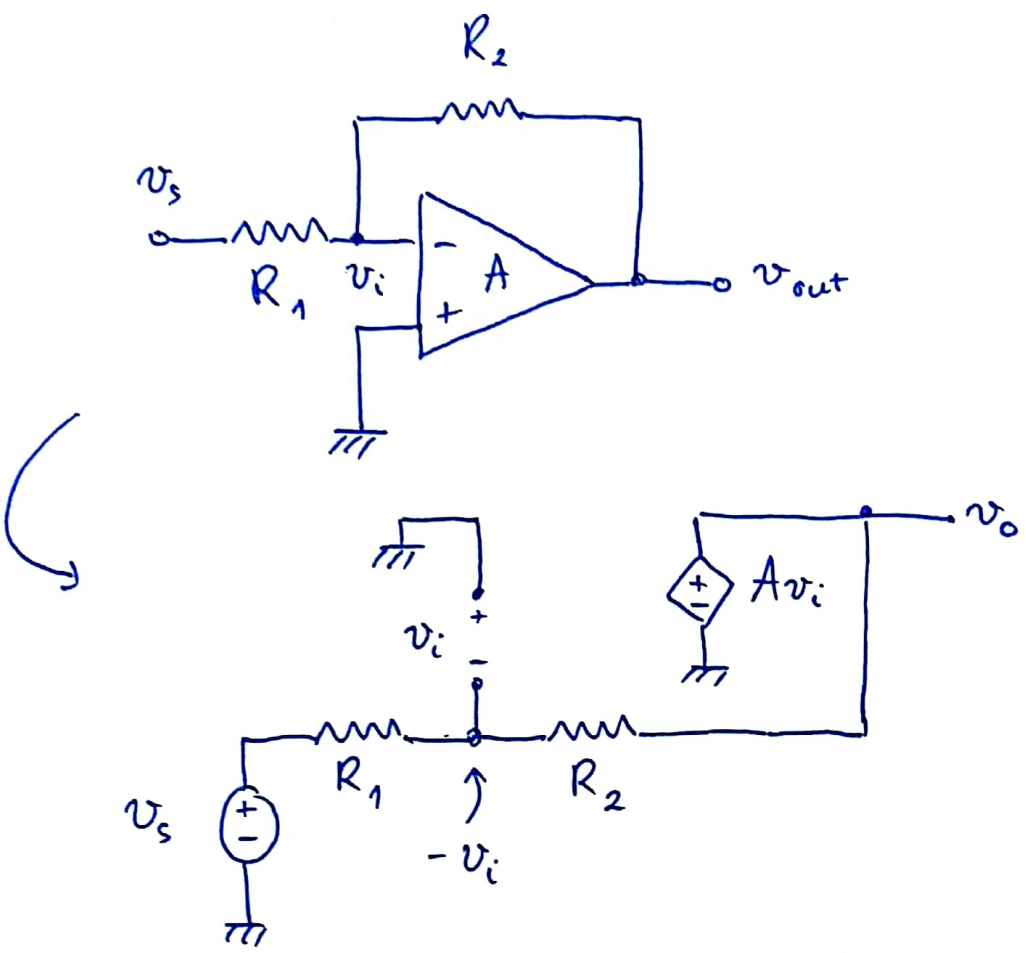
# Analog Electronics

## QUIZ # 5

(1)




Superposition :

$$-v_i = v_s \frac{R_2}{R_1 + R_2} + v_o \frac{R_1}{R_1 + R_2}$$

$$-\frac{v_o}{A} = v_s \frac{R_2}{R_1 + R_2} + v_o \frac{R_1}{R_1 + R_2}$$

$$v_o \left( -\frac{1}{A} - \frac{R_1}{R_1 + R_2} \right) = v_s \frac{R_2}{R_2 + R_1}$$

$$\Rightarrow A_f = \frac{v_o}{v_s} = \frac{-R_2}{R_1 + R_2} \times \frac{1}{\left[ \frac{1}{A} + \frac{R_1}{R_1 + R_2} \right]}$$

$$A_f = -R_2 \frac{1}{\frac{R_1+R_2}{A} + R_1} = \frac{-R_2 A}{R_1 + R_2 + R_1 A}$$

$$A_f = -\frac{A}{\frac{R_1}{R_2} + 1 + A\frac{R_1}{R_2}} \quad , \quad \frac{R_1 A}{R_2} \gg \frac{R_1}{R_2}$$

$$\Rightarrow A_f \simeq \frac{-A}{1 + A\frac{R_1}{R_2}} = \frac{-A}{1 + (-A)\left(-\frac{R_1}{R_2}\right)} = \frac{A'}{1 + A'\beta}$$

$$\Rightarrow \boxed{\beta = -\frac{R_1}{R_2}}$$

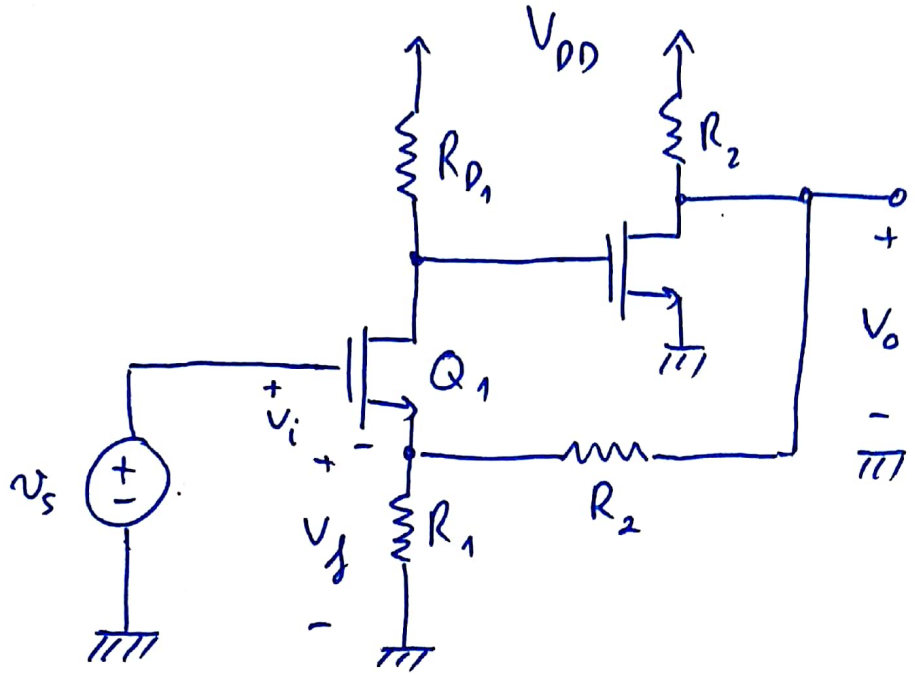
b) $$A_f \simeq \frac{1}{\beta} = -\frac{R_2}{R_1}$$

c) $$A_f' = \frac{-0.8 \times 10^4}{1 + 0.8 \times 10^4 \left(\frac{1}{20}\right)} \simeq -19.95$$

$$A_f = \frac{-10000}{1 + 10000\left(\frac{1}{20}\right)} = -19.96$$

It increases $\left(\frac{-19.95 + 19.96}{-19.96}\right) \times 100\% = -0.05\%$

(2)




a) Series - shunt topology

b) $v_f = v_o \times \frac{R_1}{R_1 + R_2} \Rightarrow \beta = \frac{v_f}{v_o} = \frac{R_1}{R_1 + R_2} = \frac{1}{A_f} = 0.05$

If $R_1 = 2^{k\Omega} \Rightarrow \frac{2}{2 + R_2} = \frac{1}{20} \Leftrightarrow R_2 = 38^{k\Omega}$

c) $V_{D_1} \nearrow \Rightarrow V_{GS_2} \nearrow \Rightarrow I_{D_2} \nearrow \Rightarrow V_{D_2} \searrow \Rightarrow V_{S_1} \searrow$

$\Rightarrow V_{GS_1} \nearrow \Rightarrow I_{D_1} \nearrow \Rightarrow V_{D_1} \searrow$