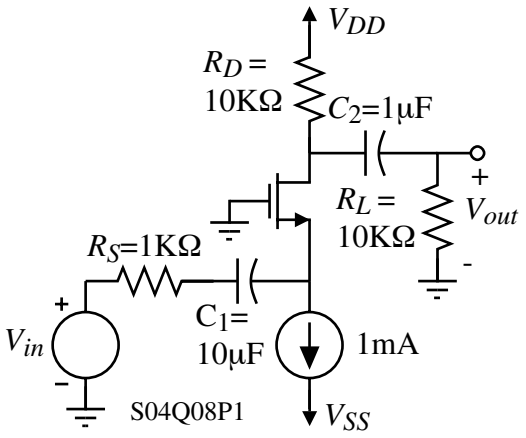
QUIZ NO. 8

(Average = 6.7/10 of those taking the quiz)

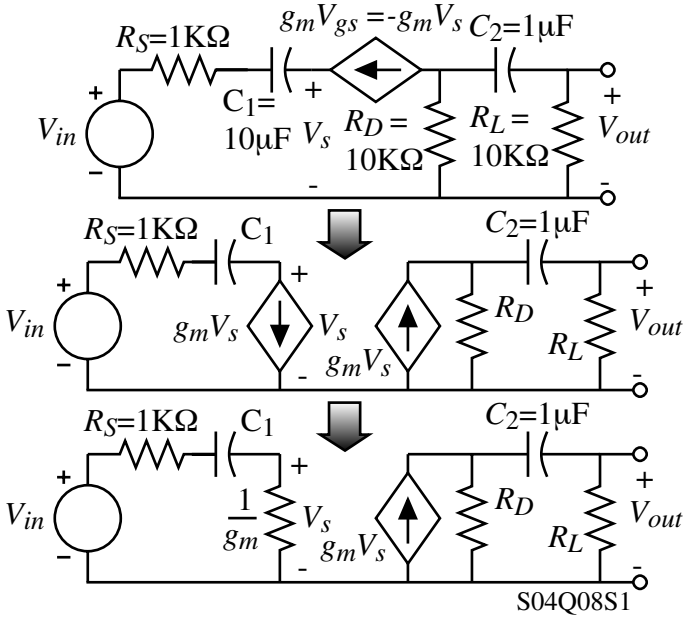
a.) If the g_m of the MOSFET is 0.1mA/V, find the midband gain and the location of all zeros and poles of the circuit shown.



b.) If the amplifier above has two zeros at the origin and a pole at –10 rads/sec and –40 rads/sec., what is the lower –3dB frequency in Hz?

Solution

a.) It is worthwhile to spend some effort in simplifying the small-signal model as follows:



$$\frac{V_{out}}{V_{in}} = \frac{V_{out}}{V_s}\frac{V_s}{V_{in}}$$

$$\frac{V_{out}}{V_s} = \frac{g_m R_D R_L}{R_D + R_L + \frac{1}{sC_1}}$$

$$= \left(\frac{g_m R_D R_L}{R_D + R_L}\right)\left(\frac{s}{s + \frac{1}{C_2(R_D + R_L)}}\right)$$

$$\frac{V_s}{V_{in}} = \frac{1/g_m}{R_S + \frac{1}{g_m} + \frac{1}{sC_1}}$$

$$= \left(\frac{1}{1 + g_m R_s}\right)\left(\frac{s}{s + \frac{g_m}{C_2(1 + g_m R_S)}}\right)$$

Thus, the MBG = $\left(\frac{g_m R_D R_L}{R_D + R_L}\right)\left(\frac{1}{1 + g_m R_s}\right)$ = (0.5)(1/1/1) = <u>0.4545 V/V</u>

There are <u>two zeros at $s = 0$</u> and two poles:

$$p_2 = \frac{-1}{C_2(R_D + R_L)} = \underline{\text{-50 rads/sec}}.\ \text{and}$$

$$p_1 = \frac{-g_m}{C_1(1 + g_m R_S)} = \frac{-0.1\text{x}10^{-3}}{10\text{x}10^{-6}(1+0.1)} = \underline{\text{- 9.09 rads/sec}}.$$

b.) $\omega_L \approx \sqrt{p_1^2 + p_2^2 - 2(z_1^2 + z_2^2)} = \sqrt{10^2 + 40^2 - 2(0)} = \sqrt{1700} = 41.23$ rads/sec.

$\therefore \quad f_L = \frac{41.23}{6.28} = \underline{6.56\ \text{Hz}}$