Quiz 3	Subject	Professor	Student ID#	Student Name	Score
Date: 2009.09.23	Microelectronics 2	Jong-Ho Lee			

1. Assume that the current source is ideal and the MOSET (M) has no back-bias effect ($\gamma=0 \rightarrow g_{mb}=0$) in common-gate amplifier shown below. The MOSFET has an output resistance r_o due to a finite Early voltage V_A. Answer for the following questions. Low frequency voltage gain of the following amplifiers is $g_m r_o$.

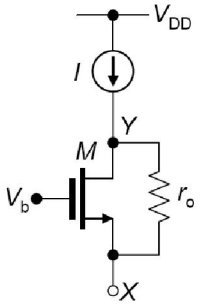


Fig. 1

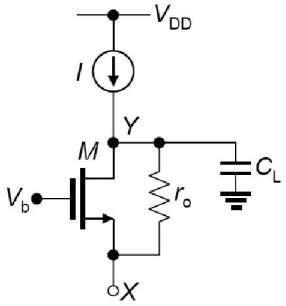


Fig. 2

(a) Using Miller theorem, compute the input resistance at node X and the output resistance at node Y for the amplifier shown in Fig. 1. (4)

Answer)

Av = gmro

Using Miller theorem, at node x

$$r_X = \frac{r_o}{1 - A_v} = \frac{r_o}{1 - g_m r_o}$$

Equivalent Resistance at node x is

$$\frac{r_0}{1-Av} // \frac{1}{g_m} - \frac{r_o}{1-g_m r_o} // \frac{1}{g_m} - Rx$$

Equivalent Resistance at node y is

$$\frac{r_0}{1-\frac{1}{Av}} = \frac{r_0}{1-\frac{1}{g_m r_0}} = \frac{g_m r_o^2}{g_m r_0 - 1} = Ry$$

(b) How many poles are there in the amplifier shown in Fig. 2? Where? Compute the upper corner frequency for the amplifier shown in Fig. 2. (2)

Answer)

CL is connected to node Y.

Thus, the number of pole is only one at output node y(ω_p).

$$upper\ corner\ frequency = \frac{1}{RC}$$

$$w_p = \frac{1}{R_y C_L}$$

(c) Find the frequency in which the gain is decreased by -40 dB in the amplifier shown in Fig. 2. (2)

Answer)

If $\omega > \omega_p$, gain is decreased by 20dB/decade. Thus, to decrease Gain by 40dB, the frequency must be $10*10*\omega_p = 100\omega_p$.

(in Bode plot)

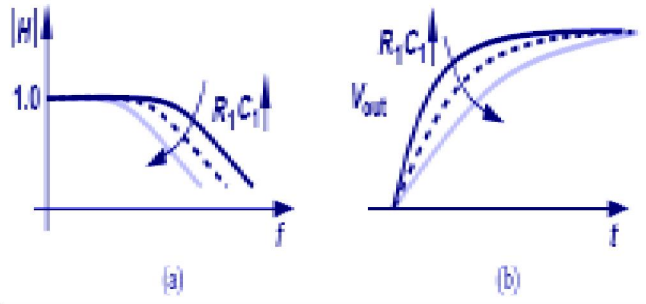
(d) With increasing C_L, briefly describe the relationship between the frequency response and step response of the amplifier shown in Fig. 2. (2)

Answer)

With increasing CL, RyCL is also increased.

Thus, the bandwidth drops and step response becomes slower.

(a) Frequency response (b) Step response



Use front side only