ECE 3050 Analog Electronics Quiz 3

June 3, 2009

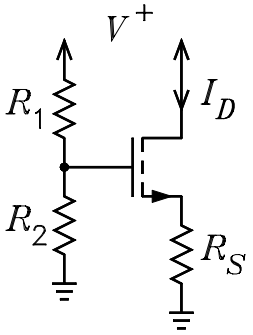
Professor Leach Last Name:_____ First Name:_____

Instructions. Print your name in the spaces above. Place a box around any answer. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials _____

$$i_D = K\left(v_{GS} - V_{TO}\right)^2 \qquad g_m = 2\sqrt{KI_D} \qquad r_s = \frac{1}{g_m} \qquad r_0 = \frac{\frac{1}{\lambda} + V_{DS}}{I_D} \qquad r_{id} = r_0\left(1 + g_m R_{ts}\right) + R_{ts}$$

For credit, you must give all equations that you use to calculate your answers. Credit will not be given for any answer without full supporting work.

1 of 2. For $V^+ = +18\,\text{V}$, $R_2 = 120\,\text{k}\Omega$, $R_S = 800\,\Omega$, $K = 5 \times 10^{-4}\,\text{S}$, and $V_{TO} = 2\,\text{V}$, solve for R_1 for $I_D = 4.5\,\text{mA}$.

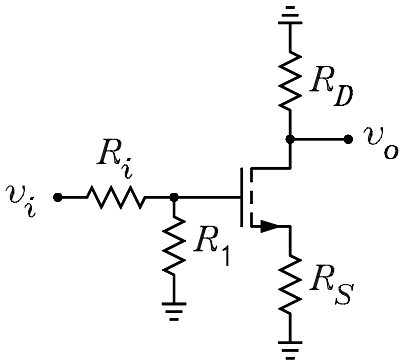


$V_p := 18$ $K := 0.0005$ $R_2 := 120000$ $R_S := 800$ $V_{TO} := 2$ $I_D := 0.0045$

$V_{GS} := \sqrt{\frac{I_D}{K}} + V_{TO}$ $V_{GS} = 5$ $V_G := V_{GS} + I_D \cdot R_S$ $V_G = 8.6$

$R_1 := R_2 \cdot \left(\frac{V_p}{V_G} - 1\right)$ $R_1 = 1.312 \cdot 10^5$

2 of 2. For $K = 5 \times 10^{-4}\,\text{S}$, $V_{TO} = 2\,\text{V}$, $I_D = 3\,\text{mA}$, $r_{id} = 50\,\text{k}\Omega$, $R_i = 2\,\text{k}\Omega$, $R_1 = 22\,\text{k}\Omega$, $R_S = 300\,\Omega$, and $R_D = 30\,\text{k}\Omega$, solve for the small-signal voltage gain $A_v = v_o/v_i$.



$K := 0.0005$ $V_{TO} := 2$ $I_D := 0.003$ $r_{id} := 50000$ $R_i := 2000$ $R_1 := 22000$

$R_S := 300$ $R_D := 30000$ $g_m := 2 \cdot \sqrt{K \cdot I_D}$ $g_m = 2.449 \cdot 10^{-3}$ $r_s := g_m^{-1}$ $r_s = 408.248$

$A_v := \frac{R_1}{R_i + R_1} \cdot \frac{1}{r_s + R_S} \cdot -R_{p2}\left(r_{id}, R_D\right)$ $A_v = -24.268$