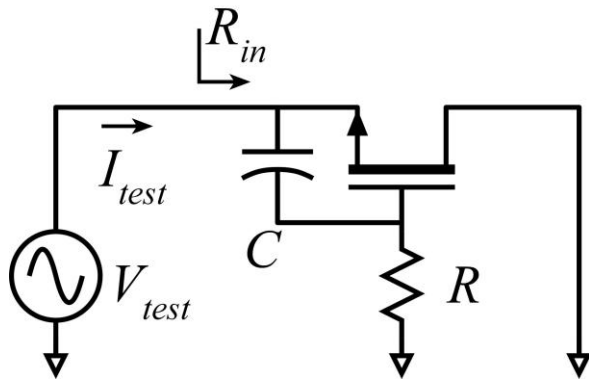


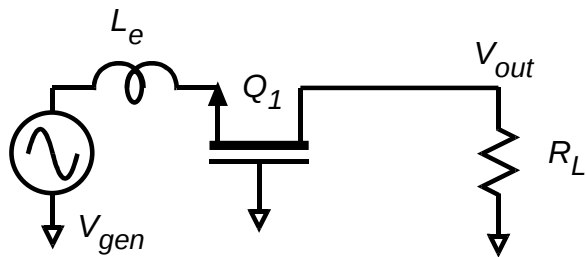
ECE137A Problem set 8



Problem 1: Ignore DC bias analysis. You don't need it. The transistor has transconductance g_m . Its output resistance R_{ds} is infinity. (a) Draw a small-signal equivalent circuit of the circuit. (b) using nodal analysis compute $Z(s) = V_{test}(s)/I_{test}(s)$ in ratio-of-polynomials form:

$$Z(s) = Z_{mid-band} \times (s\tau)^m \times \frac{1 + b_1s + b_2s^2 + \dots}{1 + a_1s + a_2s^2 + \dots}$$

here m , an integer, can be positive or negative or zero. (c) $g_m = 1 \text{ mS}$. $R = 50 \text{ k}\Omega$, $C = 1 \text{ pF}$. Find the frequencies, in Hz, of all the poles and zeros of $Z_{in}(s)$.



Problem 2: Small signal analysis. Ignore the DC bias; you don't need it. The FET has $\lambda = 0$ hence $G_{ds} = 0$ (a) Draw an accurate small-signal equivalent circuit model of the circuit. Do not show components whose element values are zero or infinity. (c) Using NODAL ANALYSIS, find the transfer function $V_{out}(s)/V_{gen}(s)$.

The answer must be in standard form

$$\frac{V_{out}(s)}{V_{gen}(s)} = \frac{V_{out}}{V_{gen}} \bigg|_{DC} \frac{1 + b_1s + b_2s^2 + \dots}{1 + a_1s + a_2s^2 + \dots}$$

(c) $g_m = 10 \text{ mS}$. $R_L = 1 \text{ k}\Omega$. $L_e = 2 \text{ nH}$. Find any/all pole and zero frequencies of the transfer function, in Hz. (d) Draw a clean Bode Plot of V_{out}/V_{in} . On the plot, LABEL AXES, LABEL all relevant gains and pole or zero frequencies, Label Slopes. The plot should be drawn on printed semilog paper, and should have axes of Hz, (not rad/sec) and dB. (e) $V_{in}(t)$ is a 100 mV amplitude step-function. Find $V_{out}(t)$. Draw a clean graph.