EE304 – Problem Set 1

Problem 3.1 [M]

Sketch the Bode Plots (magnitude and phase) for the following transfer functions.
Assume $R_iC_i >> R_kC_k$ if i > k

(a) $[1/(1 + j\omega R_1C_1)][(1/(1 + j\omega R_2C_2)]$

(b) $(j\omega R_3C_3)[(1 + j\omega R_4C_4)/(1 + j\omega R_5C_5)]$

(c) $[(1 + j\omega R_6C_6)/(1 + j\omega R_8C_8)][(1 + j\omega R_7C_7)/(1 + j\omega R_9C_9)]$

Problem 7.121 [S&S 7/e]

D *7.121 The MOSFET in the circuit of Fig. P7.121 has $V_t = 0.8$ V, $k_n' = 5$ mA/V^2, and $V_A = 40$ V.

(a) Find the values of R_S, R_D, and R_G so that $I_D = 0.4$ mA, the largest possible value for R_D is used while a maximum signal swing at the drain of ± 0.8 V is possible, and the input resistance at the gate is 10 MΩ. Neglect the Early effect.

(b) Find the values of g_m and r_o at the bias point.

(c) If terminal Z is grounded, terminal X is connected to a signal source having a resistance of 1 MΩ, and terminal Y is connected to a load resistance of 10 kΩ, find the voltage gain from signal source to load.

(d) If terminal Y is grounded, find the voltage gain from X to Z with Z open-circuited. What is the output resistance of the source follower?

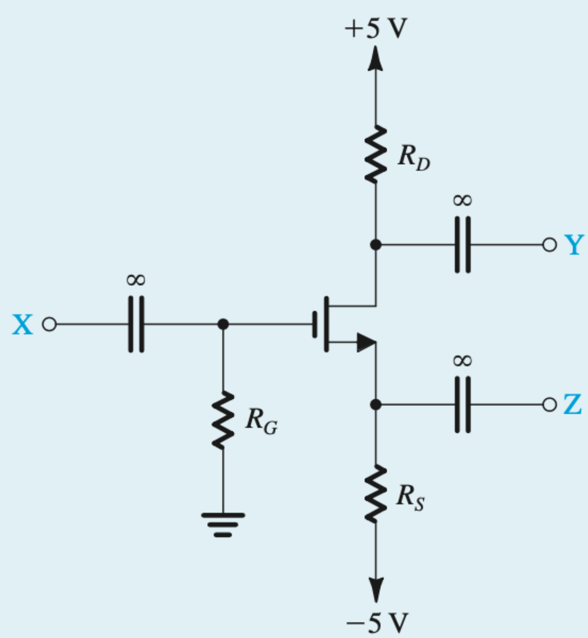

Figure P7.121

(e) If terminal X is grounded and terminal Z is connected to a current source delivering a signal current of 50 μA and having a resistance of 100 kΩ, find the voltage signal that can be measured at Y. For simplicity, neglect the effect of r_o.

Problem 7.130 [S&S 7/e]

***7.130** The amplifier of Fig. P7.130 consists of two identical common-emitter amplifiers connected in cascade. Observe that the input resistance of the second stage, R_{in2}, constitutes the load resistance of the first stage.

(a) For $V_{CC} = 15$ V, $R_1 = 100$ kΩ, $R_2 = 47$ kΩ, $R_E = 3.9$ kΩ, $R_C = 6.8$ kΩ, and $\beta = 100$, determine the dc collector current and dc collector voltage of each transistor.

(b) Draw the small-signal equivalent circuit of the entire amplifier and give the values of all its components.

(c) Find R_{in1} and v_{b1}/v_{sig} for $R_{sig} = 5$ kΩ.

(d) Find R_{in2} and v_{b2}/v_{b1}.

(e) For $R_L = 2$ kΩ, find v_o/v_{b2}.

(f) Find the overall voltage gain v_o/v_{sig}.

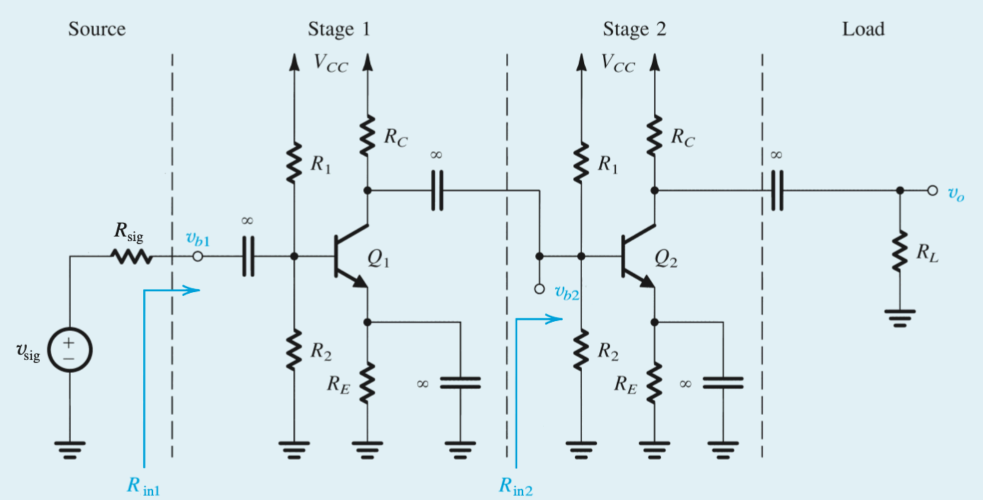

Figure P7.130

Problem E6 [S&S]

E.6 Find the high-frequency gain, the 3-dB frequency f_0, and the gain at $f = 1$ Hz of the capacitively coupled amplifier shown in Fig. EE.6. Assume the voltage amplifier to be ideal.

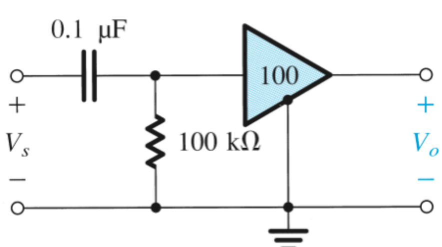

Figure EE.6

Problem 10.27 [S&S]

D 10.27 In the circuit of Fig. P10.27, the voltage amplifier is ideal (i.e., it has an infinite input resistance and a zero output resistance).

(a) Use the Miller approach to find an expression for the input capacitance C_{in} in terms of A and C.

(b) Use the expression for C_{in} to obtain the transfer function $V_o(s)/V_{sig}(s)$.

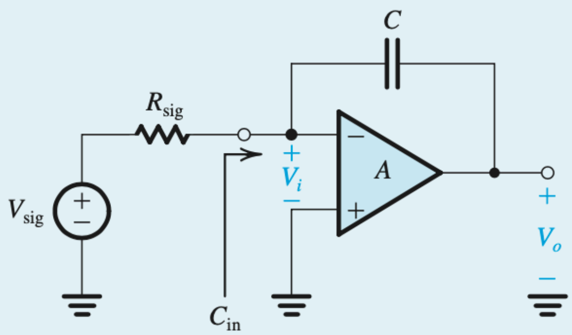

Figure P10.27

(c) If $R_{sig} = 1\ \text{k}\Omega$, and the gain V_o/V_{sig} is to have a dc value of 40 dB and a 3-dB frequency of 100 kHz, find the values required for A and C.

(d) Sketch a Bode plot for the gain and use it to determine the frequency at which its magnitude reduces to unity.