D.8 Consider the exponential response of an STC low-pass circuit to a 10-V step input. In terms of the time constant τ, find the time taken for the output to reach 5 V, 9 V, 9.9 V, and 9.99 V.

D.9 The high-frequency response of an oscilloscope is specified to be like that of an STC LP circuit with a 100-MHz corner frequency. If this oscilloscope is used to display an ideal step waveform, what rise time (10% to 90%) would you expect to observe?

E.1 Find the transfer function $T(s) = V_o(s)/V_i(s)$ of the circuit in Fig. PE.1. Is this an STC network? If so, of what type? For $C_1 = C_2 = 0.5\ \mu\text{F}$ and $R = 100\ \text{k}\Omega$, find the location of the pole(s) and zero(s), and sketch Bode plots for the magnitude response and the phase response.

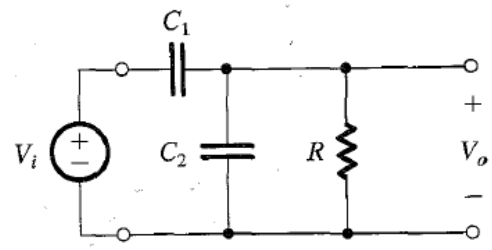

FIGURE PE.1

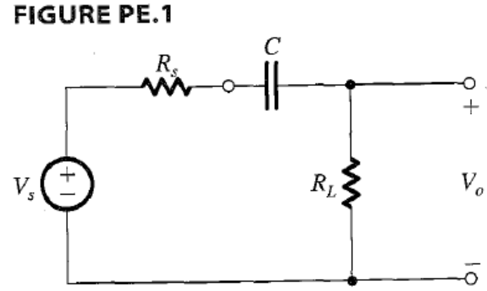

FIGURE PE.2

D*E.2 (a) Find the voltage transfer function $T(s) = V_o(s)/V_i(s)$, for the STC network shown in Fig. PE.2.

(b) In this circuit, capacitor C is used to couple the signal source V_s having a resistance R_s to a load R_L. For $R_s = 10\ \text{k}\Omega$, design the circuit, specifying the values of R_L and C to only one significant digit to meet the following requirements:

(i) The load resistance should be as small as possible.
(ii) The output signal should be at least 70% of the input at high frequencies.
(iii) The output should be at least 10% of the input at 10 Hz.

E.7 An amplifier has a voltage transfer function $T(s) = 10^6 s/(s+10)(s+10^3)$. Convert this to the form convenient for constructing Bode plots [that is, place the denominator factors in the form $(1 + s/a)$]. Provide a Bode plot for the magnitude response, and use it to find approximate values for the amplifier gain at 1, 10, 10^2, 10^3, 10^4, and 10^5 rad/s.

E.9 A transfer function has the following zeros and poles: one zero at $s = 0$ and one zero at $s = \infty$; one pole at $s = -100$ and one pole at $s = -10^6$. The magnitude of the transfer function at $\omega = 10^4$ rad/s is 100. Find the transfer function $T(s)$ and sketch a Bode plot for its magnitude.

E.10 Sketch Bode plots for the magnitude and phase of the transfer function

$$T(s) = \frac{10^4(1 + s/10^5)}{(1 + s/10^3)(1 + s/10^4)}$$

From your sketches, determine approximate values for the magnitude and phase at $\omega = 10^6$ rad/s.

D 9.1 The amplifier in Fig. P9.1 is biased to operate at $g_m = 1$ mA/V. Neglecting r_o, find the midband gain. Find the value of C_S that places f_L at 20 Hz.

9.3 The NMOS transistor in the discrete CS amplifier circuit of Fig. P9.3 is biased to have $g_m = 5$ mA/V. Find A_M, f_{P1}, f_{P2}, f_{P3}, and f_L.

D 9.4 Consider the low-frequency response of the CS amplifier of Fig. 9.2(a). Let $R_{sig} = 0.5$ MΩ, $R_G = 2$ MΩ, $g_m = 3$ mA/V, $R_D = 20$ kΩ, and $R_L = 10$ kΩ. Find A_M. Also, design the coupling and bypass capacitors to locate the three low-frequency poles at 50 Hz, 10 Hz, and 3 Hz. Use a minimum total capacitance, with capacitors specified only to a single significant digit. What value of f_L results?

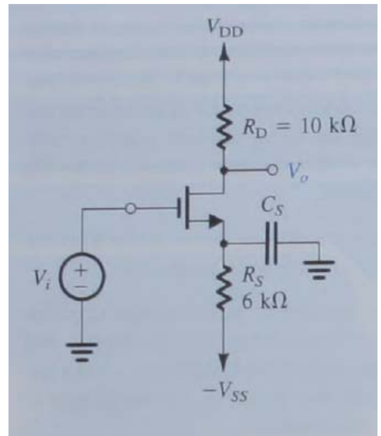

Figure P9.1

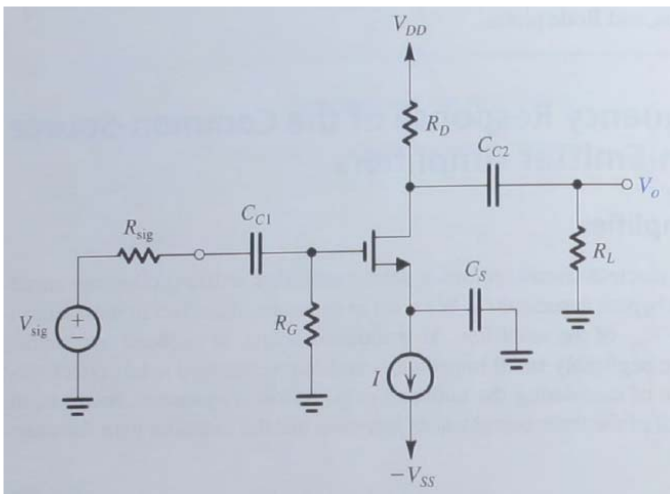

Fig. 9.2(a)

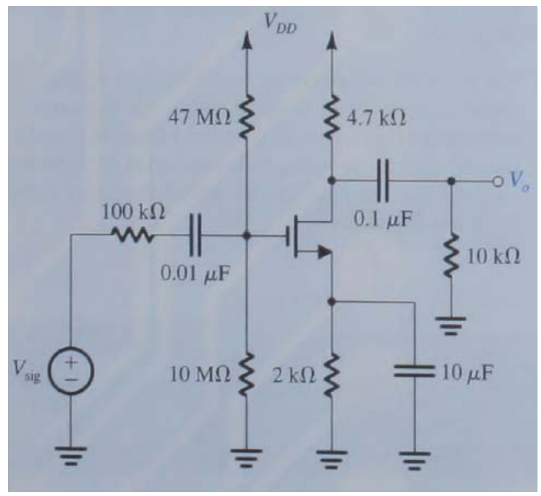

Fig. P9.3