

In the Sedra/Smith textbook: Chapter 12.

**D12.33** Design the LCR resonator of Fig. 12.17(a) to obtain natural modes with  $\omega_0 = 10^4$  rad/s and  $Q = 2$ . Use  $R = 10$  k $\Omega$ .

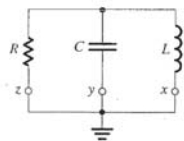


FIGURE 12.17 (a)

**12.35** Derive an expression for  $V_o(s)/V_i(s)$  of the high-pass circuit in Fig. 12.18(c).

**D12.36** Use the circuit of Fig. 12.18(b) to design a low-pass filter with  $\omega_0 = 10^5$  rad/s and  $Q = 1/\sqrt{2}$ . Utilize a 0.1- $\mu$ F capacitor.

**D12.37** Modify the bandpass circuit of Fig. 12.18(d) to change its center-frequency gain from 1 to 0.5 without changing  $\omega_0$  or  $Q$ .

**12.39** Consider the notch circuit shown in Fig. 12.18(i). For what ratio of  $L_1$  to  $L_2$  does the notch occur at  $0.9\omega_0$ ? For this case, what is the magnitude of the transmission at frequencies  $\ll \omega_0$ ? At frequencies  $\gg \omega_0$ ?

**D12.49** Design the KHN circuit of Fig. 12.24(a) to realize a bandpass filter with a center frequency of 1 kHz and a 3-dB bandwidth of 50 Hz. Use 10-nF capacitors. Give the complete circuit and specify all component values. What value of center-frequency gain is obtained?

**D12.54** It is required to design a third-order low-pass filter whose  $|T|$  is equiripple in both the passband and the stopband (in the manner shown in Fig. 12.3, except that the response shown is for  $N = 5$ ). The filter passband extends from  $\omega = 0$  to  $\omega = 1$  rad/s and the passband transmission varies between 1 and 0.9. The stopband edge is at  $\omega = 1.2$  rad/s. The following transfer function was obtained using filter design tables:

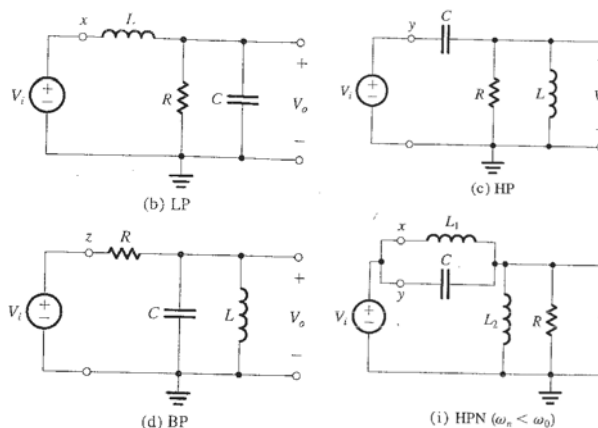
$$T(s) = \frac{0.4508(s^2 + 1.6996)}{(s + 0.7294)(s^2 + s0.2786 + 1.0504)}$$

The actual filter realized is to have  $\omega_p = 10^4$  rad/s.

(a) Obtain the transfer function of the actual filter by replacing  $s$  by  $s/10^4$ .

(b) Realize this filter as the cascade connection of a first-order LP op amp-RC circuit of the type shown in Fig. 12.13(a) and a second-order LPN Tow-Thomas biquad.

Each section is to have a dc gain of unity. Select appropriate component values. (*Note:* A filter with an equiripple response in both the passband and the stopband is known as an **elliptic filter**.)



**D12.52** Design the circuit of Fig. 12.26 to realize a low-pass notch filter with  $\omega_0 = 10^4$  rad/s,  $Q = 10$ , dc gain = 1, and  $\omega_n = 1.2 \times 10^4$  rad/s. Use  $C = 10$  nF and  $r = 20$  k $\Omega$ .

**D12.53** In the all-pass realization using the circuit of Fig. 12.26, which component(s) does one need to trim to adjust (a) only  $\omega_z$  and (b) only  $Q_z$ ?