In the Sedra/Smith textbook: Chapter 12.

D12.33 Design the LCR resonator of Fig. 12.17(a) to obtain natural modes with \( \omega_0 = 10^5 \text{ rad/s} \) and \( Q = 2 \). Use \( R = 10 \, \text{k}\Omega \).

![Fig. 12.17](image)

**FIGURE 12.17**

D12.35 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 \( \omega_0 = 10^5 \text{ rad/s} \) and \( Q = 1/\sqrt{2} \). Utilize a 0.1-\( \mu \text{F} \) 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 \( Q \).

D12.39 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 \( \pm \omega_0 \)? At frequencies \( \pm 3\omega_0 \)?

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-\( \mu \text{F} \) 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 \( \omega = 1 \text{ rad/s} \) and the passband transmission varies between 1 and 0.9. The stopband edge is at \( \omega = 1.2\text{ rad/s} \).

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 \( \omega_p = 10^4 \text{ rad/s} \).

(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.)