KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS

Electrical Engineering Department

EE-416 Analog Filter Design

Instructor: Dr. Hussain Alzaher

H.W.#1

Due Wednesday, Oct.9, 2005

1. Figure 1 shows an RCL circuit in which R_2=1 and L_1 and C_2 are to be determined so that V_2/V_1 gives a Butterworth frequency response.

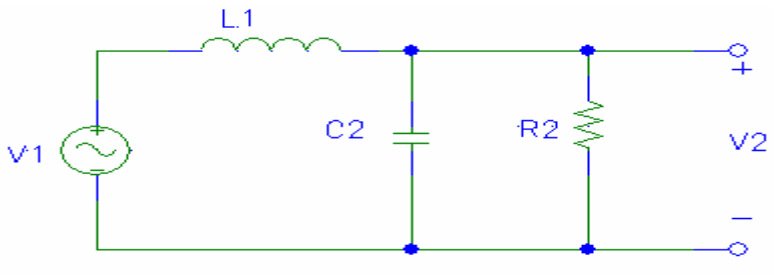

Figure 1

2. A maximally flat magnitude transfer function is characterized by the parameter ε =0.075 and n=7. Determine the minimum attenuation at the stopband frequency $\omega_s = 1.85\omega_p$. Assume $f_p = 980$ Hz. Find the transfer function and its poles:

(a) Relying on calculations (b) Relying on Butterworth tables.

3. Consider the following three sets of specifications:

	α_{max} dB	α_{min} dB	ω_p rad/s	ω_s rad/s
(a)	0.25	15	10,000	14,000
(b)	0.50	30	750	1,750
(c)	1.00	25	1,250	4,375

For each of the three cases do the following:

(i) Determine n, the required order of the LP filter with maximally flat magnitude.

(ii) Determine the actual attenuation at the edge of the passband and the edge of the stop band, $\alpha(\omega_p)$ and $\alpha(\omega_s)$.

(iii) Determine the attenuation at the frequencies $2\times\omega_s$ and $10\times\omega_s$.

4) Design a lowpass filter with a Chebyshev response satisfying the following specifications: $\alpha_{\max}$ =0.25 dB, $\alpha_{\min}$ =18 dB, $\omega_p = 1000$ rad/s, ω_s =1400 rad/s. Adjust the gain so the minimum value of $\alpha(\omega)$ is 0 dB. Magnitude scale so that the element values in your circuit realization are in practical range (Figure 2).

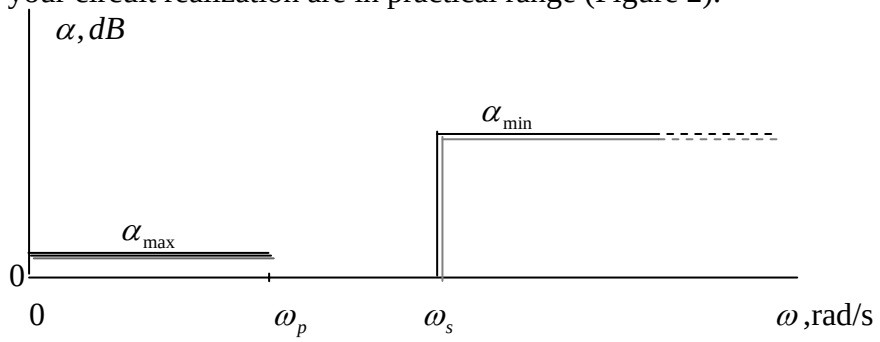

Figure 2

5) Design a lowpass filter with equal ripple passband for the following specifications:

(a) Stopband: $\alpha_{\min}$ =65 dB at f_s =10.4 kHz

(b) Passband: $\alpha_{\max}$ =0.5 dB, f_c = 4.5 kHz

Be sure to scale the frequency variable.

6) For $\alpha_{\max} = 1dB$ and $\omega_p = 1$ rad/s find the poles of 12^{th}-order lowpass filters based on (a) Butterworth's approximation (b) Chebyshev's Approximation