

**ECE4435 Design Project 3**  
**Fall 2004**  
**A Cascaded Chebyshev High-Pass Filter and**  
**Elliptic Low-Pass Filter**

Input signals to broadcast transmitter are normally filtered to prevent out-of-band signal components from producing undesired distortion in the transmitter modulator stage. The object of this design project is to design a band-pass filter that will pass audio signals in the band from 50 Hz to 10 kHz. On the low-frequency end, the filter is to exhibit the response of a 3rd-order Chebyshev filter with a  $-3$  dB cutoff frequency of 50 Hz. On the high-frequency end, the filter is to exhibit the response of a 3rd-order or higher elliptic filter with a  $-3$  dB cutoff frequency of 10 kHz.

**Circuit Specifications**

1. The circuit input and output are to be dc coupled. The input resistance is to be  $10\text{ k}\Omega$ . The dc offset at the output is to be less than 10 mV.
2. The low-frequency response of the circuit is to exhibit the transfer function of a 3rd-order Chebyshev high-pass filter. The lower  $-3$  dB cutoff frequency is to be 50 Hz. The dB ripple in the filter response is to be  $0.75u$  dB.
3. The high-frequency response of the circuit is to exhibit the transfer function of a 3rd-order, or higher, elliptic low-pass filter. The upper  $-3$  dB cutoff frequency is to be 10 kHz. The minimum attenuation at 15 kHz is to be 30 dB. The dB ripple in the filter response is to be 0.5 dB.
4. The output stage of the circuit is to have an output impedance of  $1\text{ k}\Omega$ .