**EE4435 Fall 2002**
**Design Project 1**
**A Graphic Equalizer**

## Object

The object of this experiment is to design, implement, and test a three-band octave graphic equalizer.

## Background

Devices that are used to alter the frequency response of an audio system are called equalizers. The two types of equalizers that are most commonly used are graphic equalizers and parametric equalizers. The graphic equalizer has controls which can be used to boost or cut the response of the system at fixed frequencies. The frequencies of maximum boost and cut in the graphic equalizers that are used in most professional applications are spaced one-third of an octave apart. That is, the ratio of two adjacent frequencies is $2^{1/3}$. In equalizers designed for the consumer market, octave equalizers are more common where the spacing between the frequencies is 2. The frequencies are normally chosen so that 1 kHz is one of the frequencies. A ten-band octave equalizer would have the frequencies 31.25 Hz, 62.5 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz.
In a parametric equalizer, the boost/cut frequencies are adjustable. In addition the bandwidths of the filters are adjustable. For most professional applications, a three-band parametric equalizer is adequate.
This experiment involves the design of an octave graphic equalizer having only three bands. Additional bands can be added if desired, but the design principles can be demonstrated with only three bands.

## The Basic Filter Topology

The paper "Design Aspects of Graphic Equalizers" by R. A. Greiner and Michael Schoessow that is on the class web page reviews several topologies for graphic equalizer circuits. You are to read this paper and select a circuit from it. The text for the class also discusses a possible circuit in Chapter 3. However, this circuit is based on the one published in the posted paper.

## Specifications

- The boost/cut frequencies are to be 500 Hz, 1 kHz, and 2 kHz. If you desire, you can add more octave spaced frequencies to your circuit, but only three are required to complete the lab.
- The circuit is to be designed so that the voltage gain is unity with the equalizer controls set at zero boost/cut.
- When any one of the three controls is set for maximum boost, the gain at that frequency is to be 4, i.e. +12 dB.
- When any one of the three controls is set for maximum cut, the gain at that frequency is to be 0.25, i.e. −12 dB.

- The dc offset at the output of the circuit is to be less than 10 mV.
- A high-pass filter is to be incorporated at the input of the circuit to block the application of any dc input voltage. The lower cutoff frequency of this filter is to be 2 Hz or lower.

**Schedule**

- You should read the paper and select a filter topology before the first lab meeting.
- During the first lab period, you should successfully realize the circuit with the 1 kHz filter. You should verify your design before assembling the circuit with a SPICE simulation.
- During the second lab period, you should successfully add the 500 Hz and 2 kHz filters.
- During the third lab period, you should test and document the performance of the circuit. You should take sufficient data to show how the filters interact when one or more are set in the boost and/or cut modes.
- Your lab report should include all calculations, measured data, and SPICE simulations.