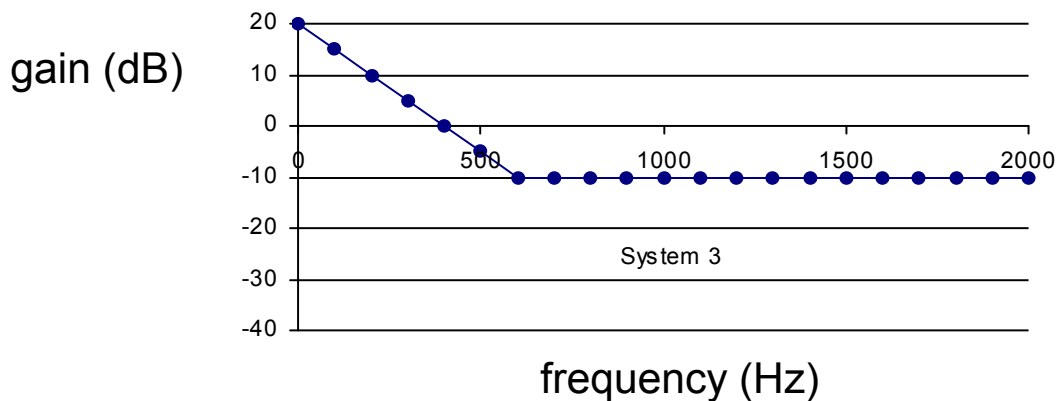
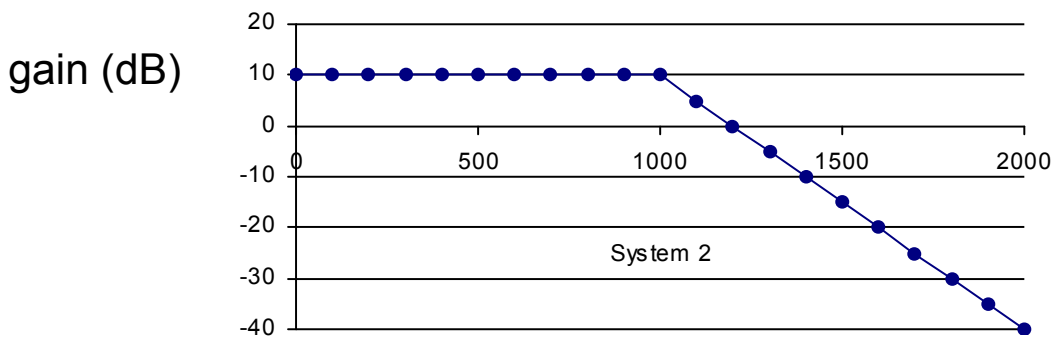
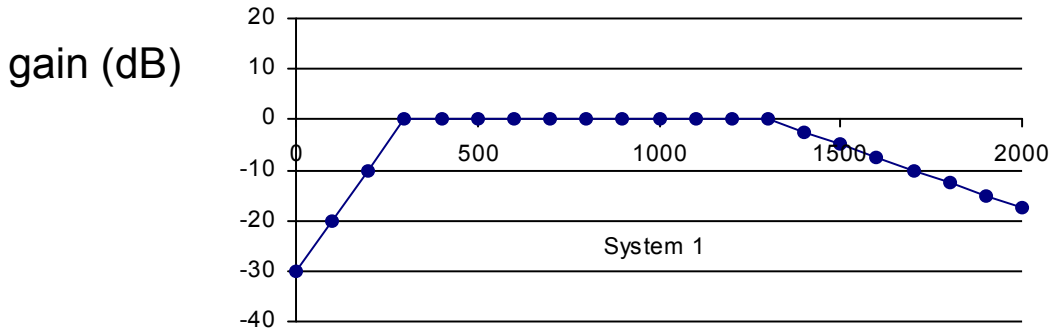


Signals, systems, acoustics and the ear: Coursework III

Handwriting is fine but must be legible. You may discuss these questions together, but please write your answers by yourself. **Show your work!**

1. Consider a cascade of three systems with the following amplitude responses. Draw the amplitude response of the complete cascade. What would be the amplitude response of the cascade if the position of Systems 1 and 2 were reversed? **(10 points)**



2. Draw the input and output spectra of white noise passed through the second system in the cascade of question 1. **(10 points)**
3. Consider the acoustic tube whose frequency response you measured in the lab. For one size of the resonator you measured, plot the frequency response (dB vs linear frequency scales) and then calculate its bandwidth. Show the bandwidth on your plot. If you do not have your own data, get the measurements from a class mate. **(20 points total)**
4. In order to reduce data, telephone systems typically band-pass filter their signals. Consider a given system that has filter cut-offs at 300 and 3500 Hz and attenuates the signal by 20 dB in its pass-band and by 50 dB outside the pass-band. It rolls off linearly in dB over 100 Hz at each side of the filter. For simplicity, assume the filter cutoff frequencies have the same gain as the passband, rather than being 3 dB down. **(20 points)**
- a. Draw a frequency response of that filter on dB amplitude and linear frequency scales up to 5 kHz.
 - b. Draw input and output spectra of the following four signals passed through this system. You are free to choose the input level in each case:
 - i. A sinewave at 200 Hz
 - ii. A sinewave at 1 kHz
 - iii. A periodic train of pulses with a period of 0.002 s. Assume the pulses are narrow enough to make the spectral envelope flat (that is, all components are at the same amplitude for the frequency region under consideration).