# ECE 321 - Homework #3

Calibration & Noise, Active Filters. Due Monday, April 17th
Please email to jacob.glower@ndsu.edu, or submit as a hard copy, or submit on BlackBoard

## Filters

1) Assume X and Y are related by the following transfer function:

$$Y = \left( \frac{80}{(s+5)(s+10)} \right) X$$

a) What is the differential equation relating x and y?

b) Determine y(t) assuming

$$x(t) = 6 + 2\cos(4t) + 3\sin(4t)$$

## Filter Design

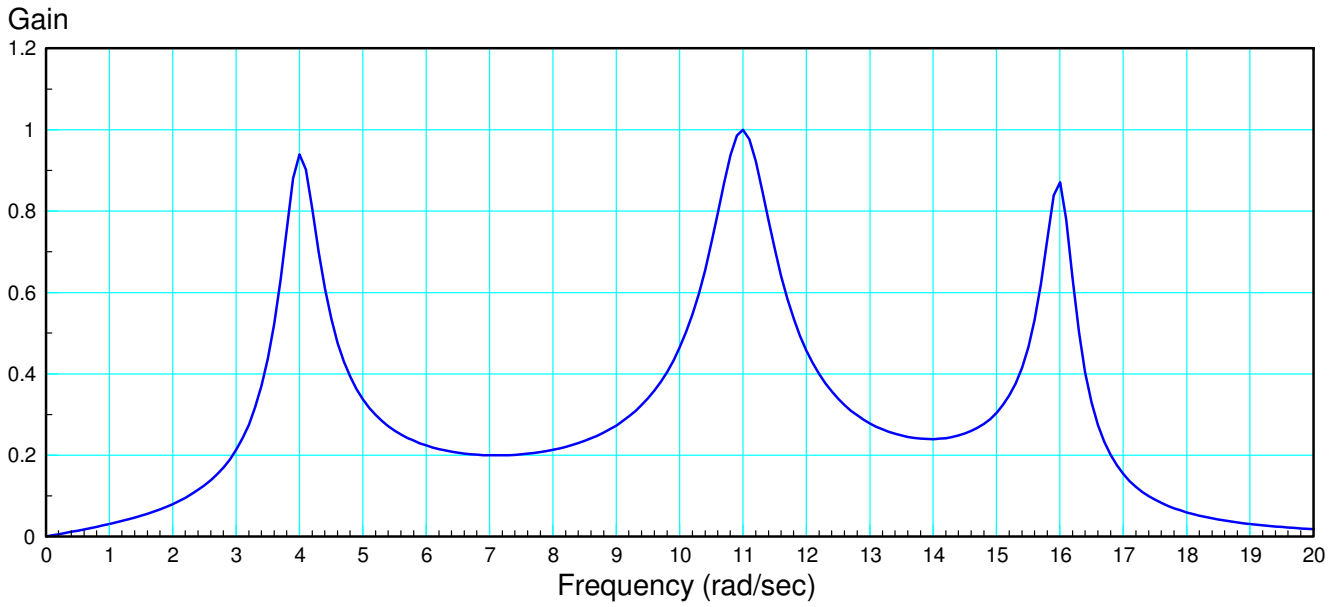
2) Give an op-amp circuit to implement the following filter

$$Y = \left( \frac{400}{(s+2)(s+8)(s+10)} \right) X$$

3) Give an op-amp circuit to implement the following filter

$$Y = \left( \frac{200}{\left(s^2+s+20\right)\left(s^2+5s+30\right)} \right) X$$

4) Give the transfer function of a filter with the following gain vs. frequency



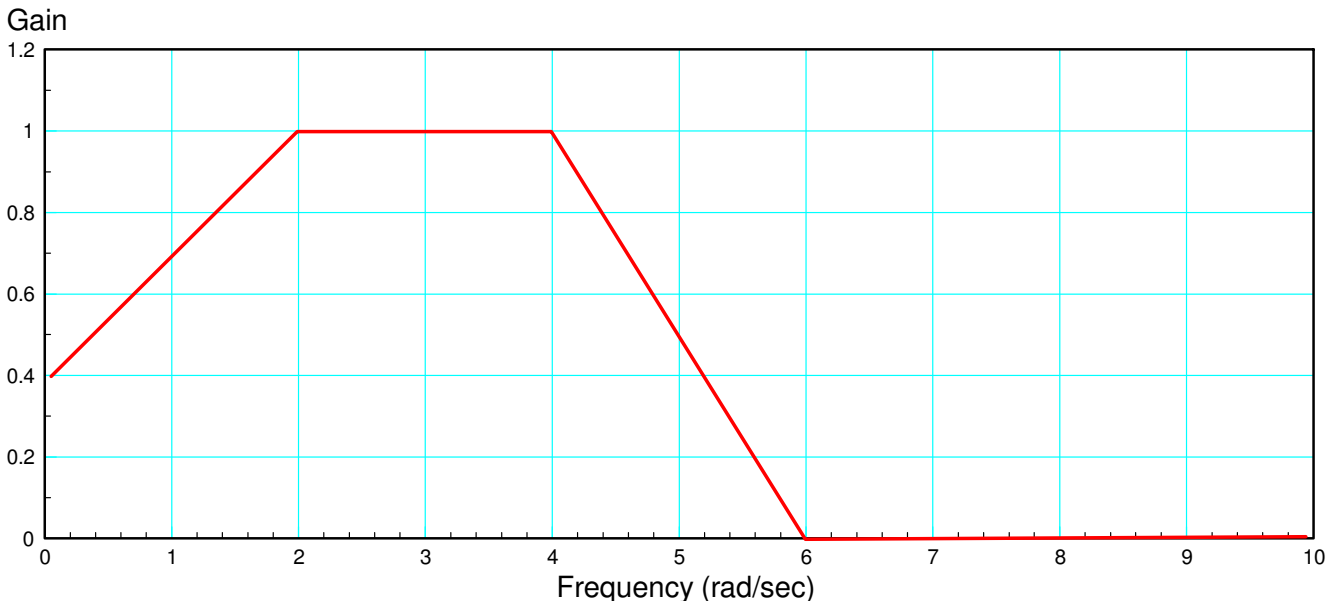
## Filter Design using *fminsearch()*

5) Design a filter of the form

$$Y = \left( \frac{a}{(s+b)\left(s^2+cs+d\right)\left(s^2+es+f\right)} \right) X$$

to give a gain vs. frequency as close to the following plot as possible over the range of (0, 10) rad/sec.

Plot your filter's actual frequency response vs. it's ideal response (red line).




6) Design circuit to implement the filter you designed in problem #5

7) Check your filter using CircuitLab