ECE 321 - Homework #3

Calibration and Filters. Due Monday, April 15th

A light sensor has a lux vs. resistance relationship of

$$R = \frac{100,000}{Lux}$$

1) Design a circuit which output -10V to +10V as the light level changes from 10 Lux to 100 Lux.

2) Determine a calibration funciton which determines Lux based upon the output voltage for problem #1

$$Lux = f(V)$$

3) Assume X and Y are related by the following filter

$$Y = \left(\frac{100}{(s+5)(s+10)} \right) X$$

a) What is the differential equation relating X and Y?

b) Determine y(t) assuming

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

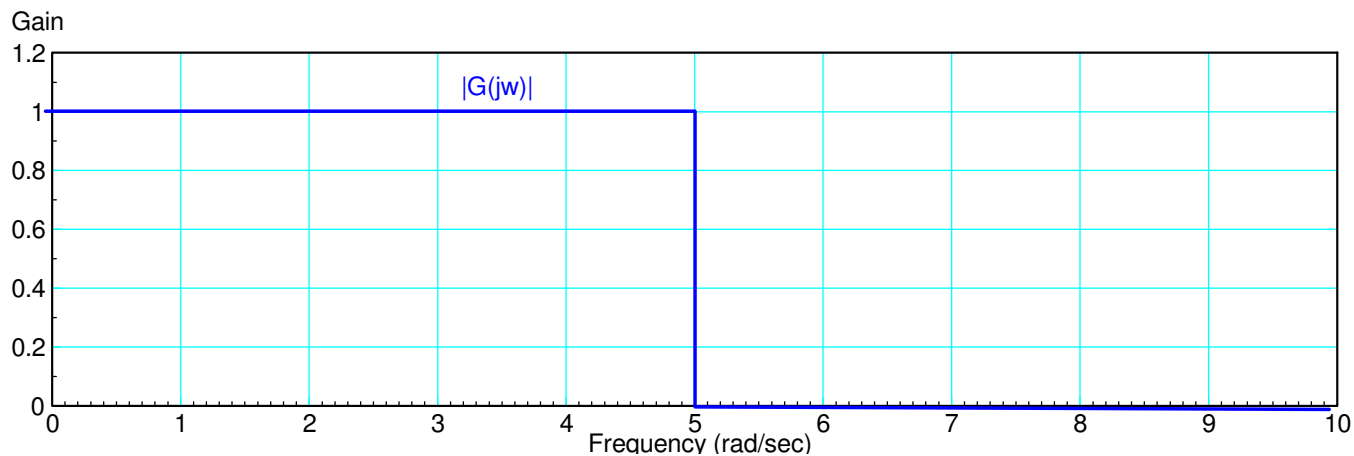c) Plot the gain vs. frequency of this filter from 0 to 20 rad/sec.

4) Use Matlab and fminsearch to find a filter to approximate

$$G(s) = \begin{cases} 1 & 0 < s < 5 \\ 0 & otherwise \end{cases}$$

Assume G(s) is in the form of

$$G(s) = \left(\frac{ace}{(s+a)\left(s^2+bs+c\right)\left(s^2+ds+e\right)} \right)$$

Plot the gain vs. frequency of your resulting filter along with it's pole locations.

5) Use Matlab and fminsearch to find a filter to approximate

$$G(s) = \begin{cases} s/5 & 0 < s < 5 \\ 0 & otherwise \end{cases}$$

Assume G(s) is in the form of

$$G(s) = \left(\frac{as}{\left(s^2+bs+c\right)\left(s^2+ds+e\right)} \right)$$

Plot the gain vs. frequency of your resulting filter along with it's pole locations.