ECE 321 - Homework #3

Calibration, Filter Circuits, and Frequency Response. Due Monday, April 20th

Please make the subject "ECE 321 HW#3" if submitting homework electronically to Jacob_Glower@yahoo.com (or on blackboard)

Calibration

Problem 1 & 2) Assume you are using a thermistor where the temperature - resistance relationship is

$$R = 1000\ \exp\left(\frac{3905}{T} - \frac{3905}{298}\right)\ \Omega$$

along with a voltage divider (10V source, 2k resistor:

$$V = \left(\frac{R}{R+2000}\right) \cdot 10V$$

1) Determine a calibration function of the form

$$T \approx aV + b$$

to estimate temperature over the range of (0C, +30C). What is the maximum error in this calibration function?

2) Determine a calibration function of the form

$$T \approx aV^3 + bV^2 + cV + d$$

to estimate temperature over the range of (0C, +30C). What is the maximum error in this calibration function?

Filters

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

$$Y = \left(\frac{30}{(s+3)(s+8)}\right)X$$

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

b) Determine y(t) assuming

$$x(t) = 5 + 6\cos(4t)$$

Filter Design using *fminsearch()*

4) Design a filter of the form

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

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

$$G_d(j\omega) = \begin{cases} 1 & 0 < \omega < 6 \\ 0 & otherwise \end{cases}$$

Plot your filter's actual frequency response vs. it's ideal response (given by Gd).

5) Design circuit to implement the filter you designed in problem #4

6) Check your filter using CircuitLab