ECE 321 - Homework #3

Calibration, Filter Circuits, and Frequency Response. Due Monday, April 19th

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

$$R = 1000\ \exp\left(\frac{3905}{T+273} - \frac{3905}{298}\right)\ \Omega$$

where T is the temperature in degrees C. Assume this is used along with a voltage divider (5V source, 2k resistor:

$$V = \left(\frac{R}{R+2000}\right) \cdot 5V$$

1) Determine a calibration function of the form

$$T \approx aV + b$$

to estimate temperature over the range of (+10C .. +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 (+10C .. +30C). What is the maximum error in this calibration function?

Filters

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

$$Y = \left(\frac{40}{(s+2)(s+7)}\right)X$$

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

b) Determine y(t) assuming

$$x(t) = 4 + 5\cos(7t) + 6\sin(7t)$$

Filter Design using *fminsearch()*

4) Design a filter of the form

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

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

$$G_d(j\omega) = \begin{cases} 1 & 0 < \omega < 2 \\ 0.5 & 2 < \omega < 4 \\ 0 & \omega > 4 \end{cases}$$

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