

# ECE 321 - Quiz #2 - Name \_\_\_\_\_

Sensors & Filters

Calculators, internet, Matlab permitted.

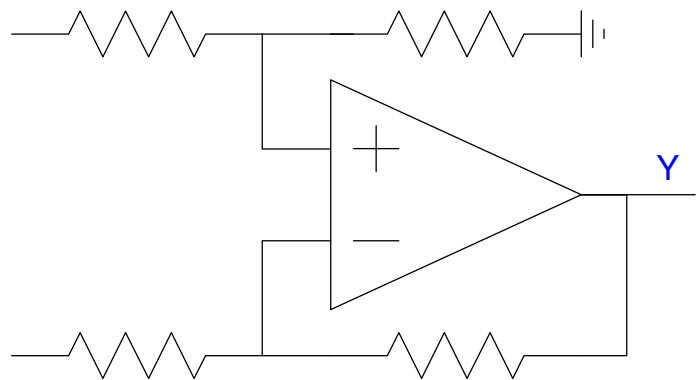
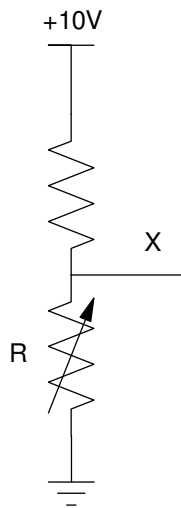
1) A thermistor has a temperature-resistance relationship of (Digikey part number 495-75201-ND) where T is the temperature in degrees C.

$$R = 10,000 \cdot \exp\left(\frac{3980}{T+273} - \frac{3980}{298}\right) \Omega$$

Design a circuit which outputs

- 0V at 25C and
- 10V at 100C

Note: A linearizing circuit isn't required.



2) A thermistor has a temperature-resistance relationship of

$$R = 10,000 \cdot \exp\left(\frac{3980}{T+273} - \frac{3980}{298}\right) \Omega$$

where T is the temperature in degrees C. Assume the thermistor is used with a voltage divider so that

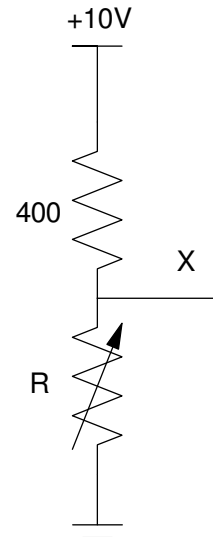
$$X = \left(\frac{R}{R+400}\right) 10V$$

2a) Determine the least squares curve fit for temperature as

$$T = aX + b$$

2b) Determine the least squares curve fit for temperature as

$$T = aX^3 + bX^2 + cX + d$$



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

$$Y = \left( \frac{50}{(s+5)(s+7)} \right) X$$

3a) What is the differential equation relating X and Y?

3b) Determine y(t) assuming

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

4) Design a circuit to implement the following filter:

$$Y = \left( \frac{500}{(s+2)(s+10)(s+20)} \right) X$$

5) Design a circuit to implement the following filter:

$$Y = \left( \frac{500}{(s+2)(s+3+j10)(s+3-j10)} \right) X$$

6) Give the transfer function for a 6th order Butterworth filter with

- A DC gain of 1.000
- A corner at 20 rads/c