

ECE 321 - Homework #2

Sensors. Due Monday, April 8th

Temperature Sensors

Problem 1-2) Design a circuit to measure temperature from 10C to +30C.

- Input: Temperature from 10C to +30C
- Output: -10V to +10V, capable of driving a 1k resistor (10mA)
- Relationship:
 - At 10C, the output is -10V
 - At +30C, the output is +10V
 - Proportioanl inbetween

Assume a thermistor with a resistance - temperature relationship of

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

Problem 1) Design a linearizing circuit so that the resistance is approximately linear from 10C to +30C

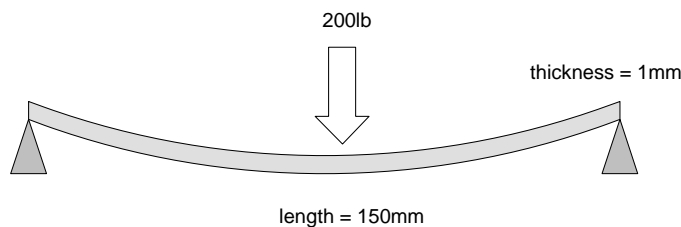
- Plot the resulting resistance vs. temperature relationship using Matlab (or similar program)

Problem 2) Using this linearizing circuit, design a circuit which ouputs -10V to +10V as temperature goes from 10C to +30C.

- Plot the resulting voltage vs. temperature relationship using Matlab (or similar program)

Strain Sensors

Problem 3) Assume a bathroom scale uses a steel beam to measure weight, and the beam deflects 5mm with a weight of 200 lb (889N)



Design a circuit which output

- 0V at 0lb (0N), and
- +10V at 200lb (889N)

Assume a strain sensor:

$$R = 120(1 + 2.14\epsilon)$$

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Problem 4) Specify the requirements for an amplifier circuit. Some suggestions are:

- Audio Mixer: Mix two signals together

$$y = aA + bB$$

$$0 < a < 10$$

$$0 < b < 10$$

- Temperature Sensor: Output -10V to +10V as the voltage goes from -10C to +10C
- Sound on a Light Beam: Output a 5Vpp sine wave when a light sensor is hit with a time-varying light source
- Cell Phone Function Generator: Amplify the output of a cell phone to -10V to +10V, turning your cell phone into a function generator.
- Other

Problem 5) Design a circuit to meet these requirements.

Problem 6) Build your circuit in lab and verify it operates correctly. Check the endpoints and one or two points inbetween.

Problem 8) Demo. Demonstrate your amplifier

Note: Save your circuit. You'll use it again in the following homework sets