ECE 321 - Homework #2

Sensors. Due Wednesday, November 14th, 2018

Temperature Sensors

Problem 1-2) Design a circuit to measure temperature from -20C to +20C.

- Input: Temperature from -20C to +20C
- Output: -10V to +10V, capable of driving a 1k resistor (10mA)
- Relationship:
  - At -20C, the output is -10V
  - At +20C, 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 -20C to +20C

- 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 -20C to + 20C.

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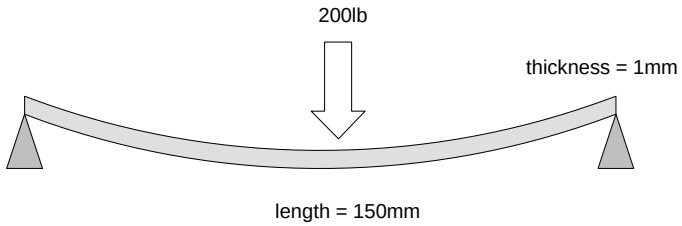
Strain Sensors

Problem 3) Assume a bathroom scale uses a steel beam to measure weight, and the beam deflects 10mm 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:

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

ECE 321 Project: Section (A)

Problem 4) Specify the requirements for your power amplifier (section A): (inputs, outputs, how they relate)

Problem 5) Design a circuit to meet these requirements. Use a TIP 112 and/or TIP117 transistors

- $\beta = 1000$
- $|V_{be}| = 1.4V$
- $\min(|V_{ce}|) = 0.9V$

Calculate the voltages and currents you should see at

- Vin = -5V, +5V (endpoints),
- Vin = -1V, +1V (points inbetween)

Problem 6) Simulate your circuit to verify it operates correctly. Check the voltages and currents at

- Vin = -5V, +5V (endpoints),
- Vin = -1V, +1V (points inbetween)

to see if they match your computations.

Problem 7) Build your circuit in lab and verify it operates correctly. Check the voltages and currents at

- Vin = -5V, +5V (endpoints),
- Vin = -1V, +1V (points inbetween)

to see if they match your computations and simulation results.

Problem 8) Demo. Demonstrate your amplfier with an audio signal (video or in person).

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