M E 345

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Lecture 34

Today, we will:

- Finish reviewing the pdf module: Temperature Measurement and do an example
- Begin to review the pdf module: Measurement of Mechanical Quantities
- Do some example problems mechanical quantities

Example: Thermistors

Given: A thermistor with $R_{\text{thermistor}} = 1633\underline{0} \ \Omega$ at 0.0°C and 624<u>7</u> Ω at 20.0°C is used in a simple voltage divider circuit, as sketched. (*Note*: Here, V_{out} is across R_s instead of $R_{\text{thermistor}}$.)

- $V_s =$ supply voltage = 5.00 V DC.
- $R_s = \text{supply resistance} = 10.00 \text{ k}\Omega.$
- (*a*) To do: Calculate the output voltage at $T = 0.0^{\circ}$ C.
- (b) To do: Calculate the output voltage at $T = 20.0^{\circ}$ C.

(c) To do: Suppose the output voltage is 2.353 V. Estimate the temperature as best as you can, given the limited amount of information provided in the problem statement.



Example: Displacement measurement

Given: A linear potentiometer is constructed using a resistor with resistance $R = 10.0 \text{ k}\Omega$ and length L = 10 cm. The supply voltage is 5.00 V DC.

To do: When $V_0 = 2.25$ V, calculate distance x.



Example: Displacement measurement

Given: The pulse-echo ultrasonic transducer in the ME 345 lab is used to measure the thickness of a piece of aluminum. The transmitted and reflected signals are read by an oscilloscope. The speed of sound in the aluminum is a = 6300 m/s.

To do: Sketch the oscilloscope trace. Also, for $\Delta t = 4.1 \,\mu s$, calculate the thickness of the specimen.



Example: Displacement measurement

Given: A home-made capacitance displacement sensor is constructed of two metal plates with air in the gap:

- initial gap distance is d = 0.100 mm
- the plate surface dimensions are $L = 1.00 \text{ cm} \times W = 1.00 \text{ cm}$ (where W is the plate dimension into the page)



(*a*) **To do**: Calculate the initial capacitance in units of picofarads.

(b) To do: If the plates move apart *vertically*, calculate the *sensitivity* of the sensor.

(c) To do: If the plates move apart *horizontally*, calculate the *sensitivity* of the sensor.