Basic Concepts

DUE: Monday, January 13, Start of class

Objective
Get your mind into issues important to instrumentation.

To Do
Note: Make reasonable assumptions where necessary and clearly state them. Each of the problems is worth an equal number of points.

1) For the four items listed below, state 4 parameters each that can be instrumented and the nature and range of the parameter being measured. For example, in a modern automobile there is a temperature transducer to measure the ambient outside temperature with a range of -75°F to +125°F.
   a. Airplane.
   b. Bicycle.
   c. Cell phone.
   d. Human body.

2) The resistance of a temperature sensor varies from 150Ω to 1.5kΩ. If R2 represents this sensor in the circuit at the right, what is the range of voltages at Vout? Take R1 = 300Ω.

3) Draw a graph of Vout vs. sensor resistance from problem 2 and answer the following questions:
   a. Does the voltage vary linearly with resistance?
   b. Does Vout decrease or increase when the sensor resistance increases?

4) Now, take Vout across R1 instead of R2.
   a. Repeat problem 2 above.
   b. Repeat problem 3 above.

5) AC analysis
   a. Calculate the RMS value of an AC signal with a peak amplitude of 10V and a frequency of 10 kHz.
   b. Calculate the average value of an AC signal with a peak amplitude of 10V and a frequency of 10 kHz.
   c. Calculate the RMS value of an AC signal with a peak amplitude of 10V, a frequency of 10 kHz, and a DC offset of 2V.

i (A)

15

25   50   75   100 t (ms)
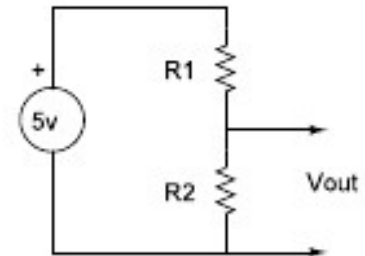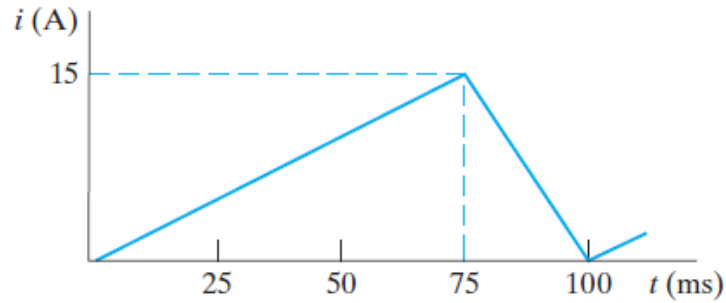
6) For the waveform shown above:
    a. Find the rms value.
    b. Suppose this current waveform is applied to a 100Ω resistor. Calculate the average power dissipated by the resistor.
    c. When the current in part (a) is applied to a different resistor, that resistor dissipates 25mW of average power. What is the value of the resistor?

7) For the following sine and cosine functions, determine the period, the frequency in hertz, and the frequency in radians/second. Note that t represents time in seconds.
    a. $\sin \pi t$
    b. $4\cos 100t$

To Turn In
- **This page** stapled to your solutions, which are to be done in accordance with the School of Engineering homework guidelines found on the course web page. Use minimal, but sufficient, problem statements.