NAME (please print) _____ SID _____

UNIVERSITY OF CALIFORNIA, BERKELEY
Electrical Engineering and Computer Sciences Department
EECS 145L Electronic Transducer Lab
MIDTERM #2 (100 points maximum)
November 22, 2010

(closed book, calculators OK, equation sheet provided)
(You will not receive full credit if you do not show your work)

PROBLEM 1 (10 points)

Draw an electronic circuit that drives a light emitting diode to produce a light intensity that is proportional to the circuit input voltage.

PROBLEM 2 (10 points)

Describe how you would use a Peltier thermoelectric heat pump to cool an electronic circuit.

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PROBLEM 3 (10 points)

Describe how you would use a metal film strain gauge (gauge factor $G_s = 2$) to convert a strain $\Delta L/L = 0.1\%$ into a output voltage of 1 V.

PROBLEM 4 (10 points)

Describe the hazardous condition that the ground fault interrupter is designed to detect, how it senses the condition, and what action it takes when the condition occurs.

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PROBLEM 5 (10 points)

Describe how you would calibrate a sensor so that you could use its electronic output to determine any physical input within its range.

PROBLEM 6 (50 points)

Design a thermocouple-based system for measuring the temperature of a furnace over the temperature range from 100 °C to 500 °C and that uses a thermistor to measure the temperature of the air near the reference junction.
Assume the following:

- The thermistor has a resistance of 11,053 ohms at 10 °C, 10,000 ohms at 20 °C, and 9,048 ohms at 30 °C.
- To reduce the effects of thermistor self heating, you use a 2 V bias for the thermistor bridge
- The thermocouple has a voltage output of 50 μV per °C

6.1 (13 points) Draw a circuit that uses a thermistor to produce an output of -1V at an air temperature of 10°C, 0 V at an air temperature of 20°C, and +1V at an air temperature of 30°C.

6.2 (13 points) Draw a circuit that uses a thermocouple to produce an output of 1V at a differential temperature of 100°C and 5V at a differential temperature of 500°C. Show the location of the thermistor.

6.3 (13 points) Draw a summing circuit that combines the thermistor and thermocouple circuit outputs (**6.1** and **6.2**) to produce 1.0 V at 100 °C and 5.0 V at 500 °C furnace temperatures, independent of room temperature over the 10 °C to 30°C range.

6.4 (6 points) If the thermistor has a thermal dissipation coefficient of 1 mW/°C in **6.1** what is the temperature of the thermistor at an air temperature of 20 °C?

6.5 (5 points) If the bridge bias voltage in **6.1** were increased from 2 V to 10 V, what would be the temperature of the thermistor at an air temperature of 20 °C?