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 16, 2005

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

PROBLEM 1 (20 points)

Briefly define the following terms

1a (5 points) Sensor

1b (7 points) Response curve (of a sensor)

1c (8 points) Sensitivity of a sensor

PROBLEM 2 (10 points)

Describe the steps you would use to calibrate a sensor

PROBLEM 3 (40 points)

Your task is to design a weather station for sensing the following four quantities and producing analog signals with the required amplitudes:
(a) Air temperature (b) Air pressure (c) Wind direction (d) Wind speed

For each section, think about the sensors used in the EECS145L course. Your designs will be graded on the basis of

- Meeting the design requirements
- Sufficient detail so that a skilled technician could build your design.
- Avoidance of unnecessary complexity (keep it simple)

3a (10 points) Describe your design (words and/or a sketch) for using a solid state temperature sensor (1 μA/K) to measure the air temperature over the range from –50 °C to 50 °C and converting it into an analog signal from – 5V to + 5V.

3b (10 points) Describe your design (words and/or a sketch) for using two 100 Ω strain gauges (gauge factor $G_S = 2$) to measure the air pressure over the range from 700 to 800 mm Hg and converting it into an analog signal from 0 V to + 10 V.

3c (10 points) Describe your design (words and/or a sketch) for using a one-turn rotary potentiometer (spiral resistor with 3 leads) to measure the wind direction over 360° and converting it into an analog signal from 0 V to + 10 V.

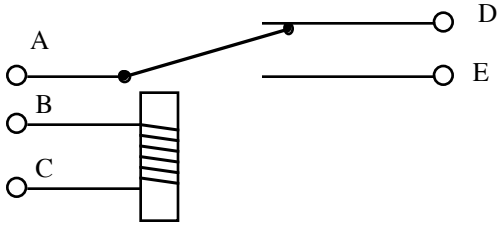
3d (10 points) Describe your design (words and/or a sketch) for using four 100-Ω strain gauges (gauge factor $G_S = 2$) to measure the wind speed over the range from 0 to 200 km/hr and converting it into an analog signal from 0 V to + 10 V.

PROBLEM 4 (30 points)

Design a system that uses sunlight to charge a battery during the day and uses the battery to power a bright LED at night. Such systems are sold for home yard lights.

You have the following components:

- eight silicon photovoltaic diode panels, each with a forward conduction voltage of 0.6 volts
- one LED with a forward conduction voltage of 3 volts and you want to drive it at its maximum power rating of 0.3 W.
- a 4.0 volt battery (assume that the voltage is always 4.0 volts, even during charging)
- one 1-volt zener diode (diode designed with 1 volt reverse breakdown)
- one op-amp
- a relay that connects A to D when the BC voltage is zero and connects A to E when the BC voltage is 4 volts



- other simple components as needed

4a (20 points) Sketch a block diagram of your system, labeling all essential components and connections

4b (5 points) Describe the state of the system during daylight

4c (5 points) Describe the state of the system at night