Homework Assignment #6
Due by online submission Friday 10/7/2016 (Saturday 9am)

1. In an SOI process with a 20um thick device layer you have a very thin piezoresistive layer on the top surface. If you make a beam that is 4um wide and 1mm long, and apply a force perpendicular to the wafer surface
   a. find the spring constant of the beam
   b. find the strain at the surface of the beam as a function of force
   c. find the strain at the surface of the beam as a function of deflection

   You make a 1kΩ strain gauge at the base of the beam, and put it in a Wheatstone bridge with a 2V excitation voltage. The resistor has a gauge factor of +30, and a TCR of +0.1%. You have an instrumentation amplifier with a noise-limited resolution of 1μV.
   d. Find the bridge output voltage as a function of strain
   e. Find the minimum detectable force
   f. Find the minimum detectable deflection
   g. Find the temperature change that gives a noise-equivalent bridge output voltage
   h. Find the power dissipation in the piezoresistor
   i. Find the thermal resistance for which the power dissipated in the resistor generates a temperature change that gives a noise-equivalent bridge output voltage
   j. Find the thermal resistance of the silicon beam as a function of its length
   k. How long can you make the piezoresistor before you have to worry about temperature effects?