SE104 Homework 4

1. For elongation measurement, we want to achieve the accuracy of 10^{-6}. For instance, for a 1-cm-long specimen, we need to detect its length change as small as 10^{-6} cm, i.e. 10 nm. Assume the gauge factor (GF) of a strain gauge is 2. By using a Wheatstone bridge, we measure the resistance change of the strain gauge (dR/R) to calculate the strain (dL/L). The smallest electrical resistance change that we can measure is 2×10^{-4} Ohm. (a) How large does the initial resistance of strain gauge (R) need to be, so that our resistance measurement resolution (2×10^{-4} Ohm) is sufficient for the strain measurement? (b) If the strain gauge is made of constantan and the wire thickness is 0.025 mm, how long should the wire be? Hint: the resistivity of constantan is 49×10^{-8} Ωm. (c) How can this wire be arranged to measure the average strain of a 1×1 cm small area?

2. List two common factors that may cause failure in strain measurement using stain gauges.

3. A Wheatstone bridge is formed by 1 strain gauge (R_1) and three resistors (R_2, R_3, and R_4). The initial resistance of all of them are the same 120 Ohm. The gauge factor of the strain gauge is 1.5. The applied voltage (E_i) on the Wheatstone bridge is 10 V. Initially, the bridge is balanced. After the strain gauge deforms, the bridge output (E_0) is measured as 10 mV. What is the strain?