SE104 Homework 4

1. (a) Plot the following data as engineering stress in SI units (MPa, *not ksi or psi*) versus engineering strain for a circular steel rod, and determine (b) the stiffness and (c) the yield strength of the steel. The initial length of the circular bar is 2 in; the initial cross-sectional diameter is 0.1 in. (d) Assume the Poisson's ratio is 0.3. What is the cross-sectional diameter when the force is 300 lbs?

Load (lbs)	Elongation (in)	Load (lbs)	Elongation (in)
0	0	597	0.16
235	0.002	589	0.20
432	0.003	573	0.24
470	0.01	542	0.28
534	0.02	510	0.32
565	0.04	440	0.36
581	0.08	400	0.38 (Fracture)

2. For elongation measurement, we want to reach the resolution of 10^{-6}; that is, for a piece of material 1 cm long, we need to detect its length change as small as 10^{-6} cm, i.e. 10 nm. The smallest electrical resistance change that we can detect is 2×10^{-4} Ohm. (a) If we use a strain gauge with the gauge factor (GF) of 2, what should be the resistance of the strain gauge, *R*? (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) The strain gauge size cannot be larger than 1 cm. How should we place the constantan wire in the strain gauge?

3. A rod is subjected to an axial stress of 400 MPa. The Poison's ratio is 0.25 and the Young's modulus is 100 GPa. The yield strength determined by the 0.2% offset method is 500 MPa. What are (a) the true stress and (b) the true strain?