University of Massachusetts, Amherst
Department of Civil & Environmental Engineering
CEE 630: Advanced Solid Mechanics (Fall 2009)

Homework #3: Due October 2

Problem 1: A recent computer simulation I ran yielded the following engineering stress/strain data points for a simulated uniaxial tension test on a steel foam material I am working on: $\sigma = [0\,11\,15\,19\,23\,28]$, $\epsilon = [0\,1\,9\,49\,99\,199] \times 10^{-3}$. Calculate the true stress and strain, and plot the engineering and true values on the same set of axes. Comment on your results.

Problem 2: 2.24

Problem 3: 2.36 Part (a) only. **Hint:** To obtain the displacements you must integrate the strains according to the strain-displacement equations. The strains can be obtained easily from the provided stresses. Be careful when integrating the strains because the strains and displacements are functions of 2 variables. Therefore, when you do indefinite integratation, you don't get a constant of integration, but rather a function of another variable. For example, $\int x^2 y dx = yx^3/3 + f(y)$, where $f(y)$ is an unknown functions. After integrating the strains you will need to use other conditions on the strains to evaluate the unknown functions of integration.

Problem 4: Any stress tensor can be transformed to a coordinate system where its component matrix is diagonal, for example, in 2D,

$$\begin{bmatrix} \sigma_1 & 0 \\ 0 & \sigma_2 \end{bmatrix}$$

with the diagonal entries the principal stresses or eigenvalues. Answer the following questions about this state of stress:
a) If $\sigma_1 \neq \sigma_2$ what are the principal directions?
b) If $\sigma_1 = \sigma_2$, write out the stress transformation expression for finding $\sigma_{x'}$. Comment on your result.
c) Again, for $\sigma_1 = \sigma_2$ determine the principal directions. Comment on your result.

Problem 5: Approximately how many hours did you spend on this assignment?