Tentamen
SOLID MECHANICS (NASM)
January 25, 2011, 14:00–17:00 h

Question 1 For each of the following statements point out if it is correct or not, *and* why:

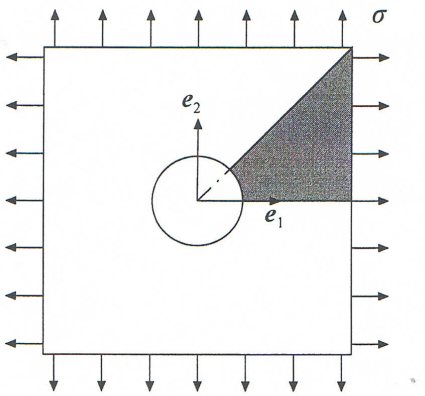
a. The elastic constants of a cubic crystal, C_{11}, C_{12} and C_{44} can be expressed uniquely in terms of Young's modulus E and Poisson ratio ν.

b. In three dimensions the stress tensor has three shear stress components and three principal values. Since there is only one shear component in two dimensions, there is only one principal stress in planar situations.

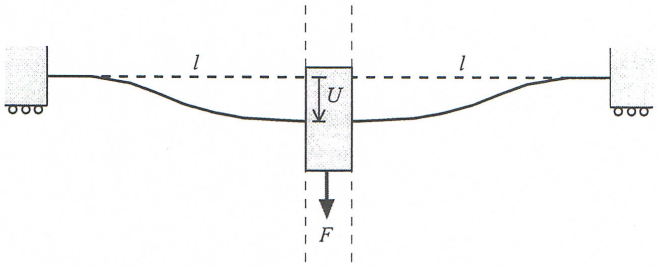
c. Plastic slip in an isotropic linear elastic material is independent of hydrostatic pressure only when the Poisson ratio $\nu = 1/2$.

Question 2 A homogeneous square plate with a circular, traction-free hole is subjected to equi-biaxial tension σ. Because of the symmetries in the problem, it suffices to only consider $1/8^{\text{th}}$ section as indicated by the gray area.

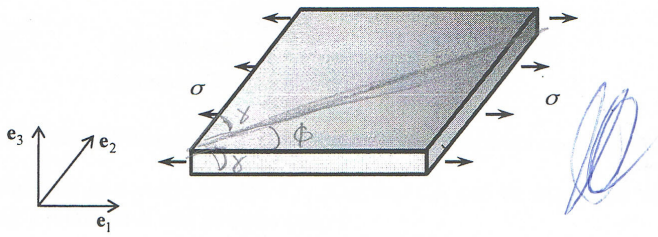
Formulate the boundary conditions for this section.



Question 3 A spring system consists of a central block which can slide up-and-down along a vertical guiding frame and two beams of length l. Both beams have a bending stiffness EI and



are clamped in blocks on their other ends (the latter are on rollers so as to provide unconstrained horizontal motion). All motions are without friction. What is the stiffness against a central force, i.e. F/U?



Question 4 Consider a homogeneous plate subject to tension in the $\boldsymbol{e}_1$ direction, see figure. The plate is made of a single crystal but its orientation is unknown.

a. First assume a uniaxial stress state (i.e. plane stress in both $\boldsymbol{e}_2$- and $\boldsymbol{e}_3$- direction). Determine the most likely slip plane and slip direction, i.e. where the resolved shear stress is maximum.

b. Repeat the analysis in case the plate is very wide in the $\boldsymbol{e}_2$-direction so that it is in a state of plane strain tension (with $\varepsilon_{22} = 0$).