Problem Set #5  
1.050 Solid Mechanics  
Fall 2002

Problem 5.1  
Given the components of stress relative to an x-y frame at a point in plane stress are:

\[ \sigma_x = 4, \quad \sigma_{xy} = 2, \quad \sigma_y = +2 \]

What are the components with respect to an axis system rotated 30 deg. counter clockwise at the point?  
Determine the orientation of axis which yields maximum and minimum normal stress components. What are their values?  
Do the above using the transformation relations alone.

Problem 5.2  
Construct Mohr’s circle for the state of plane stress of problem 5.1.

Problem 5.3  
A thin walled glass tube of radius \( R = 1 \) inch, and wall thickness \( t = 0.010 \) inches, is closed at both ends and contains a fluid under pressure, \( p = 100 \) psi. A torque, \( M_t \), of 300 inch-lbs, is applied about the axis of the tube.  
Compute the stress components relative to a coordinate frame with its x axis in the direction of the tube’s axis, its y axis circumferentially directed and tangent to the surface.  
Determine the maximum tensile stress and the orientation of the plane upon which it acts.

Problem 5.4  
Show that for the thin circular hoop subject to an axi-symmetric, radial extension \( u_r \), that the circumferential extensional strain, can be expressed as

\[ \varepsilon_{\theta} = \frac{(L - L_0)}{L_0} = \frac{u_r}{r_0} \]

where \( L_0 \) is the original, undeformed circumference.