MANE 6962 Experimental Mechanics
Homework 2
Due October 31

1. For a three-element delta rosette with $\theta_A = 0^\circ$, $\theta_B = 120^\circ$, $\theta_C = 240^\circ$, determine the equation for the principal strains ε_1 and ε_2 in terms of ε_A, ε_B, and ε_C measured with the rosette. Note: recall from our discussions of stress and strain transformations that

$$\varepsilon_A = \varepsilon_{xx}\cos^2\theta_A + \varepsilon_{yy}\sin^2\theta_A + \gamma_{xy}\sin\theta_A\cos\theta_A$$
$$\varepsilon_B = \varepsilon_{xx}\cos^2\theta_B + \varepsilon_{yy}\sin^2\theta_B + \gamma_{xy}\sin\theta_B\cos\theta_B$$
$$\varepsilon_C = \varepsilon_{xx}\cos^2\theta_C + \varepsilon_{yy}\sin^2\theta_C + \gamma_{xy}\sin\theta_C\cos\theta_C$$

   and that the principal strains may be determined, *e.g.*, from Mohr's Circle.

2. For a three-element delta rosette, determine the equation for the principal angle ϕ in terms of ε_A, ε_B, and ε_C. Recall,

$$\tan 2\phi = \frac{\gamma_{xy}}{\varepsilon_{xx} - \varepsilon_{yy}}$$

3. The following observations were made with a three-element delta rosette mounted on a steel (E = 207 GPa and ν = 0.30) specimen. Determine the principal strains ε_1 and ε_2, the principal stresses σ_1 and σ_2, and the principal angles ϕ_1 and ϕ_2.

Case No.	ε_A, με	ε_B, με	ε_C, με
1	1600	-800	800
2	3200	1600	0
3	-2400	1200	1600
4	2800	0	-2800
5	-1200	400	1600

4. The use of a circular polariscope (i.e., inserting quarter-wave plates before and after the model) for analyzing a stressed model eliminates the isoclinic fringe patterns, maintaining only the isochromatic fringe patterns. Use steps similar to those that we used to analyze the wave equation as it passes through the plane polariscope to determine the intensity of light being captured as it exits the analyzer in the circular polariscope shown here. Recall the quarter-wave plate in a polariscope is chosen such that $\Delta = \pi/2$ and $\beta = \pi/4$.