1. Kaw 2nd ed. Prob. 4.6

   4.6 The global strains at the top surface of a $[0/45/60]_s$ laminate are given as

   $$\begin{bmatrix} \epsilon_x \\ \epsilon_y \\ \gamma_{xy} \end{bmatrix} = \begin{bmatrix} 1.686 \times 10^{-8} \\ -6.500 \times 10^{-8} \\ -2.143 \times 10^{-7} \end{bmatrix}$$

   and the midplane strains in this laminate are given as

   $$\begin{bmatrix} \varepsilon_x^0 \\ \varepsilon_y^0 \\ \gamma_{xy}^0 \end{bmatrix} = \begin{bmatrix} 8.388 \times 10^{-6} \\ 4.762 \times 10^{-4} \\ -3.129 \times 10^{-3} \end{bmatrix}.$$

   What are the midplane curvatures in this laminate, if each ply is 0.005 in. thick?

2. Kaw 2nd ed. Prob. 4.7

   4.7 The global stresses in a three-ply laminate are given at the top and bottom surface of each ply. Each ply is 0.005 in. thick. Find the resultant forces and moments on the laminate if it has a top cross-section of 4 in. × 4 in.

Ply no.	σ_{xx} (psi) Top	σ_{xx} (psi) Bottom
1	-3.547×10^4	-2.983×10^3
2	-9.267×10^3	1.658×10^4
3	7.201×10^3	2.435×10^4

Ply no.	σ_{yy} (psi) Top	σ_{yy} (psi) Bottom
1	-2.425×10^4	-7.087×10^3
2	-1.638×10^4	9.432×10^3
3	3.155×10^3	3.553×10^4

Ply no.	τ_{xy} (psi) Top	τ_{xy} (psi) Bottom
1	-2.946×10^4	-5.564×10^3
2	-1.299×10^4	1.317×10^4
3	5.703×10^3	2.954×10^4

3. Kaw 2nd ed. Prob. 4.8

4.8 Find the three stiffness matrices $[A]$, $[B]$, and $[D]$ for a $[0/60/-60]$ glass/epoxy laminate. Use the properties of glass/epoxy unidirectional lamina from Table 2.2 and assume the lamina thickness to be 0.005 in. Also, find the mass of the laminate if the top surface area of the laminate is 5 in. $\times$ 7 in. Use densities of glass and epoxy from Table 3.3 and Table 3.4, respectively.

4. Kaw 2nd ed. Prob. 4.13

4.13 Find the local stresses at the top of the $60°$ ply in a $[0/60/-60]$ graphite/epoxy laminate subjected to a bending moment of $M_x = 50$ N-m/m. Use the properties of a unidirectional graphite/epoxy lamina from Table 2.1 and assume the lamina thickness to be 0.125 mm. What is the percentage of the bending moment load taken by each of the three plies?

5. Kaw 2nd ed. Prob. 4.14

4.14 Find the forces and moments required in a $[0/60/-60]$ graphite/epoxy laminate to result in bending curvature of $\kappa_x = 0.1$ in.$^{-1}$ and $\kappa_y = 0.1$ in.$^{-1}$. Use the properties of a unidirectional graphite/epoxy lamina from Table 2.2 and assume the lamina thickness to be 0.005 in.

Project: (5% of overall grade): Solve the problems 1,2,4,5 using ABAQUS Finite Element Software and compare your hand calculations with the results obtained from ABAQUS.

Due date is **Tuesday 20ᵗʰ of March, 2018**. For each delayed day **15 points** will be reduced.