Second assignment of MP-206
Resolution of this assignment is voluntary

1) A glass/epoxy lamina consists of a 70% fiber volume fraction. Use properties of glass and epoxy to determine: (i) the density of the lamina, (ii) mass fractions of the glass and epoxy, (iii) volume of composite lamina if the mass of the lamina is 4 kg, (iv) volume and mass of glass and epoxy in (iii). Use $\rho_f = 2500 \text{ kg/m}^3$ and $\rho_m = 1200 \text{ kg/m}^3$.

2) The weight fraction of glass in a glass/epoxy composite is 0.8. If the density of the glass is $\rho_f = 2500 \text{ kg/m}^3$ and the density of the epoxy is $\rho_m = 1200 \text{ kg/m}^3$. find: (i) fiber and matrix volume fractions and (ii) density of the composite.

3) A hybrid lamina uses glass and graphite fiber in a matrix of epoxy. The fiber volume fractions of glass and graphite are 40% and 20%, respectively. The densities of the glass, graphite and epoxy are respectively 2600 kg/m$^3$, 1800 kg/m$^3$ and 1200 kg/m$^3$. Find the mass fractions and the density of the composite.

4) A resin hybrid lamina is made by reinforcing graphite fibers in two matrices: resin A and resin B. The fiber weight fraction is 40%. For resin A and B the weight fraction is 30% each. If the density of resin A is 2600 kg/m$^3$, the density of resin B is 1700 kg/m$^3$ and the density of the graphite fiber is 1200 kg/m$^3$, find the fiber volume fraction and the density of the composite.

5) Show that $G_{12} = G_m/(1 - V_f)$ if the fibers are much stiffer than the matrix, i.e., $G_f >> G_m$.

6) Determine the transverse modulus $E_2$ of a carbon/epoxy composite with the following properties: $E_f = 14.8 \text{ GPa}$, $E_m = 3.45 \text{ GPa}$ and $V_f = 0.65$.

7) Determine the transverse modulus $E_2$ of a silicon carbide/aluminum (SiC/Al) composite with the properties: $E_f = 366 \text{ GPa}$, $E_m = 69 \text{ GPa}$ and $V_f = 0.40$.

8) Determine the in-plane shear modulus G12 of a glass/epoxy composite with the properties $G_f = 28.3 \text{ GPa}$, $G_m = 1270 \text{ MPa}$ and $V_f = 0.55$.

9) Compute $E_1$, $E_2$, $G_{12}$, and $\nu_{12}$ given $E_f = 230 \text{ GPa}$, $E_m = E_f/50$, $G_f = E_f/2.5$, $G_m = E_m/2.6$, $\nu_f = 0.25$, $\nu_m = 0.3$, and $V_f = 40\%$. Assume there are no voids.

10) Find the coefficients of thermal expansion for a unidirectional glass/epoxy lamina with a 60% fiber volume fraction. Use $E_f = 85 \text{ GPa}$, $E_m = 3.4 \text{ GPa}$, $\nu_f = 0.2$, $\nu_m = 0.3$, $\alpha_f = 5.0 \times 10^{-6} \text{ C}^{-1}$ and $\alpha_m = 63.0 \times 10^{-6} \text{ C}^{-1}$.

11) If one plots the transverse coefficient of thermal expansion $\alpha_2$ as a function of fiber volume fraction $V_f$ for a glass/epoxy lamina, $\alpha_2 > \alpha_m$ for a certain fiber volume fraction. Use the properties of problem (10) to find this range where $\alpha_2 > \alpha_m$. 