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 ρ_f = 2500 kg/m^3 and ρ_m = 1200 kg/m^3.

2) The weight fraction of glass in a glass/epoxy composite is 0.8. If the density of the glass is ρ_f = 2500 kg/m^3 and the density of the epoxy is ρ_m = 1200 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 GPa, E_m = 3.45 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 GPa, E_m = 69 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 GPa, G_m = 1270 MPa and V_f = 0.55.

9) Compute E_1, E_2, G_{12}, and ν_{12} given E_f = 230 GPa, $E_m = E_f/50$, $G_f = E_f/2.5$, $G_m = E_m/2.6$, ν_f = 0.25, ν_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 GPa, E_m = 3.4 GPa, ν_f = 0.2, ν_m = 0.3, $\alpha_f = 5.0\times10^{-6}\ ^{o}C^{-1}$ and $\alpha_m = 63.0\times10^{-6}\ ^{o}C^{-1}$.

11) If one plots the transverse coefficient of thermal expansion α_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 $\alpha_2 > \alpha_m$.