M.TECH.MAT. ENGG. & M. MET.ENGG.(I.M). IST. SEM. EXAM.-2017

Subject: Composite Materials

Time : Three Hours   Full Marks: 100

Answer any five questions

1.   6+8+6
   (a)   Define the term composite materials. Justify the definition of composite.
   (b)   Write the various functions of the constituent members of a composite.
   (c).   What properties should be considered to select a material as a composite
          with example?.

2.   6+8+8
   (a).   E-glass fibers in nylon provide reinforcement. If the nylon contains 40
          vol% E glass, what fraction of the applied stress is carried by glass fibers?

          $E_{glass} = 72.4$ Gpa $E_{nylon} = 2.8$ Gpa

   (b).   Derive the equation for $V_{fcritical}$ & V_{fmin}
   (c).   How does the volume fraction affected the strength properties of
          continuous fibre- reinforced composite?.

3.   5x4

   (a).   What is the basic principle used in fiber reinforced composites?
   (b).   Show that the tensile modulus of the fibre reinforced composite depends
          on the modulus of the reinforcement and its volume fraction.
   (c).   Derive the equation for the modulus of elasticity of a fibre-reinforced
          composite under isostrain condition.
   (d).   Would you expect a particle strengthened material to be stronger than a
          fiber strengthened material?

4.

(a)) A continuous and aligned fiber-reinforced composite having a cross-sectional area of 970 mm^2 is subjected to an external tensile load. If the stresses sustained by the fiber and matrix phases are 215Mpa and 5.38 Mpa respectively, the force sustained by the fiber phase is 76800 N and the total longitudinal composite strain is 1.56×10^{-3}, then determine

(i).. the force sustained by the matrix phase
(ii). the modulus of elasticity of the composite material in the longitudinal direction.
(iii). the modulus of elasticity for fiber and matrix phases.

(b). For a continuous and oriented fiber reinforced composite, the modulus of elasticity in the longitudinal and transverse directions are 19.7 and 3,66 Gpa, respectively. If the volume fraction of fibers is 0.25, determine the moduli of elasticity of fiber and matrix phases.

(c). Verify that the expression for the fiber load – matrix load ratio
$F_f / F_m = E_f V_f / E_m V_m$ is valid.
What is the F_f / F_c, ratio in terms of E_f, E_m, and V_f?

5.

(a). Derive the expression for $G_{cd} = f s G_{ic}$
(b). The density of Al_2O_3 is about 3.85 Mgm^{-3}. A SAP aluminium alloy is produced by powder metallurgy processing using powder particles having a diameter of 0.01 mm with an oxide coating of 0.0001 mm. A dispersion of spherical oxide particles 0.005 mm in diameter is produced. Calculate (a). the vol% . Al_2O_3 present in the SAP (b). the density of the SAP alloy, and (c). the number of oxide particles per 1000g of alloy.

6.

(a). What is Powder Metallurgy? Write the important characteristics of metal powders.
(b). Explain the solid state sintering mechanism in powder Metallurgy.

7. Short notes: 10x2
(a). Compo-casting
(b). Dispersion strengthened composites