M.E. METALLURGICAL & MATERIAL ENGINEERING 1ST YEAR 1ST SEMESTER EXAM-2018

Subject: Composite Materials

Time : Three Hours | Full Marks: 100

Answer any five questions

1. 8+6+6

i). Define the term 'composite material'. What guidelines are to be considered to optimize the properties of the dispersion-strengthened composite?

ii). What do you mean by V_{fmin} & $V_{fcrit.}$ in fibre reinforced composite?

iii). What are the various functions that a matrix phase perform in a composite material ?

2. 8+12

i). Draw the stress-strain curve for an aligned fiber-reinforced composite and explain.

ii). A continuous and aligned fiber – reinforced composite consisting of 30 vol% glass fiber and 70 vol% of a polycarbonate matrix , The stress on the polycarbonate matrix when the glass fibers fail is 45 Mpa. Assume that the composite has a cross-sectional area of 360 mm^2 and is subjected to a longitudinal load of 32, 500 N.

Given, $E_g = 69$ Gpa, $E_p = 2.4$ Gpa $\sigma_g = 3000$ Mpa, $\sigma_p = 55$ Mpa

(a). Compute the longitudinal tensile strength.
(b). the longitudinal modulus of elasticity
©. Calculate the fiber-matrix load ratio.
(d). Calculate the actual loads carried by both fiber and matrix phases.
(e). Compute the magnitude of the stress on each of the fiber and matrix phases.
(f). What strain is experienced by the composite?.

3. Distinguish between 5x4

(a). Apparent density and Bulk density.
(b). Pre-sintering & sintering
(c). Laminated composite & Sandwich composite
(d). Matrix and reinforcing phase
(e). Fibre strengthened composite & Dispersion strengthened composite.

4. 10+10

i). What is meant by the terms 'Isostrain' and 'Isostress'? How do they differ from each other.?

ii). An aluminium alloy containing 9% copper and 25% Al_2O_3. We find that compocasting is best accomplished when the alloy is die cast at a temperature that gives 60% liquid and 40% solid. From the phase diagram for aluminium-copper , Estimate the appropriate casting temperature.

5. 8+12

i). Write the effect of orientation of the fibre in strengthening of the fibre reinforced composite.

ii). Calculate the overall fracture energy for an aligned short fiber composite

6. i). Describe the various production methods of powders 12+8

ii). 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.

7. Short notes: 10x2

i). Compo casting

ii). Carbon fibre making