

EX/PG/MET/PE/T/115A/2025

M.E. METALLURGICAL ENGINEERING 1ST YEAR 1ST SEMESTER EXAM-2025

Subject: Composite Materials

Time : Three Hours

Full Marks: 100

Answer any five questions

Q1.

8+6+6

- i). Define the term 'composite materials and justify your definition with a suitable example.
- ii). Write the various general requirements of a material to be a composite.
- iii). How does the volume fraction affect the strength properties of composite reinforced with continuous fibres?

Q2.

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 40 vol% glass fiber and 60 vol% of a polycarbonate matrix , The stress on the polycarbonate matrix when the glass fibers fail is 50 Mpa. Assume that the composite has a cross-sectional area of 320 mm² and is subjected to a longitudinal load of 36, 500 N.

Given, $E_g = 72 \text{ Gpa}$, $E_p = 3.6 \text{ Gpa}$ $\sigma_g = 3000 \text{ Mpa}$, $\sigma_p = 60 \text{ Mpa}$

- (a). Compute the longitudinal tensile strength.
- (b). the longitudinal modulus of elasticity
- (c). 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?

Q3

- i). Write the effect of orientation of the fibre in strengthening of the fibre reinforced composite. **8+12**
- ii). Calculate the overall fracture energy for an aligned short fiber composite

[Turn over

- Q4. Distinguish between 5x4
- (i). Matrix and reinforcing phase
 - (ii). Laminated composite & Sandwich composite
 - (iii). Pre-sintering & sintering
 - (iv). Fibre strengthened composite & Dispersion strengthened composite.
- Q5. 5+5+10
- i). What guidelines are to be considered to optimize the properties of the dispersion-strengthened composite?
 - ii). Why is it not desirable to have very large volume fraction of fibres in composites?
 - ii). 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.
- Q6. i). Describe the various production methods of powders 10+5+5
- ii). A silver –tungsten composite for an electrical contact is produced by first making a porous tungsten powder metallurgy compact, then filtrating pure silver into the pores, The density of the tungsten compact before infiltration is 14.5g/cc. Calculate the the volume fraction of porosity and the final weight percent of silver in the compact after filtration.
- The densities of pure silver and pure tungsten are 10.49 g/cc and 19.3 g/cc respectively
- iii). A tensile load of 100 N is applied to an aluminium – boron composite of $1mm^2$ cross-sectional area. The volume of the parallel fibre is 40%. Whar is the stress in the fibre when the load axis
- (a). parallel to the fibres
 - (b). perpendicular to the fibres
- Q7. Short notes: 10x2
- i). Liquid State Sintering
 - ii). Carbon fibre making