

**M.E. Metallurgical and Material Engineering 1<sup>st</sup> Year 1<sup>st</sup> Semester Exam-2024**

**Subject: Composite Materials**

**Time : Three Hours**

**Full Marks: 100**

**Answer any five questions.**

10+6+4

- Q.1 (a). What are the various characteristics and properties of conventional Engineering materials?
- (b). Define composite materials with justification
- ©. What are the general requirements of all composite materials ?

Q.2.

10+10

- (a). How does the volume fraction affect the strength properties of composites reinforced with continuous fibres?
- (b). 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 40 Mpa. Assume that the composite has a cross-sectional area of 320 mm<sup>2</sup> and is subjected to a longitudinal load of 30, 000 N.

Given,  $E_g = 69 \text{ Gpa}$ ,  $E_p = 2.4 \text{ Gpa}$   $\sigma_g = 3000 \text{ Mpa}$ ,  $\sigma_p = 50 \text{ Mpa}$

- (a). Compute the longitudinal tensile strength.
- (b). Calculate 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?.

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- Q.3. Distinguish between 5x4
- (a). Dispersion Strengthened composite & Particle strengthened composite
  - (b). Laminated composite and sandwich composite
  - (c). Continuous & Discontinuous fibre reinforced composite
  - (d). Hand lay-up technique and Bag molding process
- Q.4. 5+5+10
- (a). What are the various functions of a matrix phase in a composite material ?
  - (b). Derive the shear modulus of elasticity for an aligned fibre reinforced composite.
  - ©. Calculate the overall fracture energy for an aligned continuous fiber reinforced composite.
- Q.5. 10+5+5
- (a). Derive the equation for the modulus of elasticity of a fibre reinforced composite when a stress is applied perpendicular to the axis of the fibre.
  - (b). Hard inert particles of diameter 2 microns are dispersed in a copper matrix. The average centre to centre distance between the particles, measured in the slip planes, is 20 microns. Estimate the contribution of these particles to the tensile yield strength of the alloy. Given, Shear modulus of copper =  $41 \text{ GN m}^{-2}$  and Burger's vector = 0.64 nm.
  - ©. Show that fibres carry larger proportion of the applied stress
- Q.6. 10+5+5
- (a). Describe the various characteristics of metal powder.
  - (b). What are the different production methods of metal powder?
  - (c). Write the various disadvantages of Powder Metallurgy
- Q.7. Short notes: (any two) 10x2
- (a). Infiltration technique (b). Solid State Sintering (c). Compcasting