Ref. No. Ex/Met/PC/H/T/415/2024

B.E. METALLURGICAL & MATERIAL ENGINEERING FOURTH YEAR 1ST SEMESTER EXAM -2024

Subject: Composite Materials

Time : Three Hours **Full Marks: 100**

Answer any five questions

Q1. 10+10

CO-1 i). Write the various advantages and limitations of conventional engineering materials.

CO-1 ii). What is composite material ? Write the various characteristics of composite materials with their limitations.

Q2. 12+8

CO-2 i). Draw the flow chart showing classification of composites with schematic illustration.

CO-6 ii). Write the estimated market demands of composite materials and their applications

Q3. 8+12

CO-3 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?

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Q4. 10+10

CO-2 i). Describe the strengthening mechanism of dispersion strengthened and particle strengthened composites

CO-3 ii). How does the volume fraction affect the strength properties of composites reinforced with continuous fibres?

Q5. 5+5+10

CO-2 i). Hard inert particles of diameter 2 micrometres are dispersed in a copper matrix. The average center to center distance between the particles measured in the slip planes , is 20 micrometres . Estimate the contribution of these particles to the tensile yield strength of the alloy. Shear modulus of copper = 41GN $m^{-2}$and Burger's vector = 0.64 nm.

CO-3 ii). Draw the different orientations of the fibre in the fibre reinforced composites.

CO-4 iii). Describe the interfacial debonding and pull out mechanism of continuous fibre reinforced composite mechanism

Q6. 10+10

CO-2 i). Aluminium alloy containing 10% copper and 15% 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 approximate casting temperature.

CO-5 ii). Calculate the overall fracture energy for an aligned short fiber reinforced composite with the schematic diagram.

Q7. Short notes: 10x2

CO-6

i) Infiltration Technique

ii). Fibre making processes