

EX/PG/MetIM-MatE/T/112A/2025

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

Subject: Composite Materials

Time : Three Hours

Full Marks: 100

Answer Q. no. 1 and any four questions from the rest.

Q. 1

1. Rule-of-mixture provides _____ bounds for mechanical properties of particulate composites.
(a) Lower (b) Upper (c) Both (d) None
2. Al-alloys for engine/automobile parts are reinforced to increase their
(a) Strength (b) Wear resistance (c) Elastic modulus (d) Density
3. Mechanical properties of fiber-reinforced composites depend on
(a) Properties of constituents (b) Interface strength (c) Fiber length, orientation, and volume fraction
(d) All the above
4. Longitudinal strength of fiber reinforced composite is mainly influenced by
(a) Fiber strength (b) Fiber orientation (c) Fiber volume fraction (d) Fiber length
5. The following material can be used for filling in sandwich structures
(a) Polymers (b) Cement (c) Wood (d) All
6. Not an example for laminar composite
(a) Wood (b) Bimetallic (c) Coatings/Paints (d) Claddings
7. Which of the following does not combine with fiber to give composites?
a) Metals b) Ceramics c) Non-metals d) Polymers
8. Which of the following is not a property of matrix materials which are modified by adding particulate fillers?
a) Improved performance at elevated temperature b) Decrease in surface hardness
c) Modification in electrical conductivity d) Improved abrasion resistance
9. What is the aspect ratio?
a) Length to diameter ratio b) Length to depth ratio c) Depth to length ratio d) Diameter to length ratio
10. Which of the following type of composite is not classified under the category of number of layers?
a) Unidirectional fibre reinforced b) Laminar c) Sandwich panels d) Glass-fibre reinforced
11. The matrix phase controls the environmental resistance of the composites.
a) True b) False

[Turn over

12. Select the incorrect statement from the following option.

- a) Laminar composites consist of 2-D sheets that are stacked and subsequently cemented together
- b) Sandwich panels consist of two stronger outer sheets separated by a layer of less dense core material
- c) Core material should be heavy-weight and low corrosion resistance
- d) The stiffness of the sandwich panel increases as the core thickness increases

13. A composite is a material system made of ____ or more material components:

- a. 3 b. 8 c. 9 d. 2 e. 7

14. A glass fiber composite is made up of glass fibers and:

- a. Insulation b. Kevlar c. Plastic Resin d. Super glue e. Oxygen

15. In composites, the higher the amount of _____ content the greater the strength:

- a. Reinforcement b. Glass c. Hydrogen d. Kevlar e. Plastic

16. When glass fibers are combined with other fibers, this is called a:

- a. Combination b. Hybrid c. Alloy d. Binder e. Spiral resin

17. Polymers fall into two groups, one of them is:

- a. Hydro plastics b. Poly plastics c. Thermoplastics d. Poly plastics e. Poly resin

18. Which of these is not an example of a thermoset resin?

- a. Kevlar b. Unsaturated polyester c. Urethane d. Epoxy e. Glue

19. Fillers and additives to composites add:

- a. Performance parameters b. Weight c. Volume d. Stress

20. What does thixotropic mean:

- a. Freezing b. Becoming a gel at rest c. Becoming a gel in motion d. Melting

Q.2. 10+5+5

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

(b). Glass fibers in nylon provide reinforcement. If the nylon contains 30 vol% E glass, what fraction of the applied stress is carried by glass fibers?

$$E_{\text{glass}} = 72.4 \text{ Gpa} \quad E_{\text{nylon}} = 2.8 \text{ Gpa}$$

(c). A tensile load of 120 N is applied to an aluminum – boron composite of 1 mm² cross-sectional area. The volume of the parallel fibre is 40% . What is the stress in the fibres, when the load axis is

parallel to the fibres, & ii. perpendicular to the fibres

$$E_f = 440 \text{ GNm}^{-2} \quad E_m = 71 \text{ GNm}^{-2}$$

Q.3. Distinguish between 5x4

- (a). Fibre-reinforced composite & Particulate composite
- (b). Whisker & Fibre
- (c). Continuous & Discontinuous fibres
- (d). Triaxial weave & Three- dimensional weave patterns for fibres.

Q.4. 5+5+10

- (a). Describe some of the key mechanical and physical properties we would consider in selecting a material for an air plane wing with example
- (b). Describe the Carbon fibre making process
- ©. Calculate the overall fracture energy for an aligned short fiber composite.

Q.5. 8+8+4

- (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). Derive V_{frit} & V_{fin} in the continuous fibre reinforced composite.
- ©. Show that fibres support larger proportion of the applied stress

Q.6. 10+10

- (a). Describe the various Characteristics of powder.
- (b). Limitations of Powder Metallurgy

Q.7. Short notes: 10x2

- a). Matrix
- b). Reinforcing phase