Registration No. :

Total number of printed pages – 3

Sixth Semester Back Examination – 2015

COMPOSITE MATERIALS

BRANCH (S) : MM, MME

QUESTION CODE : M 382

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any five from the rest.
The figures in the right-hand margin indicate marks.

1. Answer the following questions :   2 ×10

    (a) What is a filled composite ? Give some examples of the fillers commonly used in composites.

    (b) What are whiskers ? What are the main characteristics and limitations of whiskers ?

    (c) What are aramid fibres and where are these used ?

    (d) Differentiate between cermets and SAP type materials.

    (e) What are hybrid composites ? Give some examples of hybrid composites.

    (f) What are cermets ? Name the commercially important groups of cermets.

    (g) Why is yttria added to zirconia in zirconia toughened alumina ?

    (h) Alumina whiskers (density = 3.8 g/cm^3) are incorporated in a resin matrix (density = 1.3 g/cm^3). What is the density of the composite ? Take volume fraction of fibres, V_f = 0.35.

    (i) Compare the desired mechanical characteristics of matrix and fibre phases in a fibre reinforced composite.

    (j) Among the two toughening mechanisms of debonding and fibre pull-out which is more significant and why ?

2   A continuous and aligned fibrous reinforced composite having a cross-sectional area of 970 mm^2 is subjected to an external tensile load. If the stresses sustained by the fiber and the matrix phases are 215 MPa and 5.38 MPa respectively, the force sustained by the fiber phase is 76,800N, and the total longitudinal composite strain is 1.56 x 10^{-3}, then determine   10

    (a)   The force sustained by the matrix phase

    (b)   The modulus of elasticity of the composite material in the longitudinal direction

    (c)   The moduli of elasticity for fiber and matrix phases

3. Explain the different types of interfacial bonding mechanisms and their main features.   10

4. (a)   What are the different liquid state processes for the production of MMCs and explain the liquid melt infiltration under gas pressure technique with suitable diagrams.   5

    (b)   Give a comparison of the physical and mechanical properties of MMCs with that of monolithic metals and the variation of these properties with types of reinforcement, proportion of reinforcement and orientation of fibres in MMCs.   5

5. (a)   Alumina whiskers having density 3.8 g cm^{-3} are incorporated in a resin matrix of density 1.3 g cm^{-3}. What is the density of the composite ? Take volume fraction of fibres, V_f = 0.35. What is the relative mass of the whiskers ?   5

    (b)   A continuous and aligned fiber-reinforced composite is to be produced consisting of 45 vol% aramid fibers and 55 vol% of a polycarbonate matrix; mechanical characteristics of these two materials are as follows :   5

	Modulus of Elasticity (MPa)	Tensile Strenght (MPa)
Aramid fiber	1.3×10^5	3500
Polycarbonate	2.4×10^3	55

For this composite, calculate : (i)the longitudinal tensile strength, and (ii) the longitudinal modulus of elasticity.

6. (a) Briefly describe laminar composites. Give the characteristic features and applications of these composites. 5

    (b) What is SAP material ? Describe the properties and applications of SAP material with examples of some SAP type materials. 5

7. (a) Describe the pultrusion fabrication process and give the advantages and disadvantages of the process. 5

    (b) Describe the characteristic features of aramid fibres. What are the characteristic properties that have made Kevlar 49 / resin composites a suitable material in automotives ? What are the applications of these composites in automotives ? 5

8. Write short notes any **two** of the following : 5×2

    (a) TD-Nickel

    (b) Carbon-carbon composite

    (c) Multifilamentary superconductors

    (d) Chemical Vapor Infiltration (CVI).

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