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B – 2880

Reg. No. : .....

Name : .....

Second Semester M.Tech. Degree Examination, December 2016

(2013 Scheme)

Branch : Mechanical Engineering

MDE 2006 : MECHANICS OF COMPOSITE MATERIALS

Time : 3 Hours

Max. Marks : 60

***Instruction** : Answer **any two** questions from **each** Module. **Any** data **not** given may be suitably assumed.*

MODULE – I

1. a) Write down classification of composites. Discuss the properties and applications of composites in modern engineering. **5**

   b) Write notes on different types of reinforcements and matrices used for making composites. Justify its effects on the properties of the composites. **5**

2. a) What are the different methods of manufacture of polymer matrix composites ? Explain any one with a neat sketch. **5**

   b) What is micromechanics ? Explain the micromechanical behaviour of a lamina based on volume fraction. **5**

3. a) Calculate the longitudinal modulus and tensile strength of a unidirectional composite containing 60 percent by volume of carbon fibers (E_{1f} = 294 GPa and σ_{1fu} = 5.6 GPa) in a toughened epoxy matrix (E_m = 3.6 GPa and σ_{mu} = 105 MPa.). Compare these values with the experimentally determined values (E_1 = 162 GPa and σ_{1u} = 2.94 GPa) and comment on the variations. Also calculate the fraction of the load is carried by fibers in the composite. **5**

   b) Briefly discuss the thermal expansion and moisture expansion coefficients of lamina based on volume fractions and mechanical properties of the constituents. **5**

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MODULE – II

4. a) Formulate the stress strain relationship of a thin orthotropic lamina under plane stress state. **5**

   b) Derive the reduced transformed stiffness matrix of a thin orthotropic unidirectional lamina subjected to off-axis loading. **5**

5. a) Find the following for a 60° angle lamina of graphite/epoxy. Properties of unidirectional graphite/epoxy lamina $E_1 = 181$ GPa, $E_2 = 10.3$ GPa, $E_6 = 7.17$ GPa, $\nu_{12} = 0.28$. If the applied stress is $\sigma_x = 2$ MPa, $\sigma_y = -3$ MPa and $\tau_{xy} = 4$ MPa, find

   1) Global strains
   2) Local strains
   3) Local stresses **5**

   b) Derive the total stiffness matrix (ABD) of laminate in terms of the elastic constants of its constituents. **5**

6. a) Determine the effective laminate properties E_x, E_y, G_{xy} and ν_{xy} for a laminate $[\pm 45]_s$. The thickness of each ply is 0.25 mm and material properties are $E_1 = 145$ GPa, $E_2 = 10.5$ GPa, $E_6 = 7.5$ GPa, $\nu_{12} = 0.28$. **5**

   b) Explain different modes of failure of composites. Explain how the design of laminate is performed by First Ply Failure, Total Ply failure and partial ply failure methods. **5**

MODULE – III

7. a) How to calculate the load carrying capacity of a layered composite cantilever beam ? Explain. **5**

   b) Briefly explain the environmental effect on composite structure. **5**

8. a) Write notes on fracture and impact resistance of composite structures. **5**

   b) What is inter-laminar stresses ? Explain. **5**

9. a) Explain the difficulties in machining of composite materials. **5**

   b) Write notes on inspection and testing of composite structures. **5**