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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Second Semester, M. Tech - Civil Engineering (MCAD)

Semester End Examination; May/June - 2019

Composite and Smart Materials

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Explain how composite materials are beneficial to structural engineers in the context of light weight structures? 8

b. Calculate the fraction of load carried by the fibers of glass-epoxy composites with 30% fibers by volume. Elastic moduli of glass fibers and epoxy resin are 70 and 3.5 GPa respectively. Comment on the obtained solution. 12

2. Calculate the engineering constants for the given data,

Fiber volume fraction = 0.5; 'E' of fiber $\rightarrow E_f$ = 230 GPa; E of matrix $\rightarrow E_m$ = 3.5 GPa

Poison ratio of fiber $\rightarrow \nu_f = 0.2$; Poison ratio of matrix $\rightarrow \nu_m = 0.3$

Determine; E_c, E_{11}, E_{22}, ν_{12}, ν_{21}, G_f, G_M, G_{12}. 20

UNIT - II

3. A shear stress $\tau_{xy} = -15$ MPa is applied on a unidirectional angle-ply lamina. The fibers are at 45° to the *x*-axis. Calculate the stress in the principal material directions. 20

4. Calculate the elastic constants for the composite that consists of randomly distributed shot glass 60% by weight. The diameter and the length of the fiber used are 2.5 mm and 25 mm respectively. The epoxy resin is used as matrix. Data; E_f = 70 GPa, E_m = 3.5 GPa, $\rho_f = 2.5$ g/cm^3, $\rho_m = 1.2$ g/cm^3, $l_f = 25$ mm, $d_f = 2.5$ mm, $W_f = 0.60$. 20

UNIT - III

5. Write a short notes on :

i) Piezoelectric materials ii) Classification of smart structures

iii) Shape memory Alloy iv) Applications of shape memory alloys in high rise structure 20

6 a. Justify how smart materials are economical compared to conventional structures? 10

b. Explain the role of piezo electric materials in the construction of smart buildings. 10

UNIT - IV

7 a. Explain the usage of sensor, while constructing smart structures. 10

b. Explain the working mechanisms of Actuators. 10

8. Explain the concept of Bernoulli's Euler beam model in the context of smart structures. 20

UNIT - V

9. Explain how concept of control system can be effectively utilized in the design and construction of smart structures? 20

10. Explain with a block diagram / flow chart about the concept / mechanism in the open loop and closed loop control system for deflection control of beams. 20

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