

**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; October -2022****Composite and Smart Materials**

Time: 3 hrs

Max. Marks: 100

**Course Outcomes***The Students will be able to:**CO1: Carry out classification and application of various types of fibres.**CO2: Explain thermo-mechanical properties of materials.**CO3: Analyse environmental effects and failure theories of composite materials.**CO4: Familiarise with smart materials and structures.***Note: I) Answer any FIVE full questions, selecting ONE full question from each unit.****II) Any THREE units will have internal choice and remaining TWO unit questions are compulsory.****III) Each unit carries 20 marks.**

Q. No.	Questions	Marks	BLs	COs	POs
<b>UNIT - I</b>		<b>20</b>			
1 a.	Define composite material. Explain the classifications of composite materials.	10	L1	CO1,2	PO1,2,3,4
b.	Define weight fraction and volume fraction. Derive relationship between weight and volume fraction.	10	L2	CO1,2	PO1,2,3,4
<b>OR</b>					
1 d.	Calculate the fraction of load carried by the fibers into composites of glass fibers and epoxy matrix. One of them containing 10% fibers by volume and other one by 50%. Elastic moduli for glass and epoxy are 72 and 3.6 GN/m <sup>2</sup> respectively.	10	L1	CO1,2	PO1,2,3,4
e.	List and explain the applications of composite materials in various field of engineering.	10	L2	CO1,2	PO1,2,3,4
<b>UNIT - II</b>		<b>20</b>			
2 a.	For 2-ply laminates as shown in Fig. Q2(a), determine; i) Extensional stiffness matrix ii) Extensional bending coupling stiffness matrix iii) Bending stiffness matrix Assume both the laminate have identical stiffness matrix Q as follows:	20	L2	CO1,2	PO1,2,3,4

$$Q = \begin{bmatrix} 130 & 2.5 & 0 \\ 2.5 & 10 & 0 \\ 0 & 0 & 3.5 \end{bmatrix} \text{GPa}$$

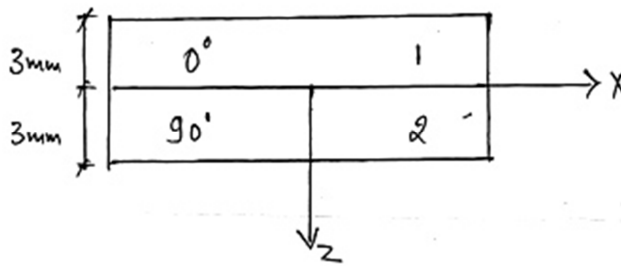


Fig. Q2(a)

**UNIT - III**

**20**

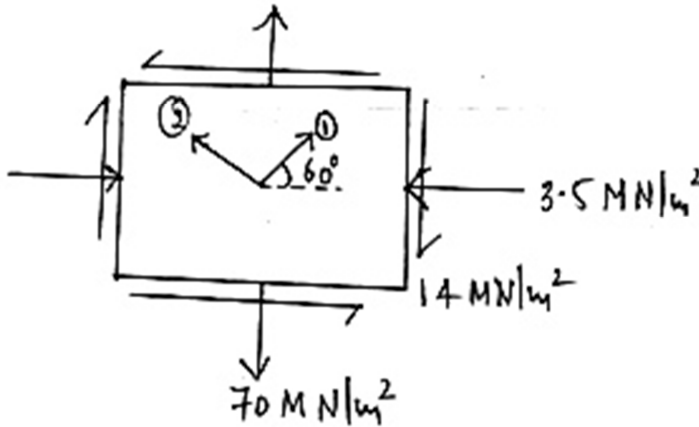
3 a. Explain Tsai-Hill failure theory of a composite material.

8

L2 CO1,2 PO1,2,3,4

b. For the lamina shown in Fig. Q3(b) find the stresses along and across the fibers and strains along  $x$  and  $y$  direction.

Given  $E_1 = 14 \text{ GN/m}^2$ ,  $E_2 = 3.5 \text{ GN/m}^2$ ,  $G_{12} = 4.2 \text{ GN/m}^2$ ,  $\nu_{12} = 0.4$



12

L1 CO1,2 PO1,2,3,4

Fig. Q3(b)

**OR**

3 d. Explain the environmental effects on composites.

10

L2 CO1,2 PO1,2,3,4

e. Explain the process of manufacture of composites.

10

L2 CO1,2 PO1,2,3,4

**UNIT - IV**

**20**

4 a. What are smart materials? Briefly explain different types of smart structures.

10

L1 CO3 PO1,2,4

b. Derive generalized piezo electric constitutive relation including thermal field.

10

L2 CO3 PO1,2,4

**UNIT - V**

**20**

5 a. Obtain an expression for beam modeling with induced strain actuator.

10

L2 CO4 PO1,4

b. Explain surface mounted and embedded actuators.

10

L2 CO4 PO1,4

**OR**

5 d. Explain the concept of Bernoulli's Euler beam model in the context

20

L2 CO4 PO1,4