Sanjay Ghodawat University, Kolhapur

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2020-21

EXM/P/09/00

Year and Program: T.Y. & BTech.	**School of Technology**	**Department: Aeronautical Engineering**
Course Code: AET307A	**Course Title: Composite Materials and Structure**	**Semester : V**
Day :Wednesday **Date: 23.12.2020**	**End Semester Examination**	**Time:2 Hrs.** **Max Marks:50**

Instructions: 1) All Questions are compulsory.
2) Use appropriate assumptions and standard values wherever necessary.

Q.1	**Answer the following (any two)–**	**Marks**	**Bloom's Level**	**CO**
a)	Afiberglass cube consists of a matrix of vinyl ester and reinforcing fibers of E-glass with dimensions 1 cm by 25cm by 200cm. The volume fraction of E-glass = 30%. The density of the vinyl ester = 0.882 g/cm^3. The density of E-glass = 2.60 g/cm^3. Assume there are no voids in the composite. Determine the (i) volume of the composite, (ii) mass of vinyl ester in the section, (iii) mass of E-glass fibers in the section, and (iv) the density of the composite.	8	L_3	CO1
b) i.	The material of a thin flat panel is changed from SAE 1010 steel (thickness = 1.5 mm) to an E-glass fiber-reinforced polyester SMC panel with equal flexural stiffness. The panel's flexural stiffness is $\frac{Eh^3}{12(1-\nu^2)}$ where E is the modulus of the panel material, ν is the Poisson's ratio and h is the panel thickness. If E_{SAE} = 207 GPa, E_{SMC} = 16 GPa, ν_{SAE} = 0.30 = ν_{SMC}, calculate the thickness of E-glass fiber-reinforced polyester SMC panel and percentage difference in change in E.	4	L_3	CO1
ii.	Mechanical characterization of test samples of a composite material yields these values for E, G and ν along the principal material directions:E_{11} = E_{22} = E_{33} =15.4 GPa, G_{12} = G_{13} = G_{23} = 6.7 GPa, ν_{12} = ν_{13} = ν_{23} = 0.35. Is the material isotropic? Support your answer with proper reasoning.	4	L_3	CO1

c) An FRP laminate is subjected to a uniaxial tensile load P in the x direction. The laminate width and thickness are 75 and 3.5 mm, respectively. The following strength properties are known: $F_{1t} = F_{1c} =$ 150 MPa, $F_{2t} = F_{2c} =$ 300 MPa, and $F_{6u} =$ 500 MPa. Analyze the stress profile with given data to determine the maximum value of load when (i) $\theta = 35$ deg, (ii) $\theta = 70$ deg. 8 L_4 CO2

Q.2 **Answer the following (any two) –**

a) i. A laminate is written by using a standardized nomenclature to help understand the laminate stacking sequence. You need to send the details of a laminate that you need to manufacture to a local vendor who does not understand that very well. Explain this nomenclature for laminate stacking so that the vendor understands the laminate codes you have sent him. 5 L_4 CO2

ii. Calculate flexural engineering constants for a 6 mm thick laminate if 3 L_3 CO2

$$[D*] = \begin{bmatrix} 5.55 & -3.45 & 0 \\ -3.45 & 10.33 & 0 \\ 0 & 0 & 11.35 \end{bmatrix} \times 10^{-4} \frac{1}{Pa - m^3}$$

b) For a laminate of$[0/30]$ where each lamina has a thickness of 4 mm: (i) Draw the laminate from laminate code, (ii) Find the stiffness matrices [B], (iii) Find the stiffness matrices [D] 8 L_3 CO3

$$[\bar{Q}]_0 = \begin{bmatrix} 181.8 & 2.897 & 0 \\ 2.897 & 10.35 & 0 \\ 0 & 0 & 7.17 \end{bmatrix} (10^9)\ Pa$$

$$[\bar{Q}]_{30} = \begin{bmatrix} 109.4 & 32.46 & 54.19 \\ 32.46 & 23.65 & 20.05 \\ 54.19 & 20.05 & 36.74 \end{bmatrix} (10^9)\ Pa$$

c) For a lamina of 40^o, ignore the mechanical strains and calculate: 8 L_3 CO3

$\alpha_1 = 8.6 \times 10^{-6}$ m/m/°C, $\beta_1 = 0$ m/m/kg/kg,

$\alpha_2 = 22.1 \times 10^{-6}$ m/m/°C $\beta_2 = 0.6$ m/m/kg/kg

(i) Coefficient of thermal expansion, (ii) Coefficient of moisture absorption, (iii) Global strains under temperature change of 40°C and moisture absorption of 0.05 kg/kg, (iv) Local strains from part (iii)

Q.3 Answer the following (any two) –

a)	i.	Explain the step-by-step procedure to calibrate brittle coating with proper diagram.	4	L_3	CO4
	ii.	To understand the analogy between various parameters for Moire fringes, you are assigned a task by the lead engineer to plot the trend between strain and ϕ. The data provided states that θ = 20 deg and p = 0.033 mm. Make the plot and tabulate the values while consideringϕ in intervals of 5 deg from 30 deg to 45 deg.	5	L_4	CO4
b)		A steel bar of E_S = 210GPa and awood bar of E_W = 100 GPa are bonded together to form a T-shaped composite bar. The T-beam is made by joining horizontal part made of steel with dimensions 50 x 5mm and vertical part made of wood with dimensions 5 x 50 mm as shown in figure 1. Determine the maximum stress in steel only when the bar is bent about a horizonal axis with M = 60Nm.Use y = -10 mm.	9	L_3	CO5
c)		Assume you are a material engineer and are allocated a project for choosing proper materials to construct a sandwich composite material for marine and industrial application. Discuss how you will choose the material including different criteria that you will have to evaluate and failure categories that you need to inspect it for.	9	L_4	CO5

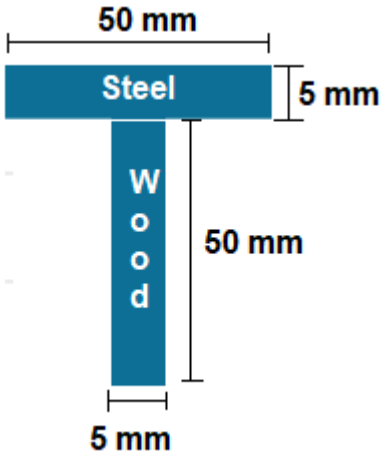


Figure 1

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