VTU B.E/B.TECH QUESTION PAPER SET

CBCS
SEMESTER V

INTRODUCTION TO COMPOSITE MATERIAL

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CBCS Scheme

USN | | | | | | | | | | 15AE52

Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Introduction to Composite Material

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define PMC. Describe the shape of the reinforcement materials. **(06 Marks)**

b. Write a note on following :

i) Thermoplastic and thermosets

ii) Carbon – carbon composites **(10 Marks)**

OR

2 a. Define MMC's. Write the type of matrix and reinforcement used their manufacture. **(08 Marks)**

b. Explain liquid metallurgy technique used manufacturing of MMC's. **(08 Marks)**

Module-2

3 a. Describe with sketch epoxy curing cycle of PMC. **(06 Marks)**

b. Explain with neat sketches the injection moulding and thermoforming process. **(10 Marks)**

OR

4 a. List the difficulties are faced in the machining of FRP's. Explain Cutting operation for PMC's. **(08 Marks)**

b. Explain with neat sketch Autoclave process. **(08 Marks)**

Module-3

5 a. Evaluate E_1 by the rule of mixture. **(08 Marks)**

b. Find E_1, E_2, V_{12} and G_{12} of a glass/epoxy lamina with 70% fiber volume fraction. The value of E_f and E_m are 85 GPa and 3.4 GPA respectively. Assume V_f and V_m are 0.2 and 0.3 respectively. **(08 Marks)**

OR

6 a. For a unidirectional lamina in a 2D plane stress state. Derive reduced stiffness matrix and express these matrix co-efficient in terms of engineering elastic constants. **(10 Marks)**

b. Find reduced stiffness matrix for a unidirectional lamina use elastic constants E_1 = 150 GPa, E_2 = 20GPa, V_{12} = 0.2, G_{12} = 5 GPa. **(06 Marks)**

Module-4

7 a. For failure analysis of a unidirectional lamina subjected to a 2D plane stress state and expresses in equation form the maximum stress criterion, the T_{sai} – Hill criterion and the T_{sai} – Wu criterion? **(08 Marks)**

b. Compute [A] [B] and [D] matrices for a [0/90°] laminate with the following properties thickness of each lamina is 0.125mm, E_1= 140 GPa, E_2 = 10 GPa, γ_{12} = 0.3, G_k = 5 GPa. **(08 Marks)**

OR

8 a. Explain CLT and derive expression for A, B and D matrices for laminate. **(08 Marks)**

b. A tensile specimen of a unidirectional composite is prepared such that the fibers make an angle of 5° with the applied load. Determine the stress to cause failure according to

i) The maximum stress criterion

ii) The maximum strain criterion

The following properties may be used

E_{11} = 76.0 GPa, E_{22} = 5.5 GPa, G_{12} = 2.35 GPA, V_{12} = 0.33, σ_{1T} = 1250 Mpa, σ_{2T} = 30MPa, τ_{12} = 50MPa, σ_{1C} = 1000MPA, σ_{2C} = 100MPa. **(08 Marks)**

Module-5

9 a. List the NDT methods are normally used for testing FRP. **(06 Marks)**

b. Explain following inspection and quality control methods.

i) Hardness testing

ii) Ultrasonic inspection **(10 Marks)**

OR

10 Write a note on application of composite materials on the following industry.

a. Automobile

b. Aircraft

c. Electrical and electronics

d. Sports. **(16 Marks**

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CBCS SCHEME

USN | | | | | | | | | | |

15AE52

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Introduction to Composite Materials

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define a composite material and give the detailed classification. **(08 Marks)**

b. Write a note on metal matrix composites and give its advantages and applications. **(08 Marks)**

OR

2 a. Explain with a neat sketch stir casting and squeeze casting process. **(12 Marks)**

b. Give the applications of Aℓ, Mg, Ti based MMC. **(04 Marks)**

Module-2

3 Explain the following with a neat sketch :

a. Hand layup process

b. Filament winding. **(16 Marks)**

OR

4 Explain the following with a neat sketch :

a. Extrusion process

b. Injection moulding process. **(16 Marks)**

Module-3

5 a. Determine the longitudinal Young's modulus by strength of material approach. **(10 Marks)**

b. Define the following :

i) Volume fraction

ii) Mass fraction

iii) Density of a composite. **(06 Marks)**

OR

6 a. Determine the global and local stresses in an angle lamina. **(08 Marks)**

b. For a graphite/epoxy unidirectional lamina, find the following :

i) Compliance matrix

ii) Minor Poisson's ratio

iii) Strains in the 1 – 2 co–ordinate system if the applied stresses are :

$\sigma_1 = 2$ MPa, $\sigma_2 = -3$ MPa, $\tau_{12} = 4$ MPa

[Use $E_1 = 181$GPa, $E_2 = 10.3$GPa, $\nu_{12} = 0.28$, $G_{12} = 7.17$GPa]. **(08 Marks)**

Module-4

7 Explain the following :

a. Tsai – Hill failure theory

b. Tsai – WU failure theory. **(16 Marks)**

OR

8 Find the 3 stiffness matrices [A], [B] and [D] for a three–ply [0/30/–45] graphite/epoxy laminate as shown in Fig.Q8, use the unidirectional properties from given data of graphite/epoxy. Assume each lamina has a thickness of 5mm.

[Use : E_1 = 181GPa, E_2 = 10.3GPa, ν_{12} = 0.28, G_{12} = 7.17GPa]. **(16 Marks)**

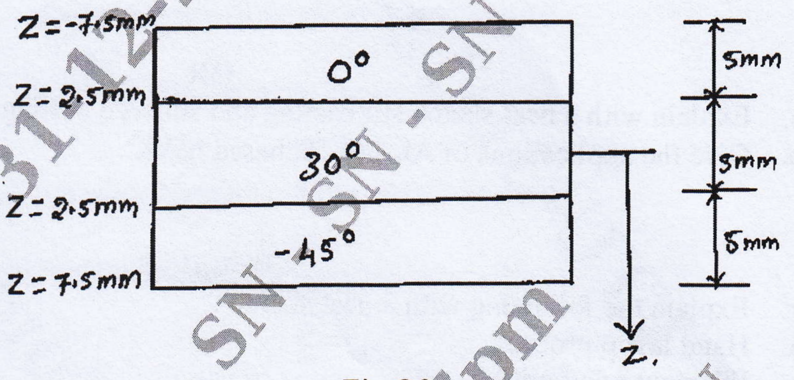

Fig.Q8

Module-5

9 a. Write a note on typical flaws in composite materials and classify according to stage of life cycle at which the fault occurs. **(08 Marks)**

b. Explain A – B – C scan in ultrasonic testing. **(08 Marks)**

OR

10 Give the applications of composites materials in the following :

a. Automobile

b. Aircrafts

c. Missiles

d. Space hardware

e. Electrical and Electronics

f. Marine

g. Sports equipment. **(16 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | |

17AE52

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Introduction to Composite Materials

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. What is a composite material and how are they classified? **(05 Marks)**

b. What are the limitations of modern composites? **(05 Marks)**

c. What advantages and drawbacks do composites have over metals? **(10 Marks)**

OR

2 a. Give five examples of naturally found composites. What are the constituents of these natural composites? **(10 Marks)**

b. Define the following:
i) Isotropic body
ii) Orthotropic body
iii) Anisotropic body
iv) Homogeneous body and
v) Non homogeneous body. **(10 Marks)**

Module-2

3 a. What are the fiber factors contribute to the mechanical performance of a composite? **(10 Marks)**

b. What are the matrix factors contribute to the mechanical performance of a composite? **(10 Marks)**

OR

4 a. Describe extrusion and injection moulding manufacturing method of polymer matrix composites with neat sketch. **(10 Marks)**

b. Applications of polymer matrix, ceramic matrix and carbon matrix. **(10 Marks)**

Module-3

5 Based on the strength of material approach, determine the four elastic moduli of a unidirectional lamina
i) Longitudinal Young's modulus E_1
ii) Transverse Young's modulus E_2
iii) Major Poisson's ratio V_{12}
iv) In-Plane shear modulus, G_{12} **(20 Marks)**

OR

6 a. Number of independent elastic constants for three-dimensional anisotropic, monoclinic, orthotropic, transversely isotropic and isotropic materials. **(05 Marks)**

b. Derive the stress transformation matrix from local fiber coordinate system (x-y) to global coordinate system (1-2) in two-dimensional. **(15 Marks)**

Module-4

7 a. Based on the Von-Mises distortional energy theory, determine the parameters of Tsai-Hill failure criterion. **(15 Marks)**

b. Explain maximum stress and maximum strain theory through Mohr circle diagram. **(05 Marks)**

OR

8 Based on classical laminate plate theory, derive the forces {N} and moments {M} resultants related to midplane strains and curvatures of a laminate. **(20 Marks)**

Module-5

9 a. Applications of composite materials in
   i) Automobile industry
   ii) Aerospace industry
   iii) Sports equipment. **(15 Marks)**

b. Short notes on future potential of composites. **(05 Marks)**

OR

10 a. Explain destructive and non-destructive testing of composite structures. **(10 Marks)**

b. Explain tensile, compression, flexural, shear and hardness testing of composite structural component. **(10 Marks)**

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