Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **M.Tech**
P2SUCC10

2nd Semester Regular / Back Examination 2018-19
COMPOSITE STRUCTURES
BRANCH : SOIL MECHANICS & FOUNDATION ENGG, STRUCTURAL & FOUNDATION ENGG, STRUCTURAL ENGG
Max Marks : 100
Time : 3 Hours
Q.CODE : F558

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part- I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) State the special features of composites compared to isotropic materials.
b) State the no of independent elastic constants in an isotropic material and in an orthotropic material.
c) What is the role of transformation matrix, $[T]$ in composite structures?
d) Define Poisson's ratio, v_{xy} .
e) Explain the difference between PMC and CMC.
f) Name the [A], [B] and [D] matrices.
g) Distinguish between *symmetric* and *antisymmetric* laminates with examples.
h) What do you mean by transverse isotropy?
i) State the various types of stresses which act at any point in a composite laminate subjected to external loading.
j) Distinguish between *micromechanics* and *macromechanics*.

Part- II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Develop the mathematical equations for *stress- strain* and *strain- stress* relationship for a specially orthotropic material.
b) What are the important observations in the relationship of stress-strain in the specially orthotropic material.?
c) In a composite laminate, distinguish between *principal material axis system* and *reference axis system*. Draw suitable figures to explain it.
d) Explain the characteristics of B matrix in a composite laminate.
e) Determine the Poisson's ratio v_{xy} at an angle $\theta = 45^0$ with the fiber direction for a material with the following properties. $E_1 = 2E_2$, $E_6 = 0.5E_2$ and $v_{12} = 0.25$.
f) Develop the *transformation matrix, T* wrt strain, when transformed from principal material axis, 1-2 to the reference axis, x-y.
g) Develop the constitutive relationship for a *specially orthotropic material.*
h) Explain if the laws of stress and strain transformation are independent of material properties.
i) Draw the diagrams to show the variation of Young's modulus values for E_{11} , and E_{22} with the variation in ply angle for a unidirectional lamina. Show some typical calculations.
j) If the weight of the matrix is 40% of the weight of the composite, calculate the fibre volume fraction. The specific gravity of fibre and matrix are 2.6 and 1.2 respectively.
k) Show that bending-extension coupling stiffnesses are zero for a symmetric laminate. Consider a 3 layered composite to derive the values.
l) State the assumptions of CLPT.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 For a FRP composite of unidirectional lamina with fibre orientation of 30 degree, calculate the compliance matrix , stiffness matrix and transformed reduced stiffness matrix if E_{11}= 130 GPa,E_{22} = 10 GPa, G_{12} = 7.1 GPa, and ν_{12} = 0.3. **(16)**

Q4 Compute the A and B matrix for a [-45/45/-45] laminate if E_1 = 130 GPa, E_2 = 8 GPa, E_6 = 6 GPa, ν_{12} = 0.3 and thickness of each lamina is 0.5 mm. **(16)**

Q5 For a 30/0/30 symmetric laminate subjected to N_x = 100 MPa-mm thrust, calculate the resultant stresses along the reference axis for each lamina. E = 130 GPa, E = 10 GPa, thickness of each layer is 0.1 mm, ν_{12} = 0.3. **(16)**

Q6 Derive the Navier's solution for finding deflection at the centre of a rectangular orthotropic laminate with all edges simply supported. **(16)**