Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH (CAAD/MET)

END SEMESTER EXAMINATIONS, APRIL 2018

SUBJECT: MECHANICS OF COMPOSITE MATERIALS [MME 5266]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Use of Mechanics of Composite materials datasheet is permitted.

1A. A rod consists of a binder and two types of filamentous reinforcement with the following constituent properties: **5**

Material	Density (g/cm^3)	Weight (%)	Elastic modulus (GPa)	Tensile strength (GPa)
Binder	1.3	35	3.5	0.06
Fiber A	2.5	45	70	1.4
Fiber B	1.6	20	6	0.45

Assume that the cross-sectional area of the rod as 10 cm^2. Determine

i). What maximum load can this rod carry without rupturing any of the constituents?

ii). What is the maximum load the rod can carry?

iii). What constituent will rupture last?

1B. Sketch and explain Resin Transfer molding process of manufacturing composites. **5**

2A. A thin plate of 50 mm x 50 mm size made up of FRP composite is subjected to tensile stress of 155 MPa along X-direction. The plate is somehow restrained from any deformation in Y-direction. The fibers of FRP composite are orientated at an angle of 30^0 with X-direction. Determine the following: **4**

i) the strain in the material along X-direction.

ii) the stress that must be applied to restrain from deformation along Y-direction.

Given: For FRP composite with fibers aligned along X-direction.

$$S = \begin{bmatrix} 7.25 & -2.17 & 0 \\ -2.17 & 111.61 & 0 \\ 0 & 0 & 140.85 \end{bmatrix} (TPa)^{-1}$$

2B. Sketch and explain Stir Casting process of manufacturing composites. **4**

2C. List at least four differences between thermoset and thermoplastic polymer matrices. **2**

3A. Derive expression for poisson's ratio in global coordinate system as a function of fiber orientation and engineering properties in fiber co-ordinate system. **3**

3B. Determine the stiffness and compliance components of aluminum with the following properties: E= 69 k N/mm^2 and υ=0.3 **3**

3C. Sketch and explain two types of microbuckling failure modes observed in unidirectional composite lamina. **4**

4A. A three ply laminate [+45/0/+45] is subjected to forces Nx=1000 N/mm, Ny= 200 N/mm and Nxy=0. The +45^0 layer is 3mm thick and 0^0 layer is 6 mm thick. Compute stresses and strains in the individual plies. Given: for fibers aligned along global X-axis, **6**

$$Q = \begin{bmatrix} 20 & 0.7 & 0 \\ 0.7 & 2.0 & 0 \\ 0 & 0 & 0.7 \end{bmatrix} \text{GPa}$$

4B. Using relevant standard, explain how the tension test is conducted on a unidirectional laminate. **4**

5A. Determine [A], [B] and [D] matrices for a quassi-isotropic [-60/0/+60] laminate with the following material properties: **6**

E_1=140 GPa, E_2=10 GPa, G_{12}=6 GPa and $\upsilon_{12} = 0.3$. The thickness of each lamina is 0.2 mm.

5B. A unidirectional lamina is subjected to biaxial stresses: $\sigma_x = 3\sigma_0$ and $\sigma_y = 2\sigma_0$. The X-axis is inclined at 60^0 to the fiber direction. The material properties are as follows: F_{1T}= F_{1C}= 2F_{2C}= 4F_6= 8F_{2T}= 500 MPa. Determine σ_0 at failure of the lamina according to Maximum stress theory and Deviatoric strain energy theory. **4**