

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M. Tech (TT)/SEM-1/MTT-104/2009-10**

**2009**

**THEORY OF TEXTILE STRUCTURE – I**

*Time Allotted : 3 Hours*

*Full Marks : 70*

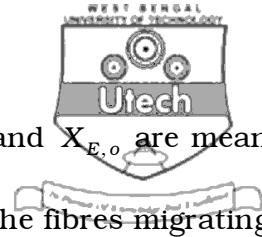
*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

Answer any *five* questions.

5 × 14 = 70

1. a) Calculate the reduction of stress in outer layer in staple yarn analysis. 8
- b) How do you apply it in calculating the ratio of yarn modulus / fibre modulus ? 4
- c) Calculate the values of  $K$  with  $L_f = 6\frac{2}{3}$  cm;  
 $a = 2 \times 10^{-3}$  cm,  $Q = 2.5$  cm and  $\mu = 0.25$ , where the symbols have their usual meanings. 2
2. a) Calculate the critical stress  $X_C$ , when the fibre will be effectively gripped in the staple yarn. 7



- b) Calculate  $X_{E,i}$  and  $X_{E,o}$  where  $X_{E,i}$  and  $X_{E,o}$  are mean normalized stress in the fibres when the fibres migrating inwards and migrating outwards. 7
3. a) Derive a relation between pressure applied and volume of fibre assembly obtained by van Wyk's analysis. 7
- b) For analysis of yarn compression, calculate the force per unit length of a yarn  $Q(\eta_1)$  where  $Q(\eta_1)$  has its usual meanings. ( i.e.  $\eta = \frac{d}{D_i}$  ). 7
4. a) For blended yarn of short staple fibre, derive
- $$E_L/E_b = \left[ B_a \frac{E_a}{E_b} + (1 - B_a) \right] V_f n_L n_{10}$$
- where the symbols have their usual meanings. 6
- b) From this relation, find critical blend ratio  $B_{crit}$  for realizing the reinforcement. What is its difference with minimum fibre-blend ratio  $B_{min}$ . 6
- c) Explain the term length and fibre orientation-efficiency factor. 2



5. a) Write the assumptions made by Tredaoar and Riding in their analysis of yarn tensile characteristics. 3
- b) Derive the specific stress  $Y$  in the yarn.

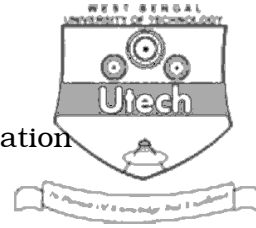
$$Y = 2/R_0^2 \int_0^{R_0} \left[ \phi(\epsilon_f) \cdot \partial \epsilon_f / \partial \epsilon_y r_0 \right] d r_0$$

where the symbols have their usual meanings. 9

- c) What is the advantage of using this method ? 2
6. a) Write assumptions for analysis of tensile force of helically twisted filament yarn. Draw the basic radial element of the analysis.

Derive the governing radial equilibrium equation  $d G/du = - X + G/u$  in the filament yarn. The symbols have their usual meanings. 2 + 1 + 7

- b) Calculate the mean normalized yarn stress  $Fy(\alpha, \sigma_1, \sigma_y)$ . The symbols have their usual meanings. 4
7. a) Derive the conditions for migration to occur in a model of a seven ply structural migration. 5
- b) Calculate the probability of yarn moving back at 4th possible migration in seven ply migration model. Explain the theoretical probability of inward migration when  $p_1$  ( probability of yarn moving back at first migration ) = 0, equal probability. 5



- c) Define ideal migration. Derive the equation

$$dZ/dr = \frac{rQ}{\left\{ cR^2 \left[ 1 + (r/R)^2 \tan^2 \alpha \right]^{\frac{1}{2}} \right\}}$$

where the symbols have their usual meanings. 4

8. a) Write the different categories of configuration of fibres within yarn in compact and ring spun yarn and compare between them. 4

- b) Discuss the nature of packing twist angle and distribution of twist angle in conventional ring spun and compact yarn and compare among them. 7

- c) Describe the method to reconstruct the yarn segments of ring and compact yarn computationally. 3

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