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 μ = 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

$$E_L/E_b = \left[B_a \frac{E_a}{E_b} + (1 - B_a) \right] V_f \, n_L \, n_{1\theta}$$

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 Tredoar and Riding in their analysis of yarn tensile characteristics. 3

b) Derive the specific stress Y in the yarn.

$$Y = 2/R_0^2 \int_0^{R_0} \left[\phi\left(\in_f\right) . \partial \in_f / \partial \in_y r_0 \right] \mathrm{d}\, r_0$$

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 $\mathrm{d}\, G/\mathrm{d}u = -X + G/u$ in the filament yarn. The symbols have their usual meanings. 2 + 1 + 7

b) Calculate the mean normalized yarn stress $Fy\left(\alpha, \sigma_1, \sigma_y\right)$. 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