Name:	
Roll No. :	An organization of the Same State of the Sta
Invigilator's Signature :	

## CS/M.Tech(TT)/SEM-1/MTT-104/2011-12 2011

## 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* of the following.  $5 \times 14 = 70$ 

- a) Prove the theoretical relationship between contraction factor and surface twist angle of a twisted yarn. Hence, find out the relationship between retraction and surface twist angle.
  - b) What is the significance of using the equation  $C_y (C_y 1) = \frac{1}{4} \tan^2 \alpha$  where, the symbols have their usual meanings.
  - c) Find out the relationship between true twist (T), nominal twist ( $T_0$ ) of a twisted yarn. Hence, determine the maximum twist angle of a yarn that can be inserted in any textile operation.
- a) Explain ideal migration with a neat diagram. Also plot the pattern of ideal migration envelop.

40244 [ Turn over

## CS/M.Tech(TT)/SEM-1/MTT-104/2011-12

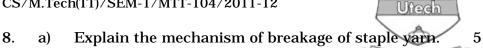
- b) Determine the general equation expressing the change in radial position of a fibre with the length measured along the fibre (in ideal migration) for a full migration period.
- c) Prove that, the ideal migration equation for the first half cycle is  $\left(\frac{r}{R}\right)^2 = \frac{4z}{z\left(1+\sec\alpha\right)} + \frac{4z^2\tan^2\alpha}{z^2\left(1+\sec\alpha\right)^2}$  where, the symbols carry the usual meaning.
- 3. a) Explain the crucial parameters for characterisation of migration behaviours in a yarn.5
  - b) Prove that  $\overline{Y} = \frac{1}{3} \cot^2 \alpha \left( \tan^2 \alpha + \sec \alpha 1 \right)$  and  $D = \frac{1}{3 (1 + \sec \alpha)} \left\{ \frac{4}{5} \sec^2 \alpha + \frac{7}{5} \sec \alpha + \frac{4}{5} \right\}^{\frac{1}{2}}.$  6
  - c) How is migration mechanism affected by tension variation? Explain.
- 4. a) Define 3-dimensional yarn elements with a neat diagram for the analysis of stress and strain on continuous filament yarn considering transverse force and lateral contraction. Also calculate the forces acting on these cuboidal yarn elements.
  - b) If  $\sum f$  is the filament strain in above analysis, then show that  $\sum f = \left(1 \sigma_y \tan^2\theta\right) \sum f_0$  where,  $\sum f_0$  is the filament strain without transverse force and lateral contraction for simple analysis of stress-strain model and  $\sigma_y$  is the yarn lateral contraction ratio and  $\theta$  is the twist angle.

- 5. a) Deduce the equation governing radical equilibrium in the yarn in terms of g, u, c,  $\sigma_1$  and  $\sigma_y$  ( all are representing the usual meanings ) and hence evaluate the relative level of tensile and transverse stresses throughout the twisted yarn.
  - b) Prove that, mean normalized yarn stress is

$$\frac{2}{1-c^2}\int\limits_C^1\left[x\frac{c^2}{u^2}-g\left(1-\frac{c^2}{u^2}\right)\right]u\mathrm{d}u.$$

- 6. a) Define the basic distribution of stresses and strains in the extended staple fibre yarn.
  - b) Derive the conditions for which a fibre will slip and magnitude of the tensions which can develop in slipping fibres.
  - c) What are the accessory fibre characteristics required for this analysis?
- 7. a) What are the different levels of approach to analyse the staple yarn stress-strain mechanism? Discuss the approach related to approximate treatment on the staple spun yarns.
  - b) Write down the expression of mean normalized stress  $(x_s)$  and the factor  $(\beta)$  responsible for the reduction of stress in outer layer of staple fibre yarn and determine its application on whole yarn.
  - c) Explain the separate effects of obliquity  $(\cos^2 \alpha)$  and slip  $(1 k \csc \alpha)$  with the help of numerical plot of the equation  $\cos^2 \alpha (1 k \csc \alpha)$ .

## CS/M.Tech(TT)/SEM-1/MTT-104/2011-12



- Compare the structure and properties of MVS yarns b) with ring and open end spun yarns.
- c) Write the different categories of configuration of fibres within yarn in compact and ring spun yarns and 4 compare between them.
- 9. What are the different rigidities of fibre affecting yarn a) structure? Explain briefly. 3
  - b) Describe the model to calculate the bending rigidity of yarn. What are the factors affecting the bending rigidity of the yarn.
  - For blended yarn of short staple fibre derive c)

$$E_L / E_B = \left[ B_a \frac{E_a}{E_b} + (1 - B_a) \right] V_f n_L n_1 \theta$$

(where the symbols have their usual meanings) 6

40244 4