THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF INDUSTRIAL STUDIES /
BACHELOR OF TECHNOLOGY
FINAL EXAMINATION – 2011 / 2012
TTX5232 YARN AND FABRIC MECHANICS
DURATION - THREE HOURS

DATE: 29th February 2012 **TIME: 0930 – 1230 Hours**

Total Number of Questions = 7 **Number of questions to be answered = 05**
Answer the question 1, which is compulsory, and four (05) additional questions.
Question 1 carries thirty (30) marks and the questions 2 to 7 carry fourteen (14) marks each.

01. Compulsory Question

a) Distinguish between "Physical Properties and Physical Characteristics". (02 %)

b) Define the following terms:
Yield Point, Hysteresis of Recovery (02 %)

c) Define the term"Relaxation"? (02 %)

d) State one of the two laws introduced by Amontons. (02 %)

e) What is the indication for a textile yarn to be dimensionally stable? (03 %)

f) What is "Twist Contraction"? (02 %)

g) What do you understand by "Fibre Migration" in textile yarns? (03 %)

h) What do you understand by "Yarn Hairiness" ? (02 %)

i) What is "Wild Fibre" according to Morton? (03 %)

j) "The frictional behaviour of textile fibres is different to the behaviour of other solid engineering materials." Briefly explain this statement. (03 %)

k) Give an illustration to show the effect of gauge length on the stress/elongation behaviour and breaking strength of yarns. (02%)

l) What is "Cover Factor" as applied to woven fabrics? (02%)

m) What is the difference between the main assumption of the approximately circular theory and the assumption of the original circular theory proposed by Peirce for fabric geometry? (02%)

02. a) The following statements are made about two different types of fibres:

(i) Fibre A has very high specific stress but a very low strain at break It also has a relatively high initial modulus and stress is linearly proportional to the strain for a relatively high stress range.

(ii) Fibre B has a high specific stress and a very high strain at break. It's initial modulus is relatively low, and it also has a very clear yield point.

Draw the stress/strain curves of the above two types of fibres and label the figure to show breaking stresses, breaking strains, initial modulus and yield points. (07%)

b) Which of the above fibres would have a larger "Hysteresis Loop of Recovery"? Give reasons for your answer. (04%)

c) What is "Elastic Recovery"? (03%)

03. a) Define the following terms with the help of a suitable diagram: Immediate elastic deformation, Primary creep and Secondary creep. (06%)

b) Relaxation and creep can be demonstrated through models made by combination of ideal springs and ideal viscose dashpots. Explain with suitable sketches how a spring and dashpot in series demonstrate **instantaneous extension**, **secondary creep** and **stress relaxation**. (08%)

04. a) What is *ideal migration*? (04 %)

b) Explain how migration is helpful in producing staple fibres with high strength. (05%)

d) Explain the occurrence of hairiness in spun yarns explaining the fibre movement and positioning of fibres during spinning. (05 %)

05.

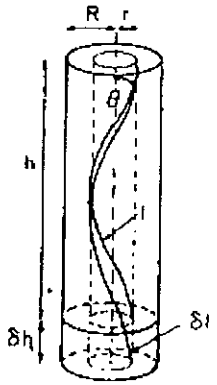

Figure 5a: Yarn under tension (only one filament is shown separately)

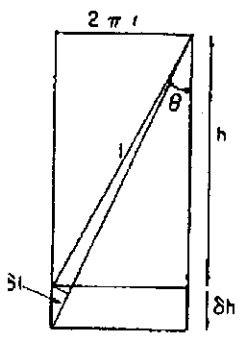

Figure 5b: Envelopes of the surface of the cylinder of radius 'r'

The Figure 5a shows length "h" of a twisted multi filament yarn having idealized helical geometry, which is elongated by a length "δh" under a tensional load. A filament at the radius "r" and how it is elongated under tensional load are also illustrated. The Figure 5b shows the envelope of the cylindrical surface of radius "r". θ is the helix angle of the filament at the radius r.

Show that $\varepsilon_f = \varepsilon_y . \cos^2 \theta$

where ε_f = Strain or % elongation of a filament at radius r
ε_y = Strain or % elongation of the yarn (14%)

06. a) Assuming idealized helical yarn geometry, the breakage of multi filament yarns under tensional loads has been predicted. Discuss two methods of prediction producing suitable illustrations to explain stress elongation behavior during breakage. (10%)

b) Explain "Stress Analysis by Energy Method" by highlighting the merits and demerits of this method over geometrical models. (04 %)

07. a) Show that $d = \frac{1}{28\sqrt{N}}$

Where, d = Diameter of the yarn
N = English Cotton Count of the yarn
Assume a specific volume of 1.1 cm^3/g for the fibre out of which the yarn is made. (08%)

b) Discuss the merits/demerits of Kemp's racetrack and Greenwood's lenticular theories against Pierce's original Plain Weave Geometry (Yarns with circular threads). (06 %)