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The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Textile and Apparel Technology

Study Programme	: Bachelor of Technology Honours in Engineering / Bachelor of Industrial Studies Honours
Name of the Examination	: Final Examination
Course Code and Title	**: TAX5532/TTX5232 Yarn and Fabric Mechanics**
Academic Year	: 2019/20
Date	: 26th July 2020
Time	: 1330-1630hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This is a Closed Book Test (CBT).
3. Write down your index number on all the papers of the answer script.
4. This question paper consists of **Eight (8)** questions in **Four (4)** pages.
5. Answer question **One (01)**, which is compulsory, and **Five (05)** additional questions.
6. Total number of questions to be answered is **Six (6).**
7. Question One (01) carries thirty (30) marks and questions Two (02) to Eight (08) carry fourteen (14) marks each.
8. Answer for each question should commence from a new page. If a question has many parts, all the parts should be answered in the chronological order under the same question.
9. Write down the answered question numbers on the front page of the answer book.
10. Answers should be in clear handwriting.
11. Do not use red colour pens to write answers.

01. Compulsory Question.

(a) Distinguish between 'physical properties' and 'physical characteristics' in relation to a textile material. (02 Marks)

(b) Illustrate the 'time effect' on internal stress of a textile fibre that is subjected to a constant extension. (03 Marks)

(c) Define the term 'Torsional Rigidity' with respect to a textile fibre. (02 Marks)

(d) Illustrate the hexagonal close packing of a multi-filament yarn that has single filament in its core. It is sufficient to draw up to three (03) layers of packing. (02 Marks)

(e) State four (04) different ways of assessing/evaluating yarn hairiness. (04 Marks)

(f) Briefly discuss the influence of 'twist' on hairiness of a staple yarn. (04 Marks)

(g) State four (04) assumptions made by Treloar and Riding when they developed the 'Energy Method' for analysis of stress in textile yarns. (04 Marks)

(h) Illustrate the effect of 'twist' on the strength of staple yarns according to the 'Traditional View'. (03 Marks)

(i) A plain-woven fabric has 72 ends/inch and 44 picks/inch. The warp and weft counts are 2/40s and 2/60s respectively. Warp and weft crimps are 6% and 8% respectively. Calculate the cloth cover factor. (04 Marks)

(j) State the main reason why Kemp proposed the 'race-track theory' over the theories developed by Morton and others. (02 Marks)

End of the compulsory question.

02. a) Define the following terms with respect to textile fibres. Illustrations are not required. (04 Marks)

i. Elongation at break

ii. Initial modulus

iii. Yield point

iv. Specific strength

b) Using a suitable illustration, explain the method used by 'Coplan' to determine the yielding point of a textile fibre. (05 Marks)

c) Characteristics of the load/elongation curves of two fibers, A and B are given below respectively. Illustrate the load/elongations curves of the two fibers on the same graph according to the given details. (05 Marks)

Fibre A: Has a high initial modulus and a high yield point. Specific strength of the fibre is also high. However, the elongation at break is very low. The fibre shows no clear yield point and the yielding region is very short.

Fibre B: Has a low initial modulus and a low yield point. Specific strength of the fibre is also low. However, the elongation at break is large. The fibre shows a clear yield point and the yielding region is considerably large/extended.

03. a) State the two (02) basic laws of friction as stated by Amontons. (02 Marks)

b) With the help of a suitable illustration, state the relationship between tensions on the two sides of a yarn going around a cylindrical guide. (02 Marks)

c) Plot on the same graph, the relationship between Load (N) and co-efficient of friction (μ) for a;

i. Engineering material

ii. Textile filament (e.g. Nylon, Teflon) (02 Marks)

d) Using the graph drawn above in part (c) of this question, discuss the differences observed in co-efficient of friction observed in normal engineering materials and textile fibres. (04 Marks)

e) With the help of a suitable illustration, discuss the effect of percentage of lubrication on the co-efficient of friction of a Nylon filament thread. (04 Marks)

04. a) State and briefly explain the three (03) fundamental structural features of yarns. (06 Marks)

b) Compare and contrast the structural features of 'high-bulk' and 'stretch' yarns. (08 Marks)

05. a) State four (04) instances where Idealized Helical Geometry will fail under practical situations. (04 Marks)

b) Using suitable illustrations, describe the 'Idealized Migration Pattern' introduced by Hearle and Gupta in 1965. Derivation of equations is not necessary. (06 Marks)

c) Describe the method used by Morton and Yen in 1952 to observe the path of individual filaments in a yarn. (04 Marks)

06. a) Illustrate the geometry of a twisted multi-filament yarn under a small tensional load. Assume there is no change on the yarn diameter due to the extension. (02 Marks)

b) Using the illustration drawn in above (a), derive the following equation. (06 Marks)

$$\varepsilon_f = \varepsilon_y \cdot \cos^2\theta$$

Where;

ε_f – Extension of the filament

ε_y – Extension of the yarn

θ- Helix angle of a filament in consideration

c) A yarn has 127 filaments in its cross-section. Individual filament of this yarn has a radius r_f =0.1 mm, and the diameter of the yarn is 12. r_f and it is having a twist of 25 turns per meter, Determine the following if the yarn is subjected to 1% extension.

i. Extension of the filament at the center of the yarn. (02 Marks)

ii. Extension of the filament at the surface of the yarn. (02 Marks)

iii. Percentage area of the cross section covered by the filaments. (02 Marks)

07. a) Discuss about the prediction of breakage of a multi-filament yarn, assuming the yarn behaves according to the Hooke's law. (04 Marks)

b) With the use of a suitable illustration, discuss the effect of twist on the 'Initial Modulus' of a multi-filament yarn made of Nylon. (06 Marks)

c) Explain why it is difficult to develop a model to analyse stress of staple yarns. (04 Marks)

08. a) Briefly describe three (03) fabric parameters that play an important role in ascertaining the geometry of a woven fabric. (06 Marks)

b) Derive the relationship between count of the yarn and the yarn diameter. (06 Marks)

c) Explain the phenomenon known as 'crimp interchange' providing a suitable example. (02 Marks)

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