THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF INDUSTRIAL STUDIES/
BACHELOR OF TECHNOLOGY
FINAL EXAMINATION 2012/2013
TTX5131 STRUCTURE AND PROPERTIES OF FIBRES
DURATION: THREE (3) HOURS

DATE:26.07.2013   **TIME:0930 – 1230 HOURS**

Answer Question Number one (1) which is compulsory and five (5) more questions. Question number 1 carries 25 marks and others carry fifteen (15) marks each.

1. (i) What are the basic building blocks of natural rubber, cotton and wool?   **(3 marks)**

   (ii) The starting materials of fibres are mainly natural or synthetic organic polymers. What are the requirements that you expect from polymers that are used for formation of *textile* fibres?   **(6 marks)**

   (iii) In order to polymerize a monomer, what are the four conditions required   **(4 marks)**

   (iv) What is the difference between thermoset and thermoplastic polymers? What is the main reason that contribute to this difference.   **(4 marks)**

   (v) Give one example each for fibres which involve following interactions or bonds.
       * H-bond, *ion-ion interaction, *disulphide bridges, *hydrophobic interaction,
       * л – electron interaction, *dispersion forces   **(6 marks)**

   (vi) State two factors that affect the glass transition temperature of polymers.   **(2 marks)**

2. If we consider the Yarn Production process of Nylon or Polyester, it involves Spinning, Drawing/draw twisting, Texturing and Heat setting.

   Explain with reasons the effect of changes given under **A** on the properties given under **B** in case of the above process, assuming that all the other process conditions are kept constant.

                                                                 (15 marks)

   Based on the theory you will have to think imaginatively to answer these questions.

   Spinning Process

Cause A	Effect B on the yarn
Increase of Spinning Temperature	Tenacity, elongation, dyeability
Increase of Viscosity of the polymer	Tenacity, elongation, dyeability
Increase of spinning speed	Tenacity, elongation

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Drawing Process

Cause A	Effect B on the yarn
Increase of Draw Ratio	Tenacity, elongation

3.(a) Define the terms: Surface Moisture, Capillary Moisture, Bound Moisture and Chemically bound moisture. **(4 Marks)**

(b) Distinguish the terms "flame resistance" and "flame retardant". **(3 marks)**

(c) Explain the three theories that provide the basis of imparting flame-retardant treatments on textiles. **(8 marks)**

4. (a) What do you understand by:

   a. Di-functional monomers
   b. Inter-molecular interaction in fibres
   c. Melt Spinning
   d. Packing density of fibres **(8 marks)**

   (b) Explain the "Porous Model" and "Free Volume Model" on diffusion of dyes into fibres. What are the fibres that favour the "Free Volume Model" and explain the reason for such behaviour. **(7 marks)**

5. a) What are the occurrences that take place during single axis drawing of undrawn synthetic yarn? **(6 marks)**

   b) What is the test to measure the orientation at a single point of a fibre ? **(3 marks)**

   c) What do you understand by "Glass Transition Temperature"? **(3 mark)**

   d) What are the factors that affect the Glass Transition Temperature of polymers? **(3 marks)**

6. (a) A burning test was carried out on four fibres A,B,C and D – suspected to be wool, viscose, rayon, cotton and polyester. Following observations were made.

   A – Burnt quickly with a yellow flame. Smelled like burning paper

   B – Burnt slowly with small flickering flame, sizzled and curled. Smelled like burning hair.

   C – Burnt quickly than A, with a bright yellow flame. Smelled like burning paper.

   D – Melted and burnt slowly. Produced a round hard, black bead.

   What could be A, B, C and D? **(8 marks)**

(b) . A solubility test was carried out on three fibres **A, B,** and **C** suspected to be Cotton, Wool and Silk.(not in the order given).

      Fibre A: Dissolves in 80% H_2SO_4, and does not dissolve in Con HNO_3 and Con.HCl at $30 - 40^0C$. It swells in 5% NaOH

      Fibre B: Dissolves in 5% NaOH, insoluble in 80% H_2SO_4 and Conc. HCl at $30 - 40^0C$. It stains yellow in Conc. HNO_3

      Fibre C: Dissolves in 5% NaOH, Stains yellow in Conc. HNO_3, Dissolves to a certain extent in 80% H_2SO_4, and does not dissolve in Conc. HCl at $30 - 40^0C$.

      Identify the three fibres A, B and C.   **(7 marks)**

7. (a) What are the factors that can influence heat-setting efficiency of synthetic yarn? Explain the effect of each factor with examples.   **(8 marks)**

   (b) What do you understand by the dielectric property? How is the dielectric constant, affected by the increase of moisture content and the temperature?   **(4 marks)**

   (c) State at least three negative effects of static charge in textile materials. Which fibre type gives the highest positive charge and highest negative charge?   **(3 marks)**

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