

# Textile Institute of Pakistan

<b>Course Title:</b>	Fibre Science
<b>Course Reference:</b>	TEXT-321
<b>Level of course:</b>	3
<b>Location of Course:</b>	Spring
<b>Credit Rating:</b>	3 Credits
<b>Pre-Requisite:</b>	TEXT-176
<b>Instructor:</b>	Aasim Ahmed
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## Course introduction

Building upon the course content of Introduction to Natural and Manmade Fibres, TEXT-176 the student will be expected to differentiate between natural and manmade Fibres and also be able to understand the basic properties of these fibres. This course should allow them to understand fibre properties (both physical and chemical), the limitations of these fibres based on their properties, the methods of production of these fibres (man made) and their end uses. The course will also go into latest developments in fibre science and what is expected off the future.

## Learning outcomes

- The students will be able to relate the properties of fibres to the behavioral characteristics of textiles during processing and end-use.
- The course will also shed light on the latest developments in fibre production and characterization techniques.
- They will understand the shaping of fibre properties during preparation of synthetic and regenerated fibres.
- They will develop an understanding of the important properties of natural and manmade fibres and the contributing factors to these properties.
- They will develop an insight of latest fibres such as Spider silk, Zetix, Vectran and others.
- They should be able to propose end uses of fibre with respect to processing and properties.

## PPD outcomes

Upon successfully completing the course, students will be able to correlate fibre properties with their functional and performance characteristics, thus enabling them to apply theoretical knowledge in the field during fibre processing from fibre production through various production processes to their end use.

They will be able to correlate fibres to specified end applications and suggest materials for advanced product development research. The course will also provide an insight into the latest in fibre development thus bringing the students up to date with the developments in fibre science and by the end of the course, leave them with fundamental knowledge with which they will be able to understand advanced concepts related to the subject.

## Teaching and learning methods

The course material will be based on books, websites, class presentations and lectures. A guest presentation seminar will also be arranged if possible and will be part of the course. Lecture notes and papers, as appropriate, will be available online on the website listed below.

Candidates will be expected to keep up with assigned tasks and will also be added to a 'google groups' mailing list through which assignments and quizzed may be communicated.

Further details available in the students' handbook, section 2.4.

## Course material

### Books

- Hearle J. W. S, Physical Properties of Textile Fibres, Second Edition, The Textile Institute, 1997
- J. Gordon Cook, Hand Book of Textile Fibres, Volume 1, Natural Fibres, Merrow Publishing Co. LTD, 1993
- J. Gordon Cook, Hand Book of Textile Fibres, Volume 3, Man-Made Fibres, Merrow Publishing Co. LTD, 1993
- Tatsuya Hongu, New Fibers, Second Edition, Woodhead Publishing LTD, Cambridge, England, 2001
- Menachim Lewin, Eli M. Pearce, Handbook of Fiber Chemistry, Second Edition, Marcel Dekker, Inc, 1998
- MC Tubbs, Textile Terms and Definitions, Ninth Edition, The Textile Institute, 1993

### Websites

- The microgalleria, <http://pslc.ws>
- Fiber source classroom, <http://fiberworld.com>
- Online lecture notes, <http://aasimahmed.googlepages.com>

### Seminar

- Guest lecture

## Attendance policy

As listed in Section 2.21 of the students' handbook, version 1.0.

## Testing and evaluation criteria

Class Tests	30%	2 X 15
Quizzes	10%	(n - y)
Project(s)	20%	
Final Exams	40%	

**A** - 90 to 100%

**B** - 80 to 89%

**C** - 70 to 79%

**D** - 60 to 69%

**F** - 0 to 59%

## Indicative course contents

- Introduction to fibre science
- Classification and structure
- Analysis of fibre properties
- Investigation into the properties of major fibre classes
- New developments in fibre production
- Beyond Kevlar
- End uses of fibres
- Fibres of the future

## Course Schedule (Tentative)

### Week 1 (2 Classes)

#### Introduction to fibre science

- Distribution of course outline.
- Discussion on prior knowledge.
- Overview and discussion on course content.
- What are fibres.
- The levels of structure in fibres. From atoms through monomers to polymers.
- Interaction between the structures in fibres, Vander Val forces and hydrogen bonds, dipole interactions.
- Brief overview of melt, dry and wet spinning.
- Polymerization.

### Week 2 & 3 (4 Classes)

#### Classification and Structure

- How components are laid out in fibres. Cross links and branching.
- Order and disorder in fibres. Crystallinity and orientation.
- Growth of crystals. Fibre formation theories, Fringed miscelle [no chain folding], lamellar [chain folding within crystal], Spherulite.
- How fibre structure is constituted from a combination of; Degree of order, degree of localization of order, length to width ratio of localized units, degree of orientation and size of localized units.

### Week 4 & 5 (4 Classes)

- Analysis of fibre properties
  - Infra red spectroscopy
  - Optical and X-ray diffraction studies
  - Optical microscopy, electron microscopy
  - Thermal analysis
  - Density
  - Nuclear Magnetic Resonance
  - General physical properties

### Week 6 & 7 (4 Classes)

- An investigation into the properties of major fibre classes.
  - Natural cellulosic fibres
  - Regenerated and modified celluloses
  - Protein fibres
  - Synthetic fibres

### **Week 9 & 10 (4 Classes)**

New developments in fibre production

- New methods of production
  - Electrospinning
  - Gel spinning
- New fibres
  - Beyond Kevlar

Fibre applications

- Fibres for technical textiles

### **Week 11 & 12 (4 Classes)**

End uses of fibres

- Biotechnology and fibres
- Electronics and fibres
- Cars and fibres
- Fibres in space
- Fibres in nuclear power
- Fibres in sport
- Fibres for geotextiles
- Fibres in the ocean

### **Week 13 (2 Classes)**

Fibres of the future

- Super function fibres
- Super-biomimetic fibre materials
- Super-natural materials
- Resource recycling
- Fibres for health

### **Week 14 (2 Classes)**

Submission and review of projects

### **Week 15 (2 Classes)**

Dead Week – Revision

### **Week 16**

Finals