GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3142904
Semester – IV
Subject Name: Fibre Physics

Type of course: Basic Science

Prerequisite: Basic knowledge of physics, chemistry and textile fibres

Rationale: Fibre is the only raw material used for all activities of textile. The fibres are varied in nature and properties due to the way they are either available or produced. It is very important to study physical properties of fibres so that their behavior in later on processes and properties of end product can be understood in better way.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No	Topics	No. of Lectures
1	**Introduction to Fibre Structure** Investigation methods of fibre structure and their limitations; Microscopic methods: Electron microscope(SEM, TEM); X-ray diffraction methods (WAXS, SAXS); Optical birefringence; Infrared spectroscopy(FTIR); Density measurements. Nuclear magnetic resonance, The general problem of fibre structure, Fine and morphological structure of: natural-cellulose fibres; regenerated and modified celluloses; protein fibres; synthetic fibres	**14**
2	**Moisture Absorption Properties** Definitions of humidity; moisture regain, moisture content, Equilibrium, Measurement of regain, Relation between regain and relative humidity, Effect of stress and temperature on regain, Heat of sorption; Swelling of fibres	**9**
3	**Tensile Properties** Definitions: breaking strength, breaking extension, tensile stress, tensile strain, mass specific stress, yield point, initial modulus, secant modulus, work of rupture and work factor; Stress-strain curves for various textile fibres and their significance. Factors influencing tensile properties of fibres; Elastic properties; Methods of tensile testing – CRL / CRT/ CRE methods, The study of time dependence, Creep, Definitions of torsional rigidity and flexural rigidity	**8**
4	**Optical and Frictional Properties** Definitions of refractive index, birefringence & orientation; Reflection and luster; Fibre friction; Theories of friction – Amonton's law; Measurement of friction and	**6**

	factors influencing fibre friction; Friction in wool;	
5	**Electrical and Thermal Properties** Definitions of dielectric properties, Definitions of electrical resistance, Measurement of electrical resistance of fibres; Thermal parameters(specific heat of fibres, thermal conductivity, expansion and contraction), Irreversible shrinkage, Thermal transitions, The secondary transitions in fibres, Melting and multiple melting phenomena	**5**

Suggested Specification Table with Marks (Theory)

Distribution of Theory Marks				
R Level	**U Level**	**A Level**	**N Level**	**E Level**
16	22	22	5	5

Legends: R- Remembrance; U-Understanding; A- Application; N-Analyze and E- Evaluate
(Revised Bloom's Taxonomy)
Note: This specification table shall be treated as general guidelines for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Physical Properties of Textile Fibres, W. E. Morton and J. W. S Hearle.
2. Textile Science, E.P.G. Gohl and L.D.Vilensky.
3. Microscopy of Textile Fibre, Greaves & Saville
4. Manufactured Fibre Technology, V.B.Gupta and V.K.Kothari

Course Outcomes:

Sr no	**CO statement**	**Marks %Weightage**
CO-1	Describe the fine and morphological structure of various fibres.	22
CO-2	Interpret the moisture absorption properties of different fibres.	22
CO-3	Evaluate tensile properties of different fibres.	16
CO-4	Distinguish the optical and frictional properties of different fibres.	5
CO-5	Differentiate the electrical and thermal properties of various fibres.	5

List of experiments:

1. To study crystal size and crystallinity of fibres using X-ray diffraction

2. To examine the surface of fibre using SEM.
3. To identify the presence of groups in molecule using infrared radiation.
4. To study orientation of fibres using birefringence.
5. To study the crystalline and amorphous region with matrix rigidity using NMR.
6. To find the density of fibres using density gradient column.
7. To find the axial swelling using extension gauge.
8. To investigate diameter swelling of fibres using microscope.
9. To find Moisture regains of fibres by absorption and desorption method.
10. To find the humidity using hygrometer.

Major Equipments:

X-ray diffraction, Scanning Electron Microscope, Fourier transform infrared microscopy, Optical Birefringence, Nuclear Magnetic Resonance, Density analyser such as density gradient column, Extension gauge, Electronic balance, and necessary glass wares, Dry and Wet bulb hygrometer(or any other hygrometer).

List of Open Source Software/ Learning websites: http://nptel.iitm.ac.in; google search engine.