

**Bahauddin Zakariya University College of Textile Engineering, Multan**



**Curriculum**

**For**

**BSc. Textile Engineering**

**(With effect from the intake 2022-onward)**

## **Preface**

The course has been designed in accordance with the guidelines of the HEC and PEC. There are 18 weeks in a semester; 16 weeks for teaching and 2 weeks for examination.

**Dr. Amir Abbas**  
**Principal**

## **College Vision**

To be a global leader in, and renowned for high quality education and research in textiles and capable of meeting industrial / societal needs.

## **Program Mission**

B.Sc. Textile Engineering program aims to produce professionals with adequate knowledge, skills and attitude by providing high quality education for successful careers.

## **Programme Educational Objectives (BSc Textile Engineering)**

1. Apply the knowledge and basic principles of science and Engineering for process designing and smooth running of textile Industry
2. Achieve professional excellence by understanding and providing solution to the engineering, social, ethical and environmental problems of the industry through effective communication in individual and team work
3. Adopt new trends and innovations in engineering by becoming a part of professional trainings and/or studies in field of textile manufacturing and management

## Program Learning Outcomes (BSc Textile Engineering):

BS Textile Engineering Program aims at achieving the following learning outcomes in the students by the time of graduation:

No	Attributes	Revised Program Learning Outcomes (PLOs)
1	Engineering Knowledge	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2	Problem Analysis	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3	Design/Development of Solutions	An ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4	Investigation	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
5	Modern Tool Usage	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
6	The Engineer and Society	An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.
7	Environment and Sustainability	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9	Individual and Team Work	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

10	Communication	An ability to communicate effectively, orally as well as in writing, on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project Management	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
12	Lifelong Learning	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

# Scheme of Studies for B.Sc. Textile Engineering Program for intake 2022-Onward

## First Year

### 1<sup>st</sup>Semester

Course		Credit Hours		
Code	Title	Theory	Lab	
TEX-101	Introduction to textile engineering	2	0	
TEX-103	Calculus and analytical geometry	3	0	
TEX-105	Applied chemistry	3	1	
TEX-107	Applied physics	3	1	
TEX-109	Islamic studies and ethics	2	0	
TEX-111	Occupational health and safety	1	0	
	<b>Total:</b>	<b>14</b>	<b>2</b>	<b>16</b>

### 2<sup>nd</sup>Semester

Course		Credit Hours		
Code	Title	Theory	Lab	
TEX-102	Textile raw materials	3	0	
TEX-104	Engineering drawing	1	1	
TEX-106	Mechanical engineering fundamentals	2	1	
TEX-108	Information and communication technologies	2	1	
TEX-110	Linear algebra	3	0	
TEX-112	Pakistan studies and global perspectives	2	0	
	<b>Total:</b>	<b>13</b>	<b>3</b>	<b>16</b>

## Second Year

### 3<sup>rd</sup>Semester

Course		Credit Hours		
Code	Course Title	Theory	Lab	
TEX-201	Introduction to yarn manufacturing	3	1	
TEX-203	Introduction to fabric manufacturing	3	1	
TEX-205	Fibre science	2	0	
TEX-207	Electrical and electronic engineering fundamentals	2	1	
TEX-209	Differential equations	3	0	
	Total:	13	3	16

### 4<sup>th</sup>Semester

Course		Credit Hours		
Code	Course Title	Theory	Lab	
TEX-202	Introduction to textile chemical processing	3	1	
TEX-204	Introduction to garment manufacturing	3	1	
TEX-206	Computer Programming	2	1	
TEX-208	Communication skills	2	0	
TEX-210	Organizational behavior	3	0	
	Total:	13	3	16

## Third Year

### 5<sup>th</sup>Semester

Course		Credit Hours		
Code	Course Title	Theory	Lab	
TEX-3X1	Engineering elective-I	2	1	
TEX-301	Textile testing and quality control	3	1	
TEX-303	Instrumentation and control	2	1	
TEX-305	Colour science	3	0	
TEX-307	Engineering economics	3	0	
TEX-309	Thermodynamics and fluid mechanics	2	0	
	Total:	15	3	18

### 6<sup>th</sup>Semester

Course		Credit Hours		
Code	Course Title	Theory	Lab	
TEX-3X2	Engineering elective-II	3	1	
TEX-3X4	Engineering elective-III	3	0	
TEX-302	Principles of management	2	0	
TEX-304	Probability and statistics	3	0	
TEX-306	Manufactured and high performance fibers	3	0	
TEX-308	Smart textiles	2	0	
	Total:	16	1	17



## Fourth Year

### 7<sup>th</sup>Semester

Course		Credit Hours		
Code	Course Title	Theory	Lab	
TEX-4X1	Engineering elective-IV	3	1	
TEX-4X3	Engineering elective-V	3	1	
TEX-401	Technical textiles manufacturing	3	0	
TEX-403	Technical writing and presentation skills	3	0	
TEX-405	Final year design project-I	0	3	
	<b>Total:</b>	<b>12</b>	<b>5</b>	<b>17</b>

### 8<sup>th</sup>Semester

Course		Credit Hours		
Code	Course Title	Theory	Lab	
TEX-402	Engineering management	3	0	
TEX-404	Environment, health and safety	3	0	
TEX-406	Textile industry utilities and services	3	0	
TEX-408	Denim manufacturing and processing	3	0	
TEX-410	Recent trends in textiles	2	0	
TEX-412	Final year design project-II	0	3	
	<b>Total:</b>	<b>14</b>	<b>3</b>	<b>17</b>

Compulsory Industrial Internship (6-8 weeks, 6 days/week, 8 hours/day during summer holidays Non-Credit

**Total Credit Hours = 133**

## List of Elective/Specialization Courses

### 1. Yarn Manufacturing

	Course Code	Course Title	Credit hours
Elective-I	TEX-311	Pre-spinning processes	2+1
Elective-II	TEX-312	Yarn production engineering	3+1
Elective-III	TEX-314	Spinning calculations	3+0
Elective-IV	TEX-411	Advanced spinning techniques	3+1
Elective-V	TEX-413	Specialty yarns	3+1
Total			18

### 2. Fabric Manufacturing

	Course Code	Course Title	Credit hours
Elective-I	TEX-321	Weaving preparatory processes	2+1
Elective-II	TEX-322	Weaving mechanisms	3+1
Elective-III	TEX-324	Weaving calculations	3+0
Elective-IV	TEX-421	Fabric design & structure	3+1
Elective-V	TEX-423	Advanced weaving	3+1
Total			18

### 3. Textile Chemical Processing

	Course Code	Course Title	Credit hours
Elective-I	TEX-331	Pre-treatment of textiles	2+1
Elective-II	TEX-332	Textile dyeing	3+1
Elective-III	TEX-334	Dyestuff engineering	3+0
Elective-IV	TEX-431	Textile printing	3+1
Elective-V	TEX-433	Textile finishing & coating	3+1
Total			18

### 4. Garment Manufacturing

	Course Code	Course Title	Credit hours
Elective-I	TEX-341	Garment sizing and pattern making	1+2
Elective-II	TEX-342	Computer aided pattern design and product development	3+1
Elective-III	TEX-344	Clothing merchandizing and sourcing	3+0
Elective-IV	TEX-441	Clothing production processes and machinery	3+1
Elective-V	TEX-443	Sewn product engineering	3+1
Total			18

## Framework for Bachelor of Textile Engineering Program

Knowledge Profile (WK-1 to WK-8)	Knowledge Area	Sub Area	Course Title	Theory	Lab	Total			
				Credit Hours					
<b>Non-Engineering Domain</b>									
			Communication Skills	2	0	2	<b>5</b>		
			Technical Writing and Presentation Skills	3	0	3			
		Culture 2	Islamic Studies and Ethics	2	0	2	<b>4</b>		
			Pakistan studies and Global Perspectives	2	0	2			
		Professional Ethics (2-6)	Organizational behaviour	3	0		<b>6</b>		
			Engineering Economics	3	0	3			
		Management Sciences	Professional Practice (2-6)	Engineering management Management	3	0	3	<b>5</b>	
				Principles of management	2	0	2		
		WK-2	Natural Science	Math (12-15)	Calculus and Analytical Geometry	3	0	3	<b>12</b>
					Linear Algebra	3	0	3	
Differential Equations	3				0	3			
Probability and Statistics	3				0	3			
WK-1		Physics (6-9) Chemistry	Applied Physics	3	1	4	<b>8</b>		
	Applied Chemistry		3	1	4				
<b>Total(Non-Engineering Domain)</b>									
				<b>38</b>	<b>2</b>	<b>40</b>			

Engineering Domain							
WK-2/WK-4/WK-5/WK-6	Computer and Information Science (6-9)	ICT/AI/ Data Science/ Cyber Security	Information and Communication Technologies(ICT)	2	1	3	6
			Computer Programming	2	1	3	
WK-3/WK-2	Engineering Foundation (22-24)	---	Introduction to Textile Engineering	2	0	2	22
			Textile Raw Materials	3	0	3	
			Engineering Drawing	1	1	2	
			Fiber Science	2	0	2	
			Manufactured and High-Performance Fibers	3	0	3	
			Environment, Health and Safety	3	0	3	
			Textile Industry Utilities and Services	3	0	3	
			Textiles Testing and Quality Control	3	1	4	
WK-4/WK-2/WK-1	Major-based core(Breadth) (23-24)	---	Colour science	3	0	3	24
			Introduction to Yarn Manufacturing	3	1	4	
			Introduction to Fabric Manufacturing	3	1	4	
			Introduction to Textile Chemical Processing	3	1	4	
			Introduction to Garment Manufacturing	3	1	4	
			Technical Textiles Manufacturing	3	0	3	
			Smart Textiles	2	0	2	
WK-5/WK-6	Major-based core(Depth) (22-24)	---	Engineering Elective-I	2	1	3	23
			Engineering Elective-II	3	1		
			Engineering Elective-III	3	0		
			Engineering Elective-IV	3	1		
			Engineering Elective-V	3	1		
			Recent Trends in Textiles	2	0	2	
			Denim Manufacturing and Processing	3	0	3	

WK-3/WK-4/WK-2/WK-1	Multi-disciplinary engineering (6-12)	---	Mechanical Engineering Fundamentals	2	1	3	<b>12</b>
			Electrical & Electronics Engineering Fundamentals	2	1	3	
			Instrumentation & Control	2	1	3	
			Thermodynamics and Fluid Mechanics	2	0	2	
			Occupational Health and Safety	1	0	1	
WK-6/WK-7/WK-8	Final Year Design Project(FYDP)/ Capstone (6)	Industrial/ Innovative/ Creative Project	FYDP(Part-I)	0	3	6	<b>6</b>
			FYDP(Part-II)	0	3		
WK-6/WK-7/	Industrial Training	Atleast 6 –8weeks internship		0	0	0	
WK-2/WK-4/WK-5/WK-6/WK-7/WK-8	<b>Innovative and Critical thinking (under Relevant Courses)</b>						
	<ul style="list-style-type: none"> <li>- Complex Problem Solving</li> <li>- Complex Engineering Activities</li> <li>- Semester Project</li> <li>- Case Studies</li> <li>- Open ended labs</li> <li>- Problem Based Learning</li> </ul>						
<b>Total Non Engineering Domain</b>				<b>38</b>	<b>2</b>	<b>40</b>	
<b>Total (Engineering Domain)</b>				<b>75</b>	<b>18</b>	<b>93</b>	
<b>Total Credit Hours</b>						<b>133</b>	

## Semester I

### TEX-101: Introduction to Textile Engineering (2+0)

#### Overall Aim of the Course:

The objective of the course is to get students familiarize with the history of textiles in general and textile history and market of Pakistan in particular. The course focuses on introductory level knowledge of textile industry, its basic raw materials, conversion departments and techniques used for conversion. Course also brief about functional textile, finishing and different testing techniques.

#### Course Learning Outcomes:

Students should be able to achieve/gain following during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Understanding the dynamics of textile Industry and related terminologies	Cognitive-2	PLO-1
CLO-2	Knowledge and understanding of conventional and unconventional Textile products	Cognitive-2	PLO-1

#### Course Contents

##### Module 1: Introduction

Introduction to textile manufacturing processes and textile machines. Introduction to various departments of textile industry, description of general terms used in textiles.

##### Module 2: History of Textiles

History and scope of textile sector in Pakistan and around the globe, textile material manufacturing, World and Pakistan's fiber, yarn and fabric production and trade volume

##### Module 3: Textile Raw Material

Introduction to textile fibers. General classification of textile fibers (natural /manmade) and their application.

##### Module 4: Cotton Ginning

Process flow chart, types of ginning, Preparation of cotton bales, terms used in ginning, factors that can

affect the fiber quality.

### **Module 5: Yarn Manufacturing**

Process flow chart, introduction to yarn manufacturing processes & machines, terms used in spinning.

### **Module 6: Fabric Manufacturing**

Types of fabric manufacturing techniques, process flow chart of weaving, introduction to weaving machines, terms used in weaving, process flow chart of knitting, introduction to knitting machines, terms used in knitting.

### **Module 7: Wet Processing**

Process flow chart of wet processing, introduction to wet processing (pre-treatment, dyeing, printing, finishing), terms used in wet processing.

### **Module 8: Garment Manufacturing**

Process flow chart of garment manufacturing, types of garments, operations of garments manufacturing, pattern making, cutting, sewing, terms used in garment manufacturing,

### **Module 9: Technical Textiles**

Introduction to technical textile, function of technical textiles, categories of technical textiles; Agro-tech, Build-tech, Cloth-tech, Geo-tech, Home-tech, Med-tech, Mobil-tech, Pro-tech, Sport-tech etc.

### **Module 10: Textile Testing and Quality Control**

Introduction to textile testing, types of textile testing & requirements, terms used in textiles testing and quality control

### **Module 11: Textile and Fashion design**

Introduction to textile and fashion design, history of textile & fashion design, terms used in fashion design.

### **Recommended Books:**

- Textiles: Fibre to Fabric by Corbman B.P. 1985.
- Textiles and Fashion; Materials, Design and Technology by Rose Sinclair Woodhead Publishing 2014.
- Introduction to Textile Technology by Ishida. T. 1991.
- Textile Engineering; An Introduction by Yasir Nawab. 2016.
- Textile Reference book for Spinning by ACIMIT 2002
- Textile Reference book for Weaving by ACIMIT 2000

- Textile Reference book for Knitting by ACIMIT 2001
- Textile Reference book for Finishing by ACIMIT 2002
- Textiles and fashion by Jenny Udale 2008

## TEX-103 Calculus and Analytical Geometry (3+0)

### Aim of the course:

To develop a clear understanding of fundamental concepts of single variable calculus. To apply concepts of differentiation and integration to solve complex engineering problems

### Course Learning Outcomes:

Students should be able to achieve/gain following during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonom yLevel	PLO
CLO-1	Apply cross and dot product to determine angles between Vectors, orientation of axes area of triangles and parallelograms inspace scalar and vector projection and volume of parallelepipeds.	Cognitive-3	PLO-2
CLO-2	Find maxima and minima critical point and inflection pointof function.	Cognitive-3	PLO-1
CLO-3	To interpret numerical integration, integration by parts.	Cognitive-3	PLO-1
CLO-4	Understand the concept of definite integral and Evaluate a definite integral using on anti-derivative (fundamental theorem of calculus). Find the arc length and surface area.	Cognitive-4	PLO-1

### Course Contents:

#### Module 1: Analytical Geometry:

- Review of vectors, scalars and vector products.
- Three-dimensional coordinate system and equation of straight line and plane

#### Module 2: Functions Limit and Continuity:

- Review of functions and graphs,
- Limits & Continuity,
- Techniques of Finding Limits,
- Discontinuity,
- Limits of Sine and Cosine and Exponential Functions



**Module 3: Differentiation:**

- Introduction to Derivatives
- Examples of Derivatives
- Derivative as Rate of Change
- Derivative's Rules
- Implicit Differentiation
- Higher order derivatives
- Leibnitz Theorem

**Module 4: Applications of Derivatives:**

- Applications of Derivatives
- Monotonic functions
- Optimization problems
- Relative and Absolute extrema
- First and second derivative tests
- Point of inflection
- Concavity
- Curvature
- Indeterminate Forms and L' Hospital rule
- Differentials

**Module 5: Integration:**

- Integrals and Properties of Integrals
- Techniques of Integration
- Integration by Parts
- Definite Integrals
- Integration of Trigonometric
- Exponential and Inverse Functions
- Integration by Partial Fractions
- Reduction Rules

**Module 6: Applications of Integration:**

- Applications of Integration
- Area under the curve
- Area between curves
- Solids of Revolution
- Volume of Solids of revolution by disk
- washer, Cylindrical shell & Cross Section Methods
- Center of Pressure and Depth of Center of Pressure
- Center of mass
- Arc length

**Module 7: Improper Integrals:**

- Improper Integrals
- Integrals and Singularities
- Convergence of improper integrals

**Module 8: Infinite Sequence and Series:**

- Sequence and Infinite Series
- Convergence and Divergence of sequences and series
- Positive Term Series
- Integral Test
- Basic Comparison Test
- Limit Comparison Test
- Ratio and Root tests
- Alternating series
- Absolute and Conditional Convergence

**Module 9: Power and Taylor Series:**

- Power series
- Maclaurin and Taylor Series and its Applications

**Recommended Books:**

- Thomas' Calculus by George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Pearson, USA.
- Swokowski, Onlinick & Pence: Calculus
- Robert T. Smith & Roland B. Minton: Calculus
- Calculus: Early Transcendentals by James Stewart. Brooks/Cole USA.

**TEX-105 Applied Chemistry (3+1)****Overall Aims of the Course:**

The objectives of this course are to enable the students to understand the chemistry and properties of the auxiliaries used in industry generally and textiles specifically. This course also intends to fortify the basic concepts of organic chemistry which are indispensable in understanding the structure and properties of fibers, colorants and other finishes used in textile industry.

**Course Learning Outcomes:**

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Understand the chemistry of different auxiliaries, soap and emulsions used in textile industry	Cognitive-2	PLO-1
CLO-2	Determine the potential application area of a surfactant by analyzing its structural formula and properties.	Cognitive-3	PLO-3
CLO-3	Prepare organic compounds and carry out tests for the identification of the functional groups of the organic compounds and explain the characteristic properties of a given functional group with reference to its structure.	Psychomotor -2	PLO-2

**Course Contents:****Module 1 Chemistry and Properties of Surfactants**

Hydrophiles, Hydrophobes, Types of Surfactants (anionic, cationic, non-ionic, amphoteric), properties of surfactants and their solutions (surface tension, hydrophilic-lipophilic balance, cloud point, critical micelle concentration)

**Module 2 Chemical auxiliaries used in textile processing**

Enzymes, Wetting agents and detergents, Sequestering/Complexing/Chelating agents, Dispersing and solubilizing agents, leveling and retarding agents, thickening agents, dye exhausting and fixing agents, migration inhibitors, anti-foaming agents.

**Module 3: Soaps and Emulsions**

Oils, fats, waxes, saponification, emulsifiers, emulsification, macro-, micro- and nano-emulsions, oil/water and water/oil emulsions

**Module 4: Applied Organic Chemistry**

Hydrocarbons and their application in textiles, Functional groups and their properties (Alcohols, carboxylic acids, esters, amines and amides), Carbohydrates (polysaccharides, starch, cellulose, chitosan)

**List of Practical:**

As per course contents

**Recommended Books:**

- Organic Chemistry, Vollhardt
- Vogel's Textbook of Quantitative Chemical Analysis, G.H. Jeffery
- Organic Chemistry, L.G. Wade
- Organic Chemistry, Paul Y. Bruice

**TEX-107 Applied Physics (3+1)****Course learning Outcomes**

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge and understanding of electric charges, electricity, current and voltage. Sources of electric and magnetic flux, fields, induction and their application	Cognitive-2	PLO-1
CLO-2	Analyze and comprehend Waves, their types and role in modern technology	Cognitive-2	PLO-1
CLO-4	Distinguish between classical and modern optics, explain nature of light and its role in textile engineering	Cognitive-2	PLO-1
CLO-5	Able to Explain thermodynamic its first and second law and the role of heat in modern technology	Cognitive-2	PLO-1

**Course Outline:****Vectors:**

Review of vectors, Ordinary Differentiation of Vector, Gradient of Scalar field, Divergence and Curl of Vector Field, Line, surface and volume integrals with their applications.

**Electricity & Magnetism:**

Electric field due to Discrete and Continuous Charge Distributions, Electrostatic Potential of discrete and Continuous charges, Gauss's Law and its Applications, Lorentz Force and Hall Effect, Ampere's Law, Maxwell's Equations, Magnetic Field due to current element (Circular Current Loop and Solenoid), Faraday's Law.

**Waves & Oscillations:**

Types of Waves and Superposition Principle, Wave Speed on a stretched string, Wave equation, Energy & Power of a Wave, Principle of Superposition and Standing Waves. Simple Harmonic oscillations. Forced & damped oscillations.

**Optics and Lasers:**

Huygens Principle, Two-slit interference, Single-Slit Diffraction, resolving power of Optical Instruments, Lasers and laser light, Working principle of lasers

**Atomic and Nuclear Physics:**

Atomic Nucleus and Properties of Nucleus, Radioactive Decay and Radioactive Dating. Nuclear Reactions, Nuclear Reactor, Thermonuclear Process, Controlled Thermonuclear Fusion, Radioactive Decay and Radioactive Dating, Radiation Detection Instruments,.

**Thermodynamics:**

Laws of thermodynamics and Heat Transfer Mechanisms, Heat and Work, Kinetic Theory of gases, Ideal gases, Mean Free path, distribution of molecular speeds, Change in Entropy and Irreversible processes.

**Recommended Books:**

- Halliday, Resnick and Walker, "Fundamentals of Physics" 10th Edition Extended
- Hugh D. Young and R.A. Freedman, University Physics. 12th Edition
- Raymond A Serway and John W. Jewett, Jr. Physics for Scientists and Engineers with modern Physics, 9th Edition.

## TEX-109: Islamic studies and ethics (2+0)

### Overall Aims of the Course:

To develop in students understanding of contemporary social, political and economic issues in the lightof the Quran and Sunnah of the Holy Prophet (S.A.W)

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Able to learn and display the principals of Islam ,Islamic teachings to express and debate issues related to religious life	Affective-3	PLO-6
CLO-2	Compare different social systems of the world with Islamic Principles of economics, family, society and environment.	Affective-4	PLO-6
CLO-3	Improve their Skills to offer prayers and other worships	Affective-2	PLO-12

### Course Contents:

#### Module 1: Introduction to Quranic Studies

- Basic Concepts of Quran
- History of Quran
- Uloom-ul-Quran
- Quran as a book of Guidance

#### Module 2: Study of Selected Text of Holy Quran

- Verses of Surah Al-Baqara Related to Faith (Verse No-284-286)
- Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- Verses of Surah Al-Anam Related to Ahkam (Verse No-152-154)

#### Module 3: Study of Selected Text of Holy Quran

- Verses of Surah Al-Ahzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
- Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

#### Module 4: Seerah of Holy Prophet (S.A.W)

- Life of Muhammad Bin Abdullah (Before Prophet Hood)
- Life of Holy Prophet (S.A.W) in Makkah

- Important Lessons Derived from the life of Holy Prophet in Makkah
- Life of Holy Prophet (S.A.W) in Madina
- Important Lessons Derived from the life of Holy Prophet in Madina

#### **Module 5: Introduction to Sunnah**

- Basic Concepts of Hadith
- History of Hadith
- Kinds of Hadith
- Uloom-ul-Hadith
- Sunnah & Hadith
- Legal Position of Sunnah

#### **Module 6:**

- Selected Studies from Text of Hadith Module

#### **Module 7: Islamic Economic System**

- Basic Concepts of Islamic Economic System
- Means of Distribution of wealth in Islamic Economics
- Islamic Concept of Riba
- Islamic Ways of Trade & Commerce

#### **Module 8: Social System of Islam**

- Basic concepts of social system of Islam
- Elements of family
- Ethical values of Islam

#### **Module 9: Concept of Ibadah in Islam**

- Main Ibadah's and their importance
- Salah, Som, Zakah, Haj, Jihad

#### **Recommended Books:**

- Seerat ul Nabi by Allama Shibli Noumani
- Tafhim ul Quran by Syed Abu al Ala Modudi
- Introduction to Islam by Hameed Ullah Muhammad, Mulana Muhammad Yousaf islahi
- Studies in Islamic Law, Religion and Society by H.S. Bhatia, Deep & Deep Publications, India,1989

### **TEX-111 Occupational Health and Safety (1+0)**

#### **Course Description:**

This course introduces the student to the study of workplace occupational health and safety. The student will learn safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations as well as in the home.

### Course Learning Outcomes:

Upon successful completion of this course, the student will be able to:

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Identify hazards in the home, laboratory and workplace that pose a danger or threat to their safety or health, or that of others.	Affective-2	PLO-6
CLO-2	Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.	Affective-3	PLO-6

### Course Outline:

#### Health and Safety Foundations

- Nature and scope of health and safety
- Reasons/benefits and barriers for good practices of health and safety
- Legal frame work and OHS Management System

#### Fostering a Safety Culture

- Four principles of safety- RAMP (Recognize, Assess, Minimize, Prepare)
- Re-thinking safety-learning from incidents
- Safety ethics and rules
- Roles and responsibilities towards safety
- Building positive attitude towards safety
- Safety cultures in academic institutions

#### Recognizing and Communicating Hazards

- Hazards and Risk
- Types of hazards: Physical (mechanical and non-mechanical), Chemical (Toxic and biological agents), electrical, fire, construction, heat and temperature, noise and vibration, falling and lifting etc.
- Learning the language of safety: Signs, symbols and labels

#### Finding Hazard Information

- Material safety data sheets
- Safety data sheets and the GHS (Globally Harmonized Systems)

#### Accidents & Their Effect on Industry

- Costs of accidents



- Time lost
- Work injuries, parts of the body injured on the job
- Chemical burn injuries
- Construction injuries
- Fire injuries

### **Assessing and Minimizing the Risks from Hazards**

- Risk Concept and Terminology
- Risk assessment procedure
- Risk Metric's
- Risk Estimation and Acceptability Criteria
- Principles of risk prevention
- Selection and implementation of appropriate Risk controls
- Hierarchy of controls

### **Preparing for Emergency Response Procedures**

- Fire
- Chemical Spill
- First Aid
- Safety Drills / Trainings:
- Firefighting
- Evacuation in case of emergency

### **Stress and Safety at Work Environment**

- Workplace stress and sources
- Human reaction to workplace stress
- Measurement of workplace stress
- Shift work, stress and safety
- Improving safety by reducing stress
- Stress in safety managers
- Stress and workers compensation

### **Incident Investigation**

- Importance of investigation
- Recording and reporting
- Techniques of investigation
- Monitoring
- Review
- Auditing Health and Safety

### Recommended Books:

- The A-Z of health and safety by Jeremy Stranks, 2006.
- The Manager's Guide to Health & Safety at Work by Jeremy Stranks, 8th edition, 2006.
- Occupational safety and health law handbook by Ogletree, Deakins, Nash, Smoak and Stewarts, second edition, 2008.

## 2<sup>nd</sup> Semester

### TEX-102 Textile Raw Materials (3+0)

#### Overall Aims of the Course:

This course is designed to give student knowledge about the raw materials for textile industry. The course involves the detailed knowledge of fibers. The course focuses on selection, properties, production and conversion of material into useful textile as per requirement.

#### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Understanding and Knowledge of the classification of raw materials used in textile Industry	Cognitive-2	PLO-1
CLO-2	Ability to demonstrate and differentiate appearance, internal structure, properties and applications of fibers in detail and knowledge about their production and processing	Cognitive-3	PLO-4
CLO-3	Ability to select a suitable raw material for particular end use and product development	Cognitive-4	PLO-3

#### Course Outline:

##### Module 1 Textile Fibers

- Definition and classifications of textile fibers

##### Module 2 Plant Fibers

- Cotton: Introduction of cotton and its types, Cultivation, harvesting and picking of cotton, Structure and morphology of cotton fiber, Physical, chemical properties and end uses of cotton fiber, Varieties of Pakistani cotton, Cotton grading.
- Bast fibers: Fibers such as jute, flax, ramie etc., Production and processing of bast fibers, Fiber structure, morphology, physical and chemical properties and end uses.

- Leaf fibers: Fiber such as abaca and sisal etc., Production, processing, structure, morphology, physical and chemical properties and end uses.

### **Module 3 Animal Fibers**

- Hair fibers: Introduction, classification, structure, production, properties and uses of wool fibers, Grading of wool, Introduction of fibers such as Camel, Mohair, Cashmere, Alpaca and Angora.
- Silk: Production, structure, properties and end uses of silk yarn.

### **Module 4 Regenerated Fibers**

- Manufacturing methods of viscose, lyocel, bamboo and cellulose acetate and its derivatives like Tencel. Their structure, properties and end uses in textile industry.

### **Module 5 Synthetic Fibers**

- Manufacturing methods of polyester, polyamide, polypropylene, polyethylene and acrylic fibers, their structure, properties and end use in textile industry.
- Manufacturing methods of various elastane fibers such as Lycra, their structure, properties and end uses in textile industry.
- Competition of natural and man-made fibers in textile industry.

### **Recommended Books:**

- Ivana Markova, Textile Fiber Microscopy A Practical Approach, 2019
- J.W.S. Hearle, Fiber Structure 2013
- J.W.S Hearle, Handbook of Textile Fibres Structures (vol. 1 and 2), 2009
- S. Gordon and You-Lohsieh, Cotton Science and Technology, 2007
- C. Woodings, Regenerated Cellulosic Fibres, 2001
- Morton, W.E. and J.W.S. Hearle, Physical Properties of Textile Fibres, 2008

## TEX-104 Engineering Drawing (1+1)

### Overall Aims of the Course:

To introduce the students to the “universal language of Engineers” for effective communication through drafting exercises of geometrical solids.

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Ability to perform basic sketching and produce engineering drawings	Psychomotor-1	PLO-5
CLO-2	Ability to interpret Orthographic, Isometric and Perspective views of objects	Psychomotor-1	PLO-5
CLO-3	Ability to use architectural and engineering scales and drawing of textile machine components	Psychomotor-2	PLO-5

### Course Contents:

#### Module 1 Introduction

- Drawing equipment and the use of instruments, Basic drafting techniques and standards.

#### Module 2 Basic Engineering Drawing

- Projection of points, lines, planes and solids. Orthographic projections.

#### Module 3 Geometrical Curves

- Plane curves, cycloid, hypocycloid, and the Involute. Intersections at various positions of geometrical bodies such as prisms, pyramids, cylinders and cones.

#### Module 4 Concept of Working Drawing

- Size, description, dimensions, and specifications, limit dimensioning, and geometric tolerance, limits fits and tolerances, conventional symbols.

#### Module 5 Drawing of Textile Machine Components

- Nuts and bolts, shafts, couplings, bearings, pulleys, connecting rods, locking arrangements. Sectioning of machine components. Assembly drawing.

## Module 6 Isometric Views

- Isometric views with especial reference to piping and ducting.

### List of Practical:

- Drawing elements and their used: “drawing board, T-square, Drawing instruments and scale”
- Lines, lettering and dimensions: types and applications in engineering drawing and graphics.
- Geometrical constructions: “angles, circles, triangles, tangents, curves and engineering projections in practices”
- Assembly and production design: “concepts of elevation and end view of projection, industrial production drawing concept with specifications.
- Mechanical joints (welded joints; rivets; nuts and bolts; screw fasters); keys; keyways.
- Tolerance limits and fits
- CAD/CAM in Engineering Drawing (Solid works or Pro-E)

### Recommended Books:

- Ashleigh Fuller, Technical Drawing 101 with AutoCAD, 2019.
- David Allan Low, Practical Geometry and Graphics, 2016.
- T. E. French and C. J. Vierich, A Manual of Engineering Drawing (Fourth Edition), 2012.
- N. D. Butt, Elementary Engineering Drawing, 2004.
- B. Bielefeld, Basic Technical Drawings, 2002.
- C. Parkinson, A First-Year Engineering Drawing, 1998.

## TEX-106 Mechanical Engineering Fundamentals (2+1)

### Overall Aims of the Course:

To develop in students an understanding of different engineering materials and properties, fundamentals of machining, heat and mass transfer and maintenance of textile machines.

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge and understanding of mechanical engineering fundamentals and engineering materials (metals, alloys, steel, ceramics etc.), their properties and applications	Cognitive-2	PLO-1
CLO-2	Knowledge and understanding of different machine components (shafts, couplings, bearings, rods, belts, chains, gears, pulleys)	Cognitive-2	PLO-1
CLO-3	Ability to design some basic mechanisms using machine components for transfer of motion.	Cognitive-3	PLO-3
CLO-4	Ability to perform shaping, milling, welding, forging etc. and working practice with Lathe machine	Psychomotor-2	PLO-3

### Course Contents:

#### Module 1 Introduction

- Basics of mechanical engineering
- Mechanical engineering codes and standards

#### Module 2 Engineering materials

- Ferrous and non-ferrous metals their properties and uses
- Alloy metals their properties and uses

#### Module 3 Simple machine component

- Design of shafts
- Torsion of circular shafts
- Horse power transmitted by shafts
- Flange, coupling, bearings, connecting rods
- Belts, chains, gears, pulleys, sprocket devices flexible shafts

### Module 3 Workshop practice

- Hand tools, their types and uses
- Mechanical workshop safety rules and practices
- Introduction to lath, principal parts of lathe i.e bed, head stock, tail stock, carriage or saddle, compound rest, tool post, lead screw, centres, work holding devices.
- Lath operations i.e. turning, boring, facing, tapering, taper turning, drilling, knurling, chamfering, threading.
- Introduction to shaper and its operations
- Introduction to milling and its operations
- Pattern making, sand moulding and casting
- Fitting
- Welding
- Forging

#### List of Practical:

As per Course Contents

#### Recommended Books:

- Mechanical Workshop Practice by K C John
- Basic Mechanical Engineering by P K Nag, K Tripathi and C B Pawar
- Mechanical engineering design by Swhigley and Mischhe (2000)

### TEX-108 Information and Communication Technologies (ICT) (2+1)

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Ability and practice to use computer software like Windows, Microsoft Word, Excel, PowerPoint etc.	Psychomotor-2	PLO-5
CLO-2	Students shall become aware of computer networks, their types and topologies and services provided by the networks like file service, web service, print service, internet etc.	Cognitive-2	PLO-1
CLO-3	Ability to work proficiently in various spheres of personal and professional lives with computing devices of different kinds and troubleshoot computing equipment/network related faults.	Psychomotor-4	PLO-12

## **Course Outline:**

### **Introducing Computer Systems: Basic Definitions**

- Computer and Communication Technology
- The applications of ICT - particularly for Engineers

### **Basic Operations and Components of a Generic Computer System**

- Basic operations: Input, Processing, Output, Storage Basic components: Hardware, Software, Data, Users
- Types of storage devices

### **Processing Data**

- Transforming data into information
- How computers represent and process data
- Processing Devices
- CPU architectures

### **The Internet**

- The Internet and the World Wide Web- browsers, HTML
- URLs/ How DNS works
- Email and other programs

### **Introduction to Embedded Systems**

- What is an Embedded System
- Applications
- Components
- Programming Languages
- Popular Development Platforms

### **Networking Basics**

- Uses of networks
- Common types of networks (LAN, WAN, MAN etc.)
- Introduction to OSI Model
- Future of Networks

### **Database Management**

- Hierarchy of Data
- Maintaining Data
- Database Management Systems



## Exposure to ICT Tools and Blogs (Student Assignment) Protecting your privacy, your computer and your data

- Basic Security Concepts
- Threats to users
- Threats to hardware
- Threats to Data ICT in Education Future
- Trends in ICT Final Presentations

### Tools / Software Requirement

Microsoft Office, Windows, Virtual Box, Netbeans

### Recommended Books:

- "Introduction to Computers", Peter Norton, 7th Edition, 2013, McGraw-Hill.
- "Computing Essentials", Timothy O'Leary and Linda O'Leary, 2010, McGraw-Hill.
- Using Information Technology: A Practical Introduction to Computers & Communications", Williams Sawyer, 6th Edition, 2005, McGraw-Hill.
- "Discovering Computers, Complete: Your Interactive Guide to the DigitalWorld.

## TEX-110 Linear Algebra (3+0)

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To comprehend basic concepts of Linear Algebra and optimization	Cognitive-3	PLO-1
CLO-2	To apply techniques of Linear Algebra and optimization for solution of engineering problems	Cognitive-3	PLO-3

### Course Outline:

#### System of Linear Equations and Applications

- Overview of linear system of equations, Cases of unique solution, No solution and infinite solutions,
- Echelon form, Gauss elimination method, Inversion of matrix in the context of solution of system of equations, LU factorization, Row space and column space
- Relevant engineering case studies such as Network analysis, Traffic Flows, balancing chemical reaction, Leontief Input-output model, Finding max stress in compound cylinder, Applications of linear systems in force balancing of structures, Markov process

## **Vector Spaces and Transformations**

- Vector Spaces: Real vector spaces, Subspaces, Basis and dimension, Rank, Nullity
- Gram-Schmidt process for finding orthonormal basis
- Linear Transformation, Kernel of Transformation, Range of Transformation, Matrix of Transformation,
- Applications: Cryptography, Coding and decoding, Breaking of codes, Robotic Applications of linear transformations

## **Eigen values and Eigen Vectors**

- Eigenvalues, Eigenvectors, Similar matrices, Diagonalization,
- Quadratic forms, Positive definite Matrices, Singular Value Decomposition, Inner product Spaces
- Applications of linear Algebra: Constructing curves and surfaces, Computer graphics, Genetics
- Linear Programming
- Solution Introduction to linear programming, Optimization, Graphical method, Simplex method, Optimization problems in engineering and economics
- Dual simplex methods, Duality theory, Primal and dual problems, transportation models, north-west corner, least-cost and Vogel's approximations methods,
- Assignment model, the transshipment model and other relevant engineering case studies

## **Application of Linear Algebra in Dynamical Systems**

- Numerical System of linear ODEs, Eigenvalue problems, Homogeneous and nonhomogeneous system of ODE.
- Dynamical systems, Population dynamics, Prey-Predator models, Stability analysis

## **Recommended Book:**

- Introductory Linear Algebra: By Bernard Kolman and David R. Hill, Latest Edition.
- Elementary Linear Algebra: By Howard Anton and Chris Rorrers, Latest Edition.

## **TEX-112 Pakistan Studies and global perspective (2+0)**

### **Overall Aims of the Course:**

To introduce students to their past, especially with history and ideology of Pakistan, to highlight various social/ political and constitutional issues and their remedies and Geo political

importance of Pakistan and its role in world affairs.

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Acknowledging the importance of the struggle and appreciate the role of different personalities in the creation of Pakistan	Cognitive-2	PLO-6
CLO-2	Understanding the strategic location of Pakistan, its people, and foreign policy	Cognitive-2	PLO-6
CLO-3	Understanding and analysis of important clauses of the constitution of Pakistan	Cognitive-2	PLO-6

### Course Contents:

#### Module 1: Historical Perspective

- Ideological rationale with special reference to
- Sir Syed Ahmed Khan
- Allama Muhammad Iqbal and
- Quaid-e-Azam Muhammad Ali Jinnah.
- Factors leading to Muslim separatism

#### Module 2: Religious Reformists

- Sheikh Ahmad Sirhindi
- Shah Wali Ullah
- Syed Ahamad Shaheed
- Bahauddin Zakariya Multani

#### Module 3: Pakistan and its people

- Location and Geo-Physical features of Pakistan.
- People, land and languages of Pakistan
- Political Parties
- Resources and population demography
- Indus Civilization

#### Module 4: Government and Politics in Pakistan

- Political and constitutional phases
- 1947-58
- 1958-71

- 1971-77
- 1977-88
- 1988-99
- 1999-2007
- 2007 onward

#### **Module 5: Constitutional process in Pakistan**

- Objective resolution
- 1956
- 1962
- 1973
- Constitutional reforms

#### **Module 6: Contemporary Pakistan**

- Economic institutions and issues
- Foreign policy of Pakistan and challenges
- Futuristic outlook of Pakistan

#### **Recommended Books:**

- Mutalialh Pakistan by Rasheed Ahamed Siddiqui
- State & Society in Pakistan by Shahid Javed Burki The Macmillan Press Ltd. 1980.
- Issue in Pakistan's Economy by Akbar, S. Zaidi, Oxford University Press, 2000.
- Pakistan's Foreign policy: An Historical Analysis by S. M. Burke and Lawrence Ziring, OxfordUniversity Press, 1993.
- Pakistan Political Roots & Development by Mehmood, Safdar. Lahore, 1994.
- The Political System of Pakistan by Sayeed, Khalid Bin, 1967.
- Politics in Pakistan by Aziz, K. K. National Commission on Historical and Cultural Research, 1976.

## 3<sup>rd</sup> Semester

### TEX-201: Introduction to Yarn manufacturing (3+1)

#### Overall Aims of the Course:

In this course, the students will study brief introduction to blow room, carding, drawing, combing, roving, ring spinning, woollen/worsted spinning systems, auto winding and yarn packing.

#### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge and understanding of different yarn manufacturing methods	Cognitive-2	PLO-1
CLO-2	Understanding of different processes involved in the manufacturing of yarn	Cognitive-2	PLO-1
CLO-3	Knowledge and understanding the different process involved in combed and carded yarn manufacturing process and ability to differentiate between combed and carded yarn.	Phsycomotor-2	PLO-2

#### Course Contents:

##### Module 1 Spinning Processes

- Flow charts of spinning processes for filament and staple-spun yarns, carded and combed yarns, cotton blended yarns, jute, flax and spun silk yarn.
- Input and output of each process.
- Intermittent spinning and continuous spinning.

##### Module 2 Blow Room

- Objectives of blow room.
- Working principles in blow room.
- Working of bale breaker, porcupine opener, various beaters, cage condenser, scutcher and removal of wastes.

##### Module 3 Carding

- Objectives of carding
- Carding actions

- Working of card
- Role of different parts and their speeds.

#### **Module 4 Drawing**

- Objectives of drawing frame
- Working of drawing frame.
- Concept of drafting
- Drafting and doubling
- Breaker, inter and finisher drawing frame.

#### **Module 5 Combing**

- Objectives of combing
- Noil %age
- Combing preparatory processes
- Working of comber.

#### **Module 6 Roving**

- Objectives of roving frame
- Principle and mechanism of twist insertion
- Working of roving frame

#### **Module 7 Spinning**

- Objectives of ring spinning
- Principle and mechanism of twist insertion
- Working of ring frame

#### **Module 8 New Spinning Systems**

- Open-End Rotor spinning
- Air-jet spinning
- Friction spinning
- Wrap spinning
- Compact spinning

#### **Module 9 Woolen Industry**

- Wool and its classification
- Woolen and worsted yarn
- Flow charts for woolen and worsted spinning processes
- Wool classification and sorting
- Impurities in wool
- Raw material for woolen industry
- Wool scouring, carbonizing, drying and blending
- Woolen carding and woolen spinning.

#### **Module 10 Worsted Industry**

- Worsted carding, backwashing and gilling

- Combing, drawing and spinning.

### **Module 11 Winding and Yarn Packing**

- Objectives of winding and packing
- Yarn clearing, knotting and splicing
- Working of auto-winder

#### **List of Practical:**

- To study the flow of material through blow-room
- To study the waste collection and filtration system of blow room
- To study the flow of material through card
- To study the wire clothing's on different rollers of card
- To study different drafting systems at draw frame
- To study flow of material through draw frame
- To study the flow of material through lap former
- To study the flow of material through comber
- To study the flow of material through roving machine
- To study the flow of material through ring machine
- To study the passage of yarn on cone winding machine
- To study the passage of material through open end rotor machine

#### **Recommended Books:**

- The Reiter Manual of Spinning, vol. 1 to 7 by W. Klein, 2008
- Fundamentals of Spun Yarn Technology by C. A. Lawrence, 2003.
- Spun Yarn Technology by E. Oxtoby, 2013.
- Advances in Yarn Spinning Technology by C. A. Lawrence, 2010.
- Hand book of Yarn Production by Peter R. Lord, 2003
- Short staple yarn manufacturing by Dan J. McCright, 1997
- Process Management in Spinning by R. Sunthil Kumar, 2014
- The Woolen & Worsted Industry by Brearley and Iredale, 1977.
- The Woolen Industry by John A. Iredale 1977
- The Worsted Industry by J. and S. Kershaw Dumville, 2010

## TEX-203 Introduction to Fabric manufacturing (3+1)

### Overall Aims of the Course:

This course is designed to give an overview of various fabric types and their manufacturing techniques. The main focus of the subject is the essential basic knowledge of weaving technique of fabric manufacturing with a brief account of its back process.

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes on completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To understand various fabric forming processes including weaving, knitting, braiding and nonwoven.	Cognitive-2	PLO-1
CLO-2	To understand various types of fabrics.	Cognitive-2	PLO-1

### Course Contents:

- Fabric
- Types of fabrics (woven, knitted, braided, non-woven)
- Various fabrics manufacturing techniques

### Module 1 Basics of Weaving

- History and scope of weaving
- Introduction to weaving
- Weaving preparatory processes: winding, warping, sizing and drawing-in and their objectives
- Weaving machine motions: Primary, secondary and auxiliary motions
- Primary motions: Shedding, Picking and Beat-up
- Different shedding systems: tappet, dobby, jacquard
- Different weft insertion systems: shuttle, shuttle less (air-jet, water-jet, rapier, projectile)
- Secondary motions: Let-off, Take-up and others
- Types of take-up motions & let-off motions
- Weave presentation, repeat, draft, peg plan and reed plan,
- Weave designs: plain weave and its derivatives twill weave and its derivatives, satin and sateen weaves.
- Woven fabric faults and inspection
- Types of woven fabrics: grey fabrics, denim fabrics, pile fabrics, towel, narrow width fabrics



## **Module 2 Basics of Knitting**

- Introduction to knitting and its scope
- Classification of knitting machines: Types of Warp and Weft knitting machines
- Knitting machine elements
- Knitting needles: beard, latch and compound needles.
- Basic knitting action of needles (knitting cycle)
- Stitch notation of warp and weft knitted structure
- Introduction to weft knitting: principles and mechanism of weftknitting
- Course and Wale
- Types of loop stitches: knit, tuck, miss loops formation and uses
- Basic weft knitted structures: plain, rib, purl and interlock
- End use of weft knitted structures.
- Introduction to warp knitting: mechanism of loop formation
- Basic warp knitted structures
- Warp knitting machines: Tricot Machine, Rachel Machine, Crochet Machine, Waltex Machine
- End usage of warp knitted structures
- Single knit and Double knit fabrics
- Single warp fabric, Two warp fabric
- Knitted fabric faults and inspection

## **Module 3 Basics of Braiding**

- Introduction to braiding and application of braids
- Braiding machines: Maypole braiding machine, Flat and circular braiding machines, Horizontal and vertical braiding machines
- Machine components, Bobbins, Yarn carriers, The braiders deck,
- Take-up mechanism
- Braided structures: Flat and Circular braids, Over-braid (braiding over a core/mandrel)

## **Module 4 Basics of Nonwovens**

- Introduction to nonwovens and their applications
- Non-woven manufacturing process: web formation, consolidation and finishing
- Classification of non-woven consolidation processes
- Needle punching, Spun-laced woven, Adhesive bonding, Thermal bonding, Stitch bonding

### **Recommended Books:**

- Weaving Conversion of Yarn to Fabric by P. R. Lord & M. H. Mohd Latest Edition

- Principles of Weaving by R. Marks & A.T.C. Robinson Latest Edition
- Knitting Technology by D. J. Spencer Latest Edition
- Woven Cloth Construction by A. T. C Robinson & R. Marks Latest Edition
- Knitting Handbook: An Instructional Guide to Knitting by Viv Foster, Latest Edition
- Braiding and braiding machine by W. A. Douglass
- Specialist yarn and fabric structures Edited by R. H. Gong
- Handbook of technical textiles edited by AR Horrocks and SC Anand

## TEX-205: Fiber Science (2+0)

### Overall Aims of the Course:

Prime objective of Fiber Science is to make student familiar with basic structure and physical properties of fibers and the relationship the fibrous structures bear on physical properties. This shall help students make a better selection based on their learning for practical use like processing on spinning or fabric machines etc.

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge and understanding of fiber as textile material and science dealing with it.	Cognitive-2	PLO-1
CLO-2	Ability to describe various physical and chemical properties of different natural and man-made fibers.	Cognitive-2	PLO-1
CLO-3	Ability to differentiate internal structures of various natural and man-made fibers and to relate fibrous structures with their properties to study their behavior during physical and chemical processing.	Cognitive-3	PLO-2
CLO-4	Students shall be able to practically use this knowledge for better selection of raw material while designing the processes.	Cognitive-4	PLO-3

### Course Contents:

#### Module 1: Chemical and Physical Structure of Natural Polymer Fibers

- Natural Cellulose Fibers
- Manufactured Cellulose Fibers
- Natural Protein Fibers

- Manufactured Protein Fibers

## **Module 2: Chemical and Physical Structure of Synthetic Polymer Fibers**

- Repeating Units
- Molecular Weight
- Configurations
- Conformations
- Bonding
- Solid Phases
- Unit Cells
- Crystalline Models
- Morphology of Crystallites
- Morphology of Synthetic Fibers

## **Module 3: Primary and Secondary Properties of Fibres**

- Primary Properties
- Secondary Properties

## **Module 4: Mechanical Properties of Fibers**

- Basic Definitions
- Tensile Properties
- Compressive Properties
- Torsional Properties
- Bending Properties

## **Module 5: Viscoelastic Properties of Fibers**

- Molecular Mechanisms of Viscoelastic Behavior
- Phenomenological Aspects of Viscoelastic Behavior
- Time-Temperature Equivalence
- Models of Viscoelastic Behavior

## **Module 6: Thermal Properties**

- Heat Capacity and Specific Heat
- Thermal Conductivity
- Thermal Expansion and Contraction
- Glass Transition
- Melting
- Degradation and Decomposition

## **Module 7: Electrical Properties of Fibres**

- Electrical Conductivity
- Static Electricity

## **Module 8: Frictional Properties of Fibres**

- Basic Concepts

- Nature of Friction
- Fiber-on-Fiber Friction
- Fiber-on-Other-Material Friction
- Lubrication

### Module 9: Optical Properties of Fibres

- Polarization and Light
- Refractive Index and Birefringence
- Reflection and Luster
- Absorption and Dichroism

### Recommended Books:

- Fundamentals of Fiber Science by Xiangwu Zhang 2014.
- Physical testing of textiles by B P Saville,
- Fiber Science by Steven B Warner,
- Physical Properties of Textile Fibres by John W S Hearle and W E Morton,
- Textile Science by E P G Gohl and L D Vilensky,
- AATCC, ASTM and ISO test methods related to the course

## TEX-207 Electrical & Electronic Engineering Fundamentals (2+1)

### Overall Aims of the Course:

To introduce students to fundamentals of electrical and electronic systems, their components and working principles.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Understanding and knowledge of significance of AC, motors, power factor and different laws of electricity and electronics	Cognitive-2	PLO-1
CLO-2	Knowledge & Understanding of semiconductors, the fundamental of a diode and transistor, its applications and current flow mechanism in diode and transistor	Cognitive-2	PLO-1
CLO-3	Calculate the total resistance, voltage, current of series and parallel electrical circuit	Psychomotor-2	PLO-1

## Course Contents:

### Module 1 Electrical engineering

- Fundamentals of AC, production of AC, measurement of rms values, phase difference, vector diagram, wave diagrams circuit containing resistance and inductance, triangle power in an AC circuit containing resistance and inductance
- Power factor, choking coil, measurement of power in an inductive circuit by three-voltmeter method and their related problems measurement of power in an inductive circuit by three-ammeter method.
- Behaviour of circuit containing capacitor only, power and power factor of circuit containing capacitor only circuit containing resistance, inductance and capacitance in series, impedances in series and their related problems.
- Series or voltage resonance, parallel circuits, current resonance and their related problems
- Interconnection of phases, symmetrical system, balanced system, and two phase three-wire system. Three phase systems, star connection. Three phase four-wire system mesh connection, power in balanced three-phase system, measurement of power in three-phase system
- Back EMF, torque, armature torque, shaft torque, losses and efficiency, power stages, series motors, shunt motors, and compound motors
- Speed control of series motors, speed control of shunt motors

### Module 2 Electronic engineering

- Semiconductor, types of materials
- Diodes, rectifiers, types of filters
- Bipolar junction transistor
- Diode limiting and clamping circuits
- Transistors as an amplifier
- Field effect transistors
- Metal oxide semiconductor FET, Depletion MOSFET, enhancement MOSFET, Characteristics and parameters, MOSFET biasing, system application

### List of practical:

- To study about electrical symbols of components and laboratory equipment
- To prepare half wave rectifier
- To prepare full wave rectifier
- To prepare bridge rectifier
- To study the operation of filter for smoothing DC supply
- To identify the type of transistor and their terminals
- To prepare Wheatstone bridge circuit to measure sensors (thermistor, strain gauge etc) output
- To determine measurements of alternating current
- To calculate power of an AC motor.
- To study star connection

- To study delta connection
- Star delta and delta star transformation

**Recommended Books:**

- Basic Engineering Circuits Analysis by J. David Irwin and R. Mark Nelms
- Electronic Devices and Circuits by T. F. Bogart
- Huges, E. Longman “Electrical Technology”, latest edition.
- Stephen J. Chapman “Electrical Machinery Fundamental”, latest edition.
- Chute, G. M and Chute, R. D., “Electronics in Industry”, McGraw-Hill Book Company, Singapore, latest edition.

**TEX-209 Differential Equations (3+0)**

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	TaxonomyLevel	PLO
CLO-1	Define basic mathematical concepts related to differential equations	Cognitive-1	PLO-1
CLO-2	Describe different types of analytical methods for solution of differential equations	Cognitive-1	PLO-1
CLO-3	Formulate different engineering problems in the form of differentialequations	Cognitive-2	PLO-1

**Course Outline:**

**Basic Concepts and Modeling**

- Linear Differential equations, Non-Linear, Differential equations, Solutions of differential equations, General solutions, Particular solutions, Initial and boundary value problems, Degree and order of ODEs
- Formulation of first-order ODEs: Case studies related to finding age of fossils, mixing problems and free fall motion, finding temperature of a building, RL, RC circuits, Airplane take-off problem, Population dynamicsand logistic equations etc.

**Analytical Methods of Solution for First-order ODEs**

- Variable separable method, Reduction to variable separable form, Homogeneous equations, Differential equations reducible to homogeneous form, Solution of the related ODE models

by these methods

- Exact equations, Integrating factors, Linear equations and related examples, Bernoulli's equations, Orthogonal trajectories and solution of the related ODE models by these methods

### **Mathematical Models Based on Second-order ODEs**

- Formulation of a single RLC circuit, Spring mass systems, Earthquake model of a single-story building
- Bungee Jumper model, Bridge collapse problem etc.

### **Analytical Methods of Solution for Second-order ODEs**

Homogeneous linear ODEs, Method of reduction order, Wronskain determinant to check independence of the solution, and related examples

- Cauchy-Euler equations and related examples, Non-homogeneous linear ODEs, Method of undetermined coefficients
- Method of variation of parameters and related example
- Analytical solution of the related ODE models by these methods

### **Series Solution for Second-order ODEs**

- Series solution of ODEs and convergence tests
- Series solution of Legendre equation, Frobenius method of solution for Bessel equation and related applications

### **Laplace Transform**

- Laplace Transform, Derivation of Basic formulae, Inverse Laplace Transform, First shift theorem
- Laplace transform of integrals and derivative, Solution of second order ODEs by Laplace Transform, Unit step function and its Laplace transform, Second shift theorem, Convolution
- Application of Laplace transform to a system of ODEs and related applications

### **Partial Differential Equations**

- Partial Differential Equations and their types, Applications of partial differential equations in Engineering
- Method of Separation of Variables Method (MSVM) and solution of wave equation by the MSVM
- Method of Separation of Variables Method (MSVM) and solution of heat equation by the MSVM

### Recommended Books:

- Advanced Engineering Mathematics by Erwin Kreyzig, John Wiley & Sons Inc. Latest Edition.
- Differential Equation with Boundary Value problems by D. G. Zill, M. R Cullen Latest Edition, Brooks/Cole Publishers.
- A First Course on Differential Equations with Modelling Applications by D. G. Zill, Latest Edition, Brooks/Cole Publishers.
  - An Introduction to Mathematical Modelling by Bender, E.A., Latest Edition, Wiley, New York

## 4<sup>th</sup> Semester

### TEX-202 Introduction to Textile Chemical Processing (3+1)

#### Overall Aims of the Course:

The objective of this course is to introduce the students to different areas of textile chemical processing, including chemical preparation of textiles, textile dyeing, textile printing and textile finishing.

**Course Learning Outcomes: Students should be able to achieve following course learning outcomes during completion of the course.**

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Ability to understand different Textile Chemical processes including Pre-Treatment, Dyeing, printing and finishing of woven and knitted fabrics.	Cognitive-2	PLO-1
CLO-2	Ability to understand and analyze Textile Chemical processes including Pre-Treatment, Dyeing, Printing and finishing	Cognitive-2	PLO-1
CLO-3	Ability to apply knowledge to develop and make assessment on different textile products	Psychomotor-1	PLO-4

#### Course Contents:

##### Module1: Introduction

Introduction to textile chemical processing, Chemical processing flow chart

##### Module 2 Introduction to pretreatments

Shearing & Singeing processes, Singeing Machine and its description, Evaluation of singed



fabric, Chemical composition of Size and Cotton, Desizing Techniques and Methods, scouring chemicals and Auxiliaries, Evaluation of desizing & scouring, Bleaching Chemicals and auxiliaries, Bleaching chemistry, Effect of Mercerization on cotton fiber, Evaluation of Bleaching & Mercerizing

### **Module 3 Introduction to Dyeing Technology**

Introduction to dyes, dyeing of cellulosic fibers with direct, reactive, sulphur and vat dyes, Dyeing of polyester, nylon, acrylic, wool and silk, important characteristics of dyed fabrics

### **Module 4 Denim Processing**

Introduction of Denim, Flow Chart of Denim manufacturing, Description of Ball Warping, Rope Dyeing, Re-beaming, Sizing, Weaving and Fabric Finishing processes, Garments Washing, Garments Dry Processing, Garments Wet processing

### **Module 5 Introduction to Printing Technology**

Design Studio & Engraving, Introduction to different methods and styles of printing,

### **Module 6 Introduction to Finishing Technology**

Classification of finishes: chemical; mechanical, Introduction to common chemical and mechanical finishes

#### **List of Practical:**

- Survey of Textile Processing Machinery
- Enzymatic desizing of woven cotton fabric by pad batch method
- Scouring of cotton fabric by exhaust method
- Bleaching of p/c blended fabric by pad-steam method
- Dyeing cotton with reactive dyes
- Dyeing polyester with disperse dyes
- Printing cotton with reactive dyes
- Denim washing with enzymes and pumice stones

#### **Recommended Books:**

- Chemistry and Technology of Fabric Preparation and Finishing by C. Tomasino, 1992.
- Basic Principles of Textile Coloration by A. D. Broadbent, 2005.
- Textile Science: An Explanation of Fibre Properties, Gohl and Vilensky 1984.
- Textile - Reference Book for Finishing Fondazione ACIMIT Pub, 2002
- Cellulosic Dyeing by John Shore, Society of Dyers and Colorists, 1995
- Textile Printing by W. C. Miles, Society of Dyers & Colorists, 2003
- Textile Finishing by Derek Heywood, Society of Dyers & Colorists, 2003

## TEX-204 Introduction to Garment Manufacturing (3+1)

### Overall Aims of the Course:

This course is designed to give in-breath knowledge of Garment manufacturing techniques/processes. This Includes the Study of Process Machinery, Operations, Design technology (CAD/CAM), Apparel Design System (ADS), Stitches, Seams and threads, cutting, sewing and pressing technology, finishing and packing sections.

**Course Learning Outcomes: Students should be able to achieve following course learning outcomes during completion of the course.**

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge and understanding of Apparel business, different functional areas, manufacturing process and machines.	Cognitive-2	PLO-1
CLO-2	Ability to comprehend apparel design and manufacturing process, development & use of product standards and specifications, quality control and production.	Cognitive-2	PLO-1
CLO-3	Ability to prepare basic clothing articles through cutting and stitching exercises	Psychomotor-2	PLO-3

### Course Contents:

#### Module 1: Introduction of Apparel Industry

- Structure of the apparel manufacturing industry in Pakistan as well as around the world
- Supply chain of the apparel industry,
- Clothing articles and differences among them

#### Module 2: Apparel Sizing and Measurements

- Anthropometry; Classification of human body shapes on the basis of various ethnicities and demographics, Introduction of Sizing Systems around the world: European and American etc.
- Taking body measurements and developing specifications
- Techniques for taking body measurements: Manual, 3D body scanners etc.

#### Module 3: Types of Articles and Apparel Product Development Process

- Product development concept including pre-adoption phase, line adoption phase and post adoption phase, concept board
- Design elements and design principles
- Steps involved in developing a sample garment

- Various types of samples being prepared in the apparel manufacturing (from customer approvals to bulk orders confirmation)

#### **Module 4: Pattern Making**

- Constructing basic bodice pattern with correct measurements and specs,
- Contouring and draping
- Pattern grading

#### **Module 5 Garment Preparatory Processes**

- Process flow of cutting department,
- Procedures of fabric receiving from folding/finishing and issuance to the cutting section,
- Classification of fabric like open width, doubled, tubular, rolled, wound, plaited, etc.,
- Marker making, dimensions of a marker, marker efficiency, marker quality, and methods of marker making
- Concept of making a lay plan manual, pantograph or computerized systems,
- Different types of lay plan like half garment lay, whole garment lay, single size lay, multi-size lays including sectional lays, interlocking lays, and mixed multi-size lays.

#### **Module 6 Fabric Spreading and Cutting**

- Spreading/Spread/lay Introduction, Various types of lay/spread like single ply, multi-ply, and stepped lay.
- Spread/lay height limitations, Methods of spreading being used in the industry like manual method, spreading carriage method, and automatic spreading machine method.
- Spreading modes like face-to-face, face-one-way, etc.
- Spreading quality, setup for spreading, spreading equipment, spreading time and cost.
- Cutting accuracy and Cutting quality
- Cutting equipment.

#### **Module 7 Sewing Process**

- Steps involved in preparation for sewing.
- Stitch formation of lock stitch, chain stitch, over lock stitch, and cover stitch.
- Stitching classes like edge finishing and ornamental stitching.
- Special stitch types used in apparel and home textiles with their application.
- Seam classes (superimposed seams, lapped seams, bound seams, flat seam).
- Types and applications of sewing thread like spun threads, monofilament threads, multifilament threads, monochord thread, texturized thread, and core-spun threads on apparel articles.
- Sewing thread selection criteria including features like sew-ability, size, strength, twist, seam performance, color availability and fastness, put-up type and size, service and quality, thread

cost.

- Use of alternatives to thread like Adhesive and welding technologies.

### **Module 8 Classification and Components of Sewing Machines**

- Bed based classification of sewing machines
- Components of sewing machines.
- Threading of sewing machines.
- Sewing machine operations.

### **Module 9 Fundamentals of Sewing Machines**

- Sewing machine casting.
- Sewing machine lubrication system.
- Stitch forming mechanism of the sewing machine (the parts and devices like thread control devices, needles, bobbins, cases & hooks, looped, spreader, throat plate, tongue and chaining devices.
- Needle parts like shank, blade, scarf, groove, needle eye, needle point, etc.
- Needle surface finishes like nickeling plating, chroming plating, super finishing and titanium coating.
- Classification of needle points and their application in apparel.
- Needle and sewing thread relationship.
- Material feeding system to sewing machine.
- Sewing defects; causes and their remedies.

### **Module 10 Garment Washing, Finishing, Pressing and Packing**

- Garment dry processes: sand blasting, raising, whiskers, tagging, scraping etc.
- Garment washing: bleaching, stone/enzyme/acid washing, desizing, tinting, neutralization, fixers and softeners etc.
- Kinds of stains in garments, their identification and removal.
- Packing types, packing material and garment presentation.
- Care instruction, care symbols, their application and use.

### **Module 11 Apparel Accessories and Work Aids**

- General types of apparel support materials being used in apparel manufacturing.
- Interlinings, properties of interlinings, application of interlinings.
- Types of linings, properties and functions of linings, etc.
- Other support materials like adhesives; collar stays, and shoulder pads etc.
- Types of trims being used in apparel, function and application of trims like embroidery, appliqué, laces, knit trims, screen prints and heat transfer prints.
- Different types of closure; zippers, buttons, laces, their different parts and applications.
- Work aids and attachments being used in the apparel, main purpose of work aids and common types of attachments.

### **Module 12 Material Handling Techniques**

- Introduction of apparel production systems.

- Progressive bundle system (PBS), advantages & disadvantages of PBS.
- Unit production system (UPS), advantages & disadvantages of UPS.
- Modular production system (MPS), advantages & disadvantages of MPS.

### **Module 13 Apparel Quality Control and Assurance**

- Defining quality and its global importance.
- Quality control systems; in-line inspection, end-line inspection,
- Quality assurance: internal and external audits.
- Brief description of Acceptable Quality Levels (AQLs), Garment Zones

#### **List of Practical:**

Study of the different parts of a Lockstitch and Over Lock Sewing Machines.

- Study of the Bobbin Winding, Needle Threading and setting of bobbin into the bobbin case of a Lockstitch Sewing Machine.
- Study of the different parts of a Flat Lock (Cover stitch) Sewing Machine.
- Study of the threading of 3 Thread Over lock and 4 Thread Over Lock Sewing Machine.
- Study of the threading of 3 Needle 5 Thread Flat lock (Cover stitch) Machine.
- Study of the Main Frame and Cover Components of a Vertical Straight Knife Cutting Machine.
- Study of the basic Sewing Machine Operation.
- Study of the Stitching: Exercise – I on Paper using Practice Sheet – 1.
- Study of the Stitching: Exercise – II on Paper using Practice Sheet – 2 (D Series).
- Study of the Stitching: Exercise – III using a Fabric Swatch.
- Study of the Stitching: Exercise – IV using Paper & Fabric Swatch.
- Study of various Stitch Types (Class 100, 300, 400, 500, 600).
- Study of Pressing Effect on different Types of Fabrics.
- Study of the Basics of CAD System.

#### **Recommended Books:**

- Introduction to Clothing Manufacture by Gerry Cooklin, 2006.
- Clothing Technology for Fashion Designers by Gerry Cooklin, 2011.
- Apparel Manufacturing: (Sewn Product Analysis) by Ruth E. Glock, Grace I. Kunz 4th Edition 2004.
- Clothing Technology by Eberle, H. Verlag Europa- Lehrmittel, 2002.

## **TEX-206 Computer Programming (2+1)**

#### **Aim of the course:**

This course introduces programming basics including – data types, control structures, algorithm development and programme design with functions – via the Python programming language. Course teaches students about different paradigms of programming in general and Object –

Oriented Programming in specific also promoting problem solving techniques with computers and developing computational thinking as well. Students, during labs, shall solve real – world problems related to all four specializations of textiles.

**Course Learning Outcomes: Students should be able to achieve following course learning outcomes during completion of the course.**

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge and understanding of different paradigms of programming like procedural, functional, object oriented etc.	Cognitive-2	PLO-1
CLO-2	Knowledge and understanding of variety of linguistic tools for programming computers	Cognitive-2	PLO-1
CLO-3	Learning to program in python with due understanding of typical lexicon of python and program structure.	Psychomotor-1	PLO-5
CLO-4	The successful completion of the course shall make students extremely productive and proficient at common programming tasks and they'll implement computing solutions to real – world problems related to all four specializations of textiles.	Psychomotor-3	PLO-5

**Course Contents:**

- Algorithms
- Information processing
- Boolean logic and data types
- Strings, text files, lists and dictionaries
- Procedural abstraction in function definitions
- Objects and classes
- Graphics and image processing
- Networks and client / server programming
- Graphical User Interface (GUI)
- Events and event – driven programming

**Recommended books**

- Mathes, Eric; Python Crash Course - A Hands - on Projects Based Introduction to Programming, No Starch Press Ltd., Second Edition.

- Lutz, Mark; Python Pocket Reference, O'Reilly Press Ltd., Fifth Edition
- Zelle, Ingram; Python Programming, Ingram Short Title, Third Edition
- Mckinney, Wez; Python for Data Analysis, O'Reilly Press Ltd., Second Edition
- Beazley, David; Python Cookbook, O'Reilly Press Ltd., Third Edition
- Berry, Paul; Head-First Python - A Brain Friendly Guide, O'Reilly Press Ltd., Second Edition
- Shaw, Zed A.; Learn Python The Hard Way, Addison-Wesley Professional, Third Edition

## TEX-208 Communication skills (2+0)

### Overall Aims of the Course:

The overall aim of this course is to develop students' communication and presentation skills. This course will guide the students how to express themselves verbally and non-verbally in different social settings.

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Understand the true nature of effective communication, social and interpersonal skills, team work and communicate effectively at work place in specific and in society in general	Affective-2	PLO-09
CLO-2	Ability to develop good writing skills and produce academic & official documents of various types	Cognitive-6	PLO-10
CLO-3	Ability to appear in interviews confidently and give presentations in academic and practical life situations.	Psychomotor-2	PLO-10

### Course Contents:

#### Module 1 Paragraph Writing

Practice in writing a good, unified and coherent paragraph

#### Module 2 Essay Writing

Descriptive, narrative, discursive, argumentative

#### Module 3 CV and Job Application Module 4 Study Skills

Skimming and scanning, intensive and extensive, and speed-reading, summary and precise

writing and comprehension

### **Module 5 Academic Skills**

Letter/memo writing and minutes of the meeting, use of library and Internet resources

### **Module 6 Presentation Skills**

Personality development (emphasis on content, style and pronunciation), presentation techniques including collecting and managing material, making and using visual aids, handling questions and audiences, attention getting techniques, personal management, persuasive communication.

### **Module 7 Handling Business Meetings**

Agenda writing, minutes of the meeting, recording and presenting the minutes, successful written and oral presentation

### **Module 8 Academic Writing**

How to write a proposal for research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

### **Recommended Books:**

- Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press 1986
- Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993.
- Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992
- Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991.
- Reading and Study Skills by John Langan
- Study Skills by Richard York.
- Writing on the job, by Cosmo F. Ferrara, latest edition
- Effective Communication, by Murphy, Prentice-Hall, latest ed.



## TEX-210 Organizational Behavior (3+0)

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Learn the principles of professional ethics and responsibilities	Affective-3	PLO-08
CLO-2	Learn Managerial skills as an individual and also as a team member	Phsycomotor-4	PLO-11

### Course Outline:

#### Introduction to Organizational Behavior

- Organizational Disciplines and topics
- Psychological Perspective
- Social-Psychological Perspectives

#### Structure and Control in Organization

- Introduction of Bureaucracy
- Managerial Work
- Contingency theory
- Organizational Design

#### Individual and Work Learning

- Learning Theories
- Learning and Work

#### Stress

- Types of Stress and Work
- Occupational Stress Management

#### Individual Differences

- Personality and its factors
- Personality dimensions and social learning Intelligence

## **Motivation and Job Satisfaction**

- Needs at Work
- Theories of Motivation and job satisfaction
- Correlates of Job satisfaction

## **Group and Work**

- Social Interaction
- Dramaturgy and impression Management
- Social Skill

## **Group and Inter Group Behavior**

- Group Structure & Norms
- Group Processes
- How throne Studies

## **Leadership**

- Leadership as an attribute
- Leadership Style

## **Patterns of Work**

- Work-the classical approach
- Marx, Weber, & The critique of labor
- Foucault & Disciplinary Power
- Conflict and Consent in Work
- The labor Process debate
- Work place control and resistance
- Industrial conflict and industrial relations

## **Organizational Culture**

- Organizational culture and strategic management
- Exploring organizational culture
- Evaluating concept of culture

## **Recommended Books:**

- Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behaviour, 3rd Oxford.
- Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. (2006), Human Resource Management, 5th ed., McGraw Hill.
- Newstrom John W. (2007), Organizational Behaviour, (12th Ed), McGrawHill.
- Luthan Fred, (2005), Organizational Behaviour, McGraw Hill Inc.

- Robins, Stephen, (2005), Organizational Behaviour, McGraw Hill Inc.

## 5<sup>th</sup> semester

### TEX-311 Pre-spinning Processes (2+1)

#### Overall Aims of the Course:

In this course students will be given in-depth knowledge of machinery related to blow-room carding, draw frame, Lap former and comber. Latest innovations in the machines and their workings will be discussed in detail.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To compare various blow room and carding machinery and their operating parameters and learn about common technical problems and propose their solutions.	Cognitive-4	PLO-2
CLO-2	To learn working Principles of drawing frame and combers and develop various machinery settings to improve production and quality of sliver being produced	Cognitive-6	PLO-3
CLO-3	To apply knowledge of machinery settings on lab machinery to understand how to execute these changes and how they can be utilized for quality improvement and trouble shooting.	Psychomotor-2	PLO-3

#### Course Contents:

##### Module 1 Raw material as factor influencing spinning

- Characteristics of raw material such as fiber fineness, length, strength, maturity, impurities, neps, fiber finish and contamination
- Bale management system

##### Module 2 Blow room

- Theories of opening, cleaning, blending/mixing and dust removal
- Basic operations in blow room. Blow room installations/sequence of machines (conventional as well as modern). The components of blow room machine, feeding

- apparatus, opening devices, grid and their interaction.
- General factors influencing opening and cleaning.
- Bale opening, Pre-cleaning, blending and fine-cleaning machines of conventional and modern blow rooms.
- Machines for card feeding
- Transport of material, mechanical transport, Pneumatic transport, control of material flow.
- Machine damage prevention and fire protection, metal detection.
- Foreign Contamination detection and removal system;
- Waste management and filtration systems;
- Evaluation of blow room output material.
- Running and cleaning efficiency.
- Optimum process atmospheric conditions.

### **Module 3 Carding**

- Theory of carding machine viz Opening, carding disposition and doffing disposition, fibers hookformation
- Material feeding systems viz Lap and chute feed
- Feeding devices for taker-in viz conventional and modern
- Taker-in zone, auxiliary carding devices, carding zone and post-carding zones;
- Detaching, crushing and coiling
- Machine drive.
- Auto-leveling equipment, Principles of short-term, medium-term and long-term auto-leveling, machine settings and auxiliary equipment, running and cleaning efficiency;
- Evaluation of card sliver.
- Optimum process atmospheric conditions.

### **Module 4 Card clothing**

- Card clothing, metallic card clothing and its geometry
- Maintenance of card clothing, stripping, brushing and grinding, Integrated grinding system (IGS).

### **Module 5: Draw Frame**

- Task of the draw frame; equalizing, parallelizing, blending, dust removal. Sliver Doubling and averaging effect, sliver blending at draw frame.
- Theory of roller drafting: Draft and attenuation, drafting force, drafting wave, Stick-slip motion, Behavior of fibers in the drafting zone, Fiber guidance, Floating fibers, fiber friction field, Influencing factors, distribution of draft.
- Creel (sliver feed), the drafting arrangement, coiling, the delivery arrangement, condensing, sliver coiling, can changers.
- Auto-leveling at draw frame. Open-loop control, Closed-loop control, Mechanical scanning of slivers, leveling process, adjustment of the draft, correction length, leveling action point and leveling intensity.
- Evaluation of draw frame sliver. Optimum Process atmospheric conditions.

## Module 6: Lap Forming Process

- Lap former, preparation of stock for combing, conventional and modern preparation system. Evaluation of sliver lap. Optimum process atmospheric conditions.

## Module 7: Comber

- Influence of feed stock on combing: parallelization of fiber in batt, batt thickness, evenness of battsheet' disposition of hooks
- Theory of combing: combing cycle, backward feed, forward feed, amount of feed per cycle, detachment setting, numbers of points on combs, top comb penetration depth, piecing
- Sequence of operations in a rectilinear comber. Comber feeding, nipper assembly, combs, detaching rollers, piecing, sliver take-off, the drafting arrangement, coiling the sliver, waste removal.
- Automation in the combing section. Comparison of carded and combed slivers. Optimum processatmospheric conditions.

## List of Practical:

- Sketching the layout side view plan of Blow room line along with waste disposal and filter system. Detail Study of the working of Blow room machine in relation to setting, speed, performance. Determination of cleaning efficiency and fiber growth of Blow Room
- Study of electric piano motion and lap doffing machine. Study of lap making, calendaring and hardening mechanisms. Determination of waste %age of Blow Room machines.
- Determination of cleaning efficiency and fiber growth of card machine. Setting of flats with respect to cylinder at card machine. Setting of carding parts relative to each other.
- Study and analysis of various card clothing. Study the web at carding machine and determination of the neps in web. Study of auto leveling system installed on card machine
- Study of drafting systems at draw frames
- Study of count control at draw frame
- Setting of drafting rollers at drawing frame
- Comparison of weight regularity of slivers before and after drawing
- Observing the blending effect of at various Draw Frame passages
- Study of auto-leveling setting at draw frame and its effect on sliver quality
- Study of auto can changing system and count meter
- Study of nippers, combing cylinder
- Study of comber waste determination and alteration
- Study of eccentricity of top drafting rollers and its measurement
- Study of forward and backward movement system of detaching rollers
- Study of drafting and coiling system

### Recommended Books:

- The Reiter Manual of Spinning, vol. 1, 2 and 3 by W. Klein, 2008
- Fundamentals of Spun Yarn Technology by C. A. Lawrence, 2003.
- Spun Yarn Technology by E. Oxtoby, 2013.
- Advances in Yarn Spinning Technology by C. A. Lawrence, 2010.
- Hand book of Yarn Production by Peter R. Lord, 2003
- Short staple yarn manufacturing by Dan J. McCright, 1997
- Process Management in Spinning by R. Sunthil Kumar, 2014

## TEX-321 Weaving Preparatory Processes (2+1)

### Overall Aims of the Course:

The objective of this course is to teach the students different weaving preparatory processes so that they may understand these processes, machine mechanisms, material flow and the necessary details thereof.

**Course Learning Outcomes: Students should be able to achieve following course learning outcomes on completion of the course.**

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To demonstrate various weaving preparatory processes.	Cognitive-3	PLO-1
CLO-2	To execute preparatory plans for various qualities and constructions.	Psychomotor- 3	PLO-1

### Course Contents:

#### Module 1 Winding

- Introduction to Winding and its objectives
- Winding process
- Technical requirements of winding process
- Winding principles
- Types of winding machines: Precision winding, Random winding, Drum winding, Cheese winding
- Functions of major parts involved in winding machines
- Factors effecting production of winding machine
- Types of packages
- Winding defects
- Yarn Strength & Twist of yarn

#### Module 2 Warping

- Introduction to warping and its objectives

- Types of warping: beam warping, sectional warping and ball warping
- Detailed process and Mechanism of direct, sectional and ball warping
- Functions of major parts involved in warping machines
- Creels and their types
- Tension control in warping
- Latest development in warping machines
- Identification and examination of faults/defects in warping process & quality control
- Yarn breakage rate and expression of warp quality in terms of length & weight
- Executing warping plan for a given quality of fabric
- Change in yarn count after warping

### **Module 3 Sizing**

- Introduction to sizing and its objectives
- Sizing process
- Sizing machine parts & their functions
- Types of sizing machines
- Beam creel & its types
- Brake operation of warp beams
- Drive of sizing machine: PIV mechanism and servomotor system
- Warp tension zones
- Determination of warp tension of each zone for a given fabric construction
- Settings of different tension zones w.r.t. different yarns types.
- Effect of tension setting in one zone w.r.t. other zones.
- Size liquor pick up & factors governing it
- Factors governing speed of sizing
- Pre-wetting and wet splitting
- Cold sizing
- Occupancy of squeezing roller
- Drying types: Cylindrical drying, Hot air drying, Infrared Drying, Combine System
- Capacity of drying rollers
- Use of after waxing system
- sequence of leasing rods
- Rubber roller grinding and rubberization
- Calibration of different sizing machine parts
- Size solution and its ingredients: binders and additives
- Sizing materials (binders): natural, semi-natural and synthetic
- Properties of different sizing materials

- Lubricants: Tello, Soap, Wax
- Size additives
- Sizing recipe and mixing procedure
- Coating and penetration
- Formulation of size recipe for a given construction
- Aqueous sizes, solvent sizes, dye sizing and indigo dye sizing
- Use different sizing materials for different types of yarns
- Sizing and beaming of filament warps, terry towels & open-end yarn
- Selection of size materials
- Viscosity measurement of sizing liquor: refractometer
- Wastages & losses in sizing process
- Ball sizing, Hank sizing
- Recycling of sizing agents
- Sizing Vs doubling
- Change in yarn count after sizing

#### **Module 4 Drawing-in and Knotting**

- Introduction to drawing-in
- Types of drawing-in: Automatic and manual drawing-in
- Drawing-in accessories: draw hooks, reed knife
- Drawing-in parts (droppers, heald frames and reed) and details associated with them
- Reed, Reed Count, Reed denting
- Harnesses and ties, their types: Dressing Harness, Goes Harness, Pressure Harness, Tie ups, Center Ties /Mixed ties
- Tying-in/ knotting process and beam gating
- Article change of weaving machine

#### **Recommended Books:**

- Weaving: Conversion of Yarn to Fabric by P. R. Lord and M. H. Mohamed, 1982
- Handbook of Weaving by Sabit Adanur, 2000
- Eurotex-An introduction to Textiles by R. Marks
- Weaving Technology and Operations by Allan Ormsrod
- Cotton Weaving, Its Development, Principles and Practice by Richard Marsden, 2000
- Theory of Sizing By Harry Nisbet
- Industrial Practices in Weaving Preparatory, by Mukesh K. Singh, (2014)



## TEX-331 Pretreatment of Textiles (2+1)

### Overall Aims of the Course:

In this course, the students will study in depth different preparatory processes to which textile materials are subjected before dyeing, printing and finishing. Students will learn in detail, the preparation of natural, manmade and blended textile materials in various forms. Students will develop understanding on rationale, principles, mechanisms, effect and control of various process parameters, most common problems, and their preventative and corrective measures. The course also includes lab practice.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To investigate in depth the preparation of natural, manmade and blended textile materials in all forms	Cognitive-4	PLO-1
CLO-2	To understand in detail, mechanisms, effect and control of various process parameters, most common problems, and their preventative and corrective measures	Cognitive-3	PLO-1
CLO-3	To develop, assess and analyze different products of pretreatment processes.	Psychomotor-3	PLO-4

### Course Contents:

#### Module 1: Greige Inspection & QC

Greige receiving and Recording, Greige faults and their grading systems, Grading systems, Fabric inspection machinery and its description, Fabric packing & storage

#### Module 2: Shearing & Singeing

Principle, method and machinery for shearing, Principle, method and machinery for singeing, Common shearing & singeing faults and their countermeasures, Testing & Q.C. of singed & sheared fabric, Faults and remedies

#### Module 3: Desizing

Principle, method and machinery, Chemical composition of Sizes and their identification, Desizing mechanisms and methods, Desizing Recipes & Process Design, Testing & Q.C. of Desized fabrics, Faults and remedies

**Module 4: Scouring**

Principle, method and machinery, Mechanism of scouring, Chemical and bio-scouring of cotton, flax, jute, wool, manmade fibers and their blends, Scouring Recipes & Process Design, Testing & Q.C. of scoured textiles, Faults and remedies

**Module 5: Heat-setting**

Principle and machinery, Mechanism of heat-setting, Dimensional stability of synthetic fiber, Structural changes taking place in fiber during heat treatment, Methods of heat setting, Heat-setting Process Design, Testing & Q.C. of heat set fabrics, Faults and remedies

## **Module 6: Bleaching**

Principle, method and machinery, Mechanism of Bleaching, Chemistry and mechanism of different bleaching agents: Hydrogen peroxide; Sodium hypochlorite; Sodium Chlorite, bleaching of cotton, flax, jute, wool, manmade fibers and their blends, Bleaching Recipes & Process Design, Testing & Q. C. of bleached textiles, Faults and remedies

## **Module 7: Value Addition processes (Mercerization, causticization, Ammonia treatment)**

Mechanism and effects of Mercerization, Yarn and Fabric Mercerization, Slack & Tension Mercerization both in the cold and hot conditions, Mercerization machines and their description, Caustic Weight reduction of Polyester, Mercerization & Causticization Process Design, Testing & Q. C. of Mercerized textiles, Cotton treated with Liquid Ammonia, Physical and chemical modification taking place during the process, Liquid Ammonia treatment machinery and its description, Testing & Q. C. of Ammonia treated fabrics

### **List of practical:**

- Enzymatic desizing of cotton and P/C woven fabrics by exhaust method
- Enzymatic desizing of cotton and P/C woven fabrics by pad batch method
- Enzymatic desizing of cotton and P/C woven fabrics by pad steam method
- Oxidative desizing of cotton and P/C woven fabrics by exhaust method
- Oxidative desizing of cotton and P/C woven fabrics by pad batch method
- Oxidative desizing of cotton and P/C woven fabrics by pad steam method
- Scouring of cotton and P/C knitted fabric by exhaust method using alkali and detergents onwinch machine
- Scouring of cotton and P/C knitted fabric by exhaust method using enzymes
- Two-step Scouring and Bleaching cotton and P/C yarn in package form using Caustic Soda and Hydrogen Peroxide
- One-step desizing and scouring of woven cotton and P/C fabrics by exhaust method
- One-step desizing and scouring of cotton and P/C woven fabrics by pad steam method
- One-step desizing, scouring and bleaching of cotton and P/C fabrics by pad steam method
- Scouring and bleaching of wool
- Scouring and bleaching of Jute
- Cold mercerization of bleached cotton fabrics
- Hot Mercerization of grey cotton fabric, followed by desizing, scouring and bleaching
- Caustic treatment of 100% polyester and P/C blended fabrics
- Heat setting of Polyester, Polyester/elastane and cotton/elastane blends

### **Recommended Books:**

- Chemical Technology in the Pre-treatment Processes of Textiles by S.R. Karmakar, 1999

- Cellulosic Dyeing by John Shore, 1995
- Chemistry and Technology of Fabric Preparation & Finishing by Charles Tomasino, 1992
- Textile Chemistry by R. H Peters
- Scouring and Bleaching by E. R. Trotman

## TEX-341 Garment Sizing and Pattern Making (1+2)

### Overall Aims of the Course:

This course focuses on the technical aspects of anthropometry and pattern making. The course covers both 2D and 3D pattern design methods. On one hand, the course covers the human body shapes, sizes, sizing system, fabric behaviour and body landmarks. On the other hand, it contains the topics related the construction of patterns for collars, sleeves, pockets, cuffs, bodice block and skirts. Several approaches to draft and manipulate the patterns to accommodate various body sizes and shapes are included in the contents.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge and understanding of anthropometry, human figure and standard sizing system for the development of garment patterns.	Cognitive-2	PLO-1
CLO-2	Ability to analyze the effect of fabric grain line and drape behavior on garment patterns.	Cognitive-4	PLO-2
CLO-3	Ability to design and develop complete basic patterns according to the given body measurements and grading process.	Psychomotor-2	PLO-3

### Course Contents:

#### Module 1: Anthropometry; Human figure

Anthropometry, History of anthropometry, new trends in anthropometry, Human anatomy, Figuretypes, Ideal standard figure, Body landmarks

#### Module 2: Sizing System

History of sizing systems, developing a Sizing system, Methods to decide Size intervals, Sizing system for Pakistani population.

### **Module 3: Basic Block Pattern**

Measurements to construct a basic block, Basic block Pattern & its different types, Grain line, lengthwise grain, crosswise grain, Bias grain, true bias and selvedge

### **Module 4: Paneled Bodice & Contouring**

Development of paneled bodice block, Development of princess style bodice, Development of wing seamed bodice, the basic principles of contouring, Contour guide pattern, Surplice/wrap designs, Off shoulder designs

### **Module 5: Dart Manipulation, Gathers & Pleats**

Darts, Objectives of darts, Dart manipulation techniques, what are pleats, Gathers & flares, types of pleats, Development of pleat cluster

### **Module 6: Draping**

Introduction to 2D and 3D pattern making, Comparison of draping & drafting, Sketch understanding, Identification of different elements, Pattern design using draping, Development of basic skirt's pattern by draping, Development of trousers' pattern by draping

### **Module 7: Collars, Sleeves, Cuffs, Plackets Pockets & Skirts**

Collar terms, types & Collar classification, Basic shirt collar foundation, different types of sleeves & cuffs, different types of plackets & Pockets, Basics of Skirt patterns, Different skirt lengths, Different skirt silhouettes

### **Module 8: Pattern grading & fabric properties**

Developing measurement chart of a sewn product, why grading is used? Manual pattern grading process, manipulating fabric stretch in pattern making, manipulating fabric shrinkage in pattern making, Dart-less stretch fabric Foundations, Types of lining/interlining, Cut-out necklines & armholes

#### **List of practical:**

- To construct the pattern of Band Collar
- To construct the pattern of band collar with button extension
- To construct the pattern of pointed bottom wing collar (curved Neckline)
- To construct the pattern of two-piece shirt collar
- To construct the pattern of one-piece shirt collar
- To construct the pattern of basic bodice block (back panel)
- To construct the pattern of basic bodice block (front Panel)
- Main bodice blocks on 1/4 scale
- Truing of basic bodice blocks
- To construct the pattern of basic sleeve block
- To construct the pattern of dart manipulation Basic skirt block

- To construct the pattern of sleeve placket
- To construct the pattern of round corner cuff
- To construct the pattern of straight corner cuff
- To construct the pattern of patch pocket
- To construct the pattern of patch pocket with flap

**Recommended Books:**

- Fashion patternmaking techniques: how to make skirts, trousers and shirts women/men byDonnanno & Antonio, Promo press
- Patternmaking for Fashion Design by Helen Joseph Armstrong, Pearson
- Fabric and pattern cutting: fabric, form and flat pattern cutting by Aldrich and Winifred, John Wileyand Sons
- Pattern cutting and making up: the professional approach by Shoben and Matin, CBS publishers anddistributers
- Guide to Basic Garment Assembly by Jayne Smith

**TEX-301 Textile Testing & Quality Control (3+1)**

**Overall Aims of the Course:**

This would deal with the testing of fiber, yarn, fabric, garments, coatings/finishes and technical textiles. (aesthetically and performance wise).Different parameters would be taught in detailalong with sampling and quality control.

**Course Learning Outcomes: Students should be able to achieve following course learning outcomesduring completion of the course.**

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge and understanding of different fiber, yarn and fabric properties.	Cognitive-2	PLO-1
CLO-2	Ability to measure and evaluate different fiber, yarn and fabric and garment properties of various types using different standard tests.	Psychomotor-2	PLO-2
CLO-3	Testing of different finishes, coatings and other technical textiles	Psychomotor-2	PLO-2

**Course Contents:**

**Module 1: Quality Control and its application in textile industry**

- Quality, quality checks, control of raw materials, preparatory processes and their effects on final product quality, quality control on finishing processes, Quality audit
- Selection of Samples for Testing

- Fibre Sampling Techniques
- Yarn Sampling Techniques
- Fabric Sampling Techniques
- Standard Atmosphere for Testing

### **Module 2: Structure, mechanics and testing of fibers and yarns**

- Fiber strength: single fiber strength, bundle strength. Different tests of fibers of various materials, shapes and sizes. Fibre Length/Fineness Measurement, Cotton Maturity, Fibre Strength Measurement, Moisture Regain, Determination of Trash and Lint in Cotton, High Volume Instrument(HVI)
- Breaking strength; tensile strength, stress, specific stress, tenacity, breaking length, elongation, strain, extension percentage, gauge length, force elongation curve, yield point, modulus, work of rupture, time dependence, elastic recovery, factor affecting tensile test, types of testing machines, specimen length, rate of loading and time to break, effect of humidity and temperature.
- Linear density, evenness, imperfections, diameter, hairiness, twist; and their measurements. USTER statistics; Interpretation of yarn evenness testing results; Relationship of fiber properties with yarn properties; Relationship of yarn structure and its mechanical properties (strength, elongation, elasticity, recovery, modulus).
- Yarn strength: Single strand method, skein method

### **Module 3: Structure, mechanics and testing of fabrics**

- Physical properties and construction of fabric; Relationship of yarn properties with fabric properties; Relationship of fabric structure and its mechanical properties; Tensile, bending, shear, tear, burst, crease recovery, pilling, abrasion and air permeability of fabrics
- Fabric tensile strength: strip strength, grab strength

### **Module 4: Structure, mechanics and testing of garments**

- Effect of joining methods such as sewing/stitching and types of seam on fabric bending and drape properties
- Seam Strength and Seam Slippage
- Effect of garment construction on its properties (drape, fit and appearance)
- Symmetry check, Size fitting, seam twisting and measurements
- Fasteners fatigue and zip quality test
- Waterproof and windproof test
- Fabric weight test (for knitted garments)
- Needle damage check, Burn test (for 100% cotton garment)
- Mold contamination prevention and testing
- Metal contamination prevention and testing

- Ventilation test, air permeability and Flammability
- Harmful substances in Garments, its testing and eco labelling (formaldehyde, azo)
- Strength of Buttons and other trims
- Stretch and recovery
- thermal, moisture and sensory comfort of garments.
- Mechanical hazards – drawstrings, small parts and sharp points and edges
- Dimensional change/shrinkage
- Snagging resistance
- Abrasion and pilling

#### **Module 5: Testing of different finishes, Printings, Dyeing, Coatings and other specific functional aspects**

- Color fastness check (Rub test), Color fastness to light, perspiration, saliva, water, bleach, etc.
- Color shading
- Adhesive check (logos, printings, markings fastness)
- Coating and finishing fastness, thickness and stiffness testing
- Special Testing for Nonwoven and Technical Textiles

#### **Module 6: Yarn, Fabric, processing and garments faults**

- Classification and detection of different faults due to process and materials

#### **List of Practical:**

- Determination of span length and effective length of fibers by using Comb Sorter
- Determination of fiber fineness, bundle strength of fibers and count/linear density of textile Yarn
- Determination of uniformity (Evenness) of sliver/roving and uniformity (Evenness & hairiness) of yarn
- Determination of strength of single yarn and skein
- Determination of twist per inch and twist per meter, crimp of yarn in woven fabric
- Determination of bending stiffness, flexural rigidity and crease recovery of fabric
- Determination of strength of fabric
- Determination of pilling and the abrasion of fabric
- Determination of bursting strength and air permeability of fabric
- Classification and detection of yarn and fabric faults.

#### **Recommended Books:**

- Principles of Textile Testing by J. E. Booth, 1961, Heywood Books, London.
- Physical testing of textiles by B. P. Saville, 1999.



- A practical guide to textile testing by K Amutha 2016 CRC press.
- Advanced Textile Testing Techniques by Sheraz Ahmad et al. CRC Press.
- Structure and mechanics of textile fiber assemblies by P. Schwartz, latest edition.
- Structure and mechanics of woven fabrics by Jinlian Hu, Woodhead Publishing in Textiles, 2004.
- Fabric testing by J. Hu, 2008.
- Bona, M., "Textile Quality: Physical Methods of Product and Process Control", Eurotex, Italy, latest edition.
- Leaf, G., "Practical Statistics for the Textile Industry: Part I and II", The Textile Institute. UK

## TEX-303 Instrumentation & Control (2+1)

### Overall Aims of the Course:

To introduce students to the working principles of different types of measuring instruments and control systems used in textiles

**Course Learning Outcomes: Students should be able to achieve following course learning outcomes during completion of the course.**

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Familiarity of working principles and control of measurement devices, gauges, sensors and transducers used in textile machinery and testing equipment	Cognitive-2	PLO-1
CLO-2	Understanding of electronic systems, their modules, Programmable logic control (PLC) and functions.	Cognitive-2	PLO-1
CLO-3	To diagnose problems with the automation systems and resolve issues or design new system for the resolution	Psychomotor-5	PLO-5

### Course Contents:

#### Module 1 Introduction

- Introduction to automation, types of automation, reasons for automation. Production operation and automation strategies.

#### Module 2 Measurement Devices and Gauges used in Textile Mills

- Fundamental principles of instrumentation system, instrument performance errors, measurement classification and methods, strain measurement, linear and angular displacement measurement, force,

pressure, fluid flow, time, frequency and speed measurement, vibration measurement and temperature measurement, signal processing, displays and recording instruments.

### **Module 3 Sensors/Transducers used in Textile Machines**

- General principles of sensors/transducers, active and passive transducers, resistive, capacitive, inductive, thermo-electric, piezoelectric, optical, elastic, pneumatic, differential pressure and rotating discs' sensors/transducers,

### **Module 4 Signal Conditioning and Processing**

- Wheat stone bridge, potentiometer, amplification, attenuation, filtering, modulation, voltage to current and current to pressure conversion.

### **Module 5 Data Display and Recording**

- Moving coil meter, galvanometric, potentiometric, monitors, data loggers, printers and electronic storage devices.

### **Module 6 Control System**

- General introduction, open-loop and close-loop systems, basic elements of a close loop system, close and open loop transfer function, feedback, effect of disturbance, dynamic characteristics. Transfer function and transfer operator, derivation of control, analysis of multi loop-system.

### **Module 7 Actuating and Controlling System**

- Introduction, single conversion, electric, pneumatic, hydraulic and thermal actuators control elements. Two step controls, proportional, integral and differential controls. Linear feedback control systems, optimal control system, computer assisted optimal control.

### **Module 8 Computer Process Control of Textile Machines**

- The computer process interface, interface hardware, computer process monitoring, types of computer process control, direct digital control, supervisory computer control, programming for computer process control. Technical study of the computer process control of various textile machines.

### **Module 9 Electronics platform**

- Arduino applications with digital and analogue input sensors and actuators
- Arduino programming with MATLAB and other software.

**List of Practical:**

- To demonstrate Transducer used in UTR
- To demonstrate the transducer used in weaving machine.
- To demonstrate the basic components of Automation used in Uster Tester.
- To demonstrate the pointer, display devices such as stelometer
- To Measure the speed of Shaft or spindle by using Stroboscope
- To study the force measuring equipment.
- To Measure the Temperature by applying Thermo coupling
- To demonstrate the function of microprocessor used in Textile Machines.
- To demonstrate Auto leveler used in carding
- To demonstrate the Auto leveler used in draw frame
- To demonstrate the working principle and functions of robot used in Rotor (Automated).
- Designing the (temperature, humidity etc.) measuring and controlling system utilizing Arduino

**Recommended Books:**

- Engineering Instrumentation by Collett, C. V. and Hop, A. D. latest edition.
- Engineering Instrumentation and Control by Haslam, J. A. et al
- Automation in the Textile Industry by Grady, P. L. et al.

## TEX-305 Color Science (3+0)

### Overall Aims of the Course:

In this course the students study fundamentals of colour perception, description, notation, communication and measurement. The course covers topics such as elements of colour perception, standard illuminants, specification of color, Munsell system, CIELAB system, color difference, pass/fail system, shade sorting, strength analysis of dyes from solution, relative dye strength and tone analysis, assessment of whiteness and degree of yellowness, anatomy of colour measuring instruments, and principles of computer colour matching.

**Course Learning Outcomes: Students should be able to achieve following course learning outcomes during completion of the course.**

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Understand fundamentals of color perception, description and notation and relate these to the communication and measurement of color.	Cognitive-2	PLO-1
CLO-2	Understand the factors influencing the color differences between similarly dyed samples and select a color difference formula for a particular case.	Cognitive-2	PLO-1
CLO-3	Discuss the principles of computer color matching.	Cognitive-2	PLO-1

### Course Contents:

#### Module 1: Introduction

Importance of color in textiles, Application of color science in textiles, Elements of color perception: light, object, observer, Standard illuminants, Major types & characteristics of textile objects, Visual perception and defective color vision

#### Module 2: Specification of Color

Subjective methods of color specification, Objective methods of color specification, Opponent color coordinates and the L a b Concept, Lightness Chroma and Hue, Some Practical Application based On the L a b C h System

#### Module 3: Measurement of Color

Anatomy of a Spectrophotometer: Illumination, Optics, Sample Presentation and Viewing Geometry, Mono-chromation, Photo-detection, Major types of

spectrophotometers: desktop spectrophotometer; portable spectrophotometer; on line spectrophotometer, Effect of viewing geometry, sample size, specular component and different instruments on color, Selection of a spectrophotometer for process house, Color quality control system, Recipe prediction and related programs, Color analysis methods and systems in textile mills, Color analysis hardware and software in various color systems, Review of recent developments in measurement, communication, management and analysis of color, Application of color measuring systems, Color management systems

#### **Module 4: Measurement of Color Difference**

Acceptability and perceptibility, Different color difference formulae, Selection of color difference formula, Grey scale and color difference, Practical experience in shade evaluation, Setting up tolerance limits

#### **Module 5: Assessment of Whiteness and Degree of Yellowness**

Formulae for Computing Whiteness Indices, Selection of Whiteness Formula, Yellowness Index

#### **Module 6: Shade Sorting**

Importance of shade sorting, Difference between shade sorting and pass-fail, Shade sorting according to 555 system

#### **Module 7: Strength Analysis of Dyes from Solution**

Lambert-Beer Law, Practical Applications of Beer's Law, Determining Strength Ratios from a Mixture of Dyes, Transmission Measurements of modern color system, Relative dye strength and tone analysis, Comparison of different methods & practical examples

#### **Module 8: Computer Color Matching**

Theory of Computer Color Matching, Accuracy of Match Prediction, Preparation of Database, Sampling of Dye, Calibration Dyeing, Data Verification and Rectification, Measurement of Reflectance, Processing Variables, Compatibility of Dyes, Variations in Dye Strength, Batch Correction, Tri-stimulus Color Matching, Utilization of Leftover Dyes, Benefits from Computer Color Matching

#### **Module 9: Reproducibility & Right First Time Dyeing**

Factors affecting reproducibility and right first-time dyeing

#### **Recommended Books:**

- Computer Color Analysis by A. D. Sule
- Colour Physics for Industry by Roderick McDonald
- Textile Science by E. P. G. Gohl
- Instrumental Color Formulation by James Park

- Color and its Application by F. W. Culolow
- Basic Principles of Textile Coloration by A D Broadbent
- Assorted Color Literature by Datacolor, Macbeth, Hunterlab, X-Rite

## TEX-307 Engineering Economics (3+0)

**Course Learning Outcomes: Students should be able to achieve following course learning outcomes during completion of the course.**

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Apply the appropriate engineering economics analysis method(s) for problem solving i.e. present worth, annual cost, rate of return, payback, break-even, benefit-cost ratio	Cognitive-4	PLO-2
CLO-2	Evaluate the cost effectiveness of individual projects using the methods learnt, draw inferences for investment decisions, and compare the life cycle cost of multiple projects.	Cognitive-5	PLO-3
CLO-3	Compute the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value	Affective-4	PLO-12

### Course Outline:

#### Engineering Economics

- Role of engineers in business
- Economic decisions v/s design decisions
- Large scale engineering projects and types of strategic economic decisions
- Fundamental principles of engineering economics

#### Interest Rate and Economic Equivalence

- Interest: The Cost of Money
- Economic Equivalence
- Development of Formulas for Equivalence Calculation
- Unconventional Equivalence Calculations

#### Understanding Money and Its Management

- Nominal and Effective Interest Rates

- Equivalence Calculations with Effective Interest Rates and with Continuous Payments
- Changing Interest Rates
- Debt Management
- Investing in Financial Assets

### **Present-Worth Analysis**

- Project Cash Flows
- Initial Project Screening Methods: payback Screening and Discounted Cash Flow Analysis
- Variations of Present-Worth Analysis
- Comparing Mutually Exclusive Alternatives

### **Annual Equivalent-Worth-Analysis**

- Annual Equivalent-Worth Criterion
- Capital Costs versus Operating Costs
- Applying Annual-Worth Analysis
- Life-Cycle Cost Analysis
- Design Economics

### **Rate-of-Return Analysis**

- Rate of Return and Methods of Finding It
- Internal Rate-of-Return Criterion
- Mutually Exclusive Alternatives

### **Cost Concepts Relevant to Decision Making**

- General Cost Terms; Classifying Costs for Financial Statements
- Cost Classifications for Predicting Cost Behavior
- Future Costs for Business Decisions
- Estimating Profit from Production

### **Depreciation and Corporate Taxes**

- Asset Depreciation: Economic versus Accounting
- Book and Tax Depreciation Methods (MACRS)
- Depletion
- Income Tax Rate to be used in Economic Analysis
- The Need for cash Flow in Engineering Economic Analysis

### Developing Project Cash Flows

- Cost-Benefit Estimation for Engineering Projects
- Developing Cash Flow Statements

### Project Risk and Uncertainty

- Origins of Project Risk
- Methods of Describing Project Risk: Sensitivity, Break-Even and Scenario Analysis

### Special Topics in Engineering Economics

- Replacement Decisions
- Capital Budgeting Decisions
- Economic Analysis in the Service Sector

### Recommended Books:

- Contemporary Engineering Economics by Chan S. Park, 6th edition, Pearson 2015, ISBN: 9780134105598
- Engineering Economic Analysis by Donal G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, 12th edition, Oxford University Press, ISBN: 978- 0199339273
- Engineering Economy by Leland T. Blank and Anthony Tarquin

## TEX-309 Thermodynamics and Fluid Mechanics (2+0)

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	y	PLO
CLO-1	Learn the principals of energy conservation and its importance	Cognitive-2		PLO-7
CLO-2	Knowledge of different fluid properties, thermodynamic cycles and their application in textiles	Affective-5		PLO-2

### Course Outline:

#### Module 1: Ideal Gas:

- Thermodynamic processes; Gas laws; Specific heats of an ideal gas; Dalton's Law of Partial Pressure; Third Law of Thermodynamics; Entropy of an ideal gas



**Module 2: Energy and its Conservation:**

- Relation of mass and energy; Different forms of energy; Different types of Open and Closed systems; Energy equation, devices and systems for steady flow; Perpetual motion of the first kind and second kind; Thermodynamics equilibrium; Reversibility; specific heats and their relationship; entropy. First Law of Thermodynamics; Second Law of Thermodynamics; Property relation from energy equation; Frictional energy; Clausius's inequality; Availability and irreversibility

**Module 3: Thermodynamic Cycles:**

- Cycle work; Thermal efficiency and heat rate; Carnot cycle; Sterling cycle; Reversed and reversible cycles; most efficient engine; gas and steam power cycles

**Module 4: Fluid Properties:**

- Pressure, Vapour pressure, Density, Specific weight, Specific gravity, Viscosity, Bulk modulus of elasticity, Surface tension, capillary action, Ideal, Newtonian and non-Newtonian fluids, Relevance of fluid properties to textiles and textile processes

**Module 5: Fluid Statics:**

- Pressure variation in a static fluid; Pascal's law; hydrostatic force on a plane surface, Pressure prism method; hydrostatic force on a curved submerged surface; buoyant force, Archimedes' principle; the stability of floating and submerged objects,

**Module 6: Fluid Dynamics:**

- Flow characteristics; Equation of continuity; Application of Newton's second law to fluid flows; development, uses, and limitations of the Bernoulli equation; static, dynamic and stagnation pressures; Laminar and turbulent pipe flow; losses in pipe flows; velocity and flow rate measurement devices; pipe flow; pumps and turbines

**Module 7: Fluid Flow Applications in Textile Processing:**

- Air jet spinning, Nozzle design and performance in air jet spinning, Spun bonding process of non-woven, Textile wet processing, Air-jet and water jet weft insertion mechanisms

**Recommended Books:**

- J.B. Franzini and E.J. Finnemore, Fluid Mechanics with Engineering Application. McGraw Hill Education. 2003.
- Y. A. Cengel and M. A. Boles. Thermodynamics: An engineering Approach. McGraw-Hill Education. 2014.
- T. D. Eastop, and A. McConkey, Applied Thermodynamics for Engineering and Technologists. 5th Ed. Pearson Education Ltd. 2009.
- B. R. Munson, A. P. Rothmayer and T. H. Okiishi. Fundamentals of Fluid Mechanics, 7th Non-Engineering Domain

**6<sup>th</sup> Semester****TEX-312 Yarn production Engineering (3+1)****Overall Aims of the Course:**

In-depth study of ring spinning frame will be discussed in this course. Modern concepts related to drafting, twisting, and package formation on roving frame and ring spinning frame will be focused. Different effects of conditioning and environmental conditions will also be discussed in this course.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To learn the working of roving frame and ring spinning systems and effect of various machine settings and their effect on quality and cost of yarn being produced.	Cognitive-4	PLO-2
CLO-2	To compare various machine/models of ring and roving frame and learn how machinery manufacturers have achieved various improvements in quality and production.	Cognitive-3	PLO-2
CLO-3	To learn how to apply various machine settings practically and then propose new methods for quality and cost improvement.	Psychomotor-3	PLO-7

**Course Contents:****Module 1 Roving Formation**

- Roving frame as a production necessity, tasks of the roving.
- Operating zones of the roving frame: Creel, drafting arrangement,

aprons, pressure arm, condensers and spacers.

- Spindle and Flyer: Imparting twist, winding system. Package formation.
- Machine drive system: Mechanical drive systems, viz. Bobbin drive, Cone drive transmission, Shifting the belt, Correction rail, Lifter motion, Builder motion, Shifting the cone belt, Reversal of the bobbin rail movement, Shortening the lift, electronic drive systems.
- Automation at Roving Frame: Manual and automatic doffing. Accessories and automation transport of bobbins to ring spinning machine. Roving tension monitoring, Evaluation of roving. Optimum process atmospheric conditions.

### **Module 2 Ring Spinning**

- Functions and mode of operation,
- Structure of the machine, bobbin creel, drafting system, top rollers, roller covers, rollers pressure loading, fiber guidance devices. Spindle, thread guide devices, balloon control ring, separators. Ring structure and its functions. Traveller, types, shape, mass and traveler clearer. Machine drive and cop buildup.
- Automation, the potential for automation. Monitoring systems and auxiliary equipment. Automatic doffing, Automatic transport to the winding machine.
- Compact spinning: principle and advantages of compacting. Different compacting systems. Optimum process atmospheric conditions.

### **Module 3 Winding**

- Objectives; Working principle of yarn winding, Yarn package types and their building; types of winding machines, uniform buildup of cones, automatic electronic yarn clearer and its settings.
- Yarn tensioners, patterning, reasons and their remedies.
- Yarn fault classifying systems. Basic features of various auto-winders. Latest developments in winding machinery. Optimum process atmospheric conditions.

### **Module 4 Yarn Conditioning and Packaging:**

- Conventional and modern yarn conditioning systems; Merits of conditioning by autoclaves; Impact of yarn conditioning on yarn quality and productivity.

### **List of Practical:**

- Study of change of draft and twist on roving frame.
- Study of the change of coils/inch and roving tension at speed frame.
- Preparation of given hank roving at roving frame.

- Study of package building mechanism at roving frame.
- Study the change of draft and twist on ring frame.
- Study of drafting system of ring frame.
- Study of the cop building mechanism on ring.
- Study of the change of roller settings on ring frame.
- Study of the settings of spindle gauge, balloon height and lappet guide.
- To study the effect of cone winding on yarn quality
- To study the settings of yarn cleaner
- To check the weight gained by cotton yarn during yarn conditionings (yarn steaming) processes using a yarn conditioning machine

**Recommended Books:**

- Fundamentals of Spun Yarn Technology by C. A. Lawrence, 2003.
- The Rieter Manual of Spinning by W. Klein, 2008
- Advances in Yarn Spinning Technology by C. A. Lawrence, 2010.
- Spun Yarn Technology by Eric Oxtoby, 1987.
- Manual of Cotton Spinning by Gilbert R. Merrill, 1961.

**TEX-322 Weaving Mechanisms (3+1)**

**Overall Aims of the Course:**

The objective of this course is to develop an understanding in students about different weaving mechanism related with primary, secondary and auxiliary motions.

**Course Learning Outcomes:**

Students should be able to achieve following course learning outcomes on completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To demonstrate loom motions and illustrate the related details.	Cognitive-3	1
CLO-2	To make settings of various loom motions for a particular quality of fabric.	Psychomotor-3	1

**Course Contents:**

**Module 1 Shedding Systems**

- Introduction to shedding
- Shed types: center closed shed, bottom closed shed, open shed, semi open shed
- Shedding mechanism and its types
- Tappet shedding mechanism
- Types of tappets
- Design of tappets

- Types of tappet shedding: positive and negative
- Merits and demerits of tappet shedding
- Cam shedding on projectile, rapier and various models of air jet looms
- Cam installation
- Dobby shedding mechanism
- Types of Dobbies
- Conventional Dobbies: Single and Double Lift Dobbies, Cam Dobby, Paper Dobby
- Jacquard shedding mechanism
- Basics of Jacquard System
- Constructions and working of jacquard shedding mechanism
- Types of jacquards: Conventional Jacquards, Single Lift Jacquard, Double Lifts Jacquard
- Types of special Jacquard: Compound, Blister, Sectional, Damask, Twilling, Inverted hook, cross border, Verdol Shed and Scale Jacquard

## **Module 2 Weft Insertion Systems**

- Introduction of Weft insertion systems and its types
- Shuttle weft insertion system
- Over picking and Under picking
- Picking and receiving box
- Multiple Box motion
- Projectile weft insertion system
- Projectile features: speed, weight, size, and type of projectiles for different types of yarns
- Mechanism: picking and receiving units, guide teeth, Projectile circulation and Conveyor belt
- Torsion rod mechanism
- Picking cycle
- Picking force of the projectile
- Projectile lubrication system
- Rapier weft insertion system
- Versatility of rapier weft insertion mechanism for all types of conventional and high-performance yarns.
- Types of rapier weaving mechanisms; Rigid and flexible rapiers, Single and double rapiers, Dewas and Gabler system
- Use of rapier weaving for technical fabrics.
- Machine settings for higher performance yarns like carbon, Kevlar, glass.

### **Module 3 Beat-up Mechanism**

- Beat-up mechanism and its types
- Crank beat-up: principle, construction and working
- Cam beat-up: principle, construction and working
- Comparison b/w crank & cam beat up motion
- Crank throw
- Sley eccentricity
- Beat-up on projectile, rapier and various models of air jet looms
- Reed, Reed Count, Reed denting
- Beat-up mechanism of towel weaving machine
- Beat-up mechanism for denim weaving

### **Module 4 Let-off Mechanism**

- Let-off motion and its objectives
- Types of let-off motion
- Negative let-off motion: Construction and Working
- Positive let-off motion: Construction and Working
- Electronic let-off motion: Construction and Working
- Effect of warp tension in let-off motion
- Relationship b/w beam diameter & RPM of weaver's beam
- Back rest Rollers and easing motion

### **Module 5 Take-up Mechanism**

- Take-up motion and its objectives
- Construction & working of take up motion on shuttle loom
- Take-up on projectile, rapier and various models of air jet loom
- Relation of take up rate with weft density on shuttle & shuttle-less looms
- Periodicity due to eccentricity in take up motion
- Cloth control, Ring Temples, spreader bar and fabric width

### **Module 6 Stop Motions**

- Stop motions, its objectives and types
- Warp stop motion and its objectives
- Types of warp stop motions: electrical and mechanical
- Construction & working of electrical warp stop motion
- Construction & working of mechanical warp stop motion
- Weft stop motion and its objectives
- Types of weft stop motions: mechanical and electrical

- Construction & working of mechanical weft stop motion
- Construction & working of electrical weft stop motion
- Warp protector motion and its objectives
- Types of warp protector motion
- Construction & working of warp protector motion

#### Recommended Books:

- Weaving Conversion of Yarn to Fabric by P. R. Lord & M. H. Mohd Latest Edition
- Principles of Weaving by R. Marks & A.T.C. Robinson Latest Edition
- Handbook of Weaving by Sabit Adanur, (2000)
- Weaving: Machines, Mechanisms, Management. by Talukdar, Marinal Kanti, P. K. Sriramulu, and Dinkar Bapurao Aijaonkar. Mahajan Publishers, (1998)
- Weaving Technology and Operations by Allan Ormsrod (1995)
- Mechanisms Of Flat Weaving Technology, by Choogin, Valeriy V., Palitha Bandara, and Elena V. Chepelyuk.. Elsevier, (2013)
- Shuttle-less weaving machines by Idrich Talavasek (1981)
- Cotton Weaving, Its Development, Principles and Practice by Richard Marsden, 2000
- Eurotex-An introduction to Textiles by R. Marks

### TEX-332 Textile Dyeing (3+1)

#### Overall Aims of the Course:

At the end of this course the students should be able to dye cellulosic and non cellulosic/synthetic/ modified textile substrates with different dyestuffs by exhaust, semi-continuous and continuous methods. Moreover, the students should be able to troubleshoot and solve common problems in textile dyeing.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Understand and identify different dyes, auxiliaries, dyeing methods and related dyeing machinery for all kind of substrates.	Cognitive-4	PLO-1
CLO-2	To apply different dyes on various substrates by different methods and different machines.	Cognitive-3	PLO-2
CLO-3	To develop, assess and analyze different colored textile products as per requirements	Psychomotor-3	PLO-4

## **Course Contents:**

### **Module 1 Introduction to Dyes and Dyeing**

Brief introduction of dyes and dyeing history, Essential definitions and terms used in dyeing and their explanation, Processing flow chart for yarn, woven, denim and knitwear textiles

### **Module 2 Theory of Coloration of Textiles**

Relationship between fiber structure and dyes during the dyeing process, Dyeing equilibrium: thermodynamic aspects of equilibrium; Isotherm and affinities; Electrical effects, heat and dyeing entropy, Kinetics of Dyeing, Characteristics of dyeing: color fastness

### **Module 3 Dyeing with Direct Dyes**

Mechanism of dyeing with direct dyes, Exhaust/batch-wise, semi-continuous and continuous application of direct dyes, After-treatment of textiles dyed with direct dyes, Design of recipe and process for dyeing cellulosics with direct dyes, Faulty dyeing and their correction

### **Module 4 Dyeing with Reactive Dyes**

Mechanisms of dyeing with dyes of different reactive groups, Exhaust/batch-wise, semi-continuous and continuous application of reactive dyes, After-treatment of textiles dyed with reactive dyes, Design of recipe and process for dyeing cellulosics with reactive dyes, Faulty dyeing and their correction

### **Module 5 Dyeing with Vat and Indigo Dyes**

Mechanism of dyeing with vat dyes, Exhaust/batch-wise, semi-continuous and continuous application of vat dyes, dyeing of denim yarn with indigo dyes, After-treatment of textiles dyed with vat dyes, Design of recipe and process for dyeing cellulosic with vat dyes, Faulty dyeing and their correction

### **Module 6 Dyeing with Sulphur Dyes**

Mechanisms of dyeing with sulphur dyes, Exhaust/batch-wise, semi-continuous and continuous application of sulphur dyes, After-treatment of textiles dyed with sulphur dyes, Design of recipe and process for dyeing cellulosics with sulphur dyes, Faulty dyeing and their correction

### **Module 7 Selection of Dyes for Cellulose**

Properties of dyes on the basis of their colour constitution, Behavior of different dyes in dyeing processes, Selection of dyes keeping the colour properties, behaviour, cost factor and application methods in mind, Customer requirement consideration and its effect on dye selection



## **Module 8 Dyeing Machinery**

Fundamentals of functional design of coloration machines, Exhaust dyeing machines (Fiber dyeing, Yarn dyeing, Fabric dyeing and Garment dyeing), Pad dyeing machines

## **Module 9 Dyeing of Polyester and Acetate Materials**

Mechanisms of dyeing with disperse dyes, Exhaust/batch-wise, semi-continuous and continuous application of disperse dyes, After-treatment of textiles dyed with disperse dyes, Design of recipe and process for dyeing with disperse dyes, Faulty dyeing and their correction

## **Module 10 Dyeing of Acrylic Textiles**

Mechanisms of dyeing with basic dyes, Dyeing methods for dyeing acrylic with basic dyes, After- treatment of dyed acrylic textiles, Design of recipe and process for dyeing with basic dyes, Faulty dyeing and their correction

## **Module 11 Dyeing of Protein and Polyamide Fibres**

Dyes and mechanisms of dyeing protein and polyamide fibres, Dyeing methods for dyeing protein fibres, After-treatment of dyed protein fibres, Design of recipe and process for dyeing protein fibres, Faulty dyeing and their correction, Dyeing method for Polyamide fibres including Nylon

## **Module 12 Blend Dyeing**

Objective and need of blending, Discussion of commercially important blends, Dyeing of P/C blend with disperse/vat and disperse/reactive dyes by different methods, Different routes adopted in continuous dyeing of p/c blend, Dyeing of other important blends like poly/viscose, poly/acrylic etc, Design of recipes and processes for dyeing different blends, Faulty dyeing and their correction

## **Module 13 Pigment Dyeing**

Introduction to Pigment Dyeing, Method used in pigment dyeing, Difference between pigment dyeing and conventional dyeing, Binders and cross-linking agents used in pigment dyeing, Color fastness in pigment dyeing

### **List of practical:**

- Dyeing of cellulosic fabric with direct dyes by exhaust method, followed by fastnessimprovement treatments
- Dyeing of knitted and towel cellulosic fabric with reactive dyes by exhaust method
- Dyeing of woven cellulosic fabric with reactive dyes by pad steam method
- Dyeing cellulosic yarn with reactive dyes by exhaust method in package form
- Dyeing woven cellulosic fabric with vat dyes using pad-steam method
- Dyeing woven cellulosic fabric with vat dyes using pad-jig method

- Dyeing cellulosic fabric with sulphur dyes
- Dyeing Polyester fabric by exhaust method/ HT method
- Dyeing Polyester/Cotton blended knitted fabric using Disperse/Reactive dyes in jet/soft-flow machine
- Dyeing polyester/cotton blended woven fabrics using disperse/reactive dyes by two-stage pad-thermosol-pad-steam method
- Dyeing polyester/cotton blended woven fabrics using disperse/reactive dyes by one-bath, one-stage pad-thermosol-pad-steam method
- Dyeing polyester/cotton blended woven fabrics using disperse/vat dyes by using pad-thermosol-pad-steam method
- Dyeing polyamide fabrics using acid dyes
- Dyeing wool / silk fabric with acid dyes
- Dyeing acrylic fabrics using cationic dyes
- Pigment dyeing of polyester, cotton or blended fabric by pad-dry-cure method

#### **Recommended Books:**

- Basic principles of Textile Coloration by A. D. Broadbent, 2005
- Fundamentals and Practices in Coloration of Textiles by Chakraborty, 2009.
- Cellulosic Dyeing by John Shore, 1995
- Dyeing of Textile Materials, by Jose Cegarra, Textilia, 1992
- Critical Solutions in Dyeing of Cotton Textile Materials by R. Shamey and T. Hussain, 2005
- Textile Science by E. P. G. Gohl, 1995
- Theory of Coloration of Textiles, Society of Dyers and Colorists
- Engineering in Textile Coloration, Society of Dyers and Colorists
- Chemical Principles of Synthetic Fibre Dyeing by S. M. Burkinshaw, 1995
- Blends Dyeing by John Shore, 1995
- Continuous Dyeing of Polyester/Cellulosic Blended Fabric by Sumitomo, 1995
- Dyeing and Finishing of Polyester Fibers and its Blends, BASF 1990
- Wool Dyeing, Society of Dyers and Colorists, 1992
- Theory of Coloration of Textiles, Society of Dyers and Colorists

- Engineering in Textile Coloration, Society of Dyers and Colorists

## **TEX-342 Computer Aided Pattern Design and Product Development (3+1)**

### **Overall Aim of Course:**

This course is on computer aided design system and application of these systems in Pattern Making, Marker Making, spreading, Lay and cut Planning. It also illustrates many significant advances of computer applications in garment product development and design process.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

<b>Sr. No</b>	<b>Course Learning Outcomes (CLOs)</b>	<b>Taxonomy Level</b>	<b>PLO</b>
CLO-1	Knowledge and understanding of Fashion, Fashion Cycles, Fashion elements & principles, style development and changes in it with time.	Cognitive-2	PLO-1
CLO-2	Ability to analyze any garment with respect to style elements and principles, color, materials and trims	Cognitive-4	PLO-2
CLO-3	Knowledge and ability to work with a computerized pattern making and grading system for designing a complete set of graded style	Psychomotor-3	PLO-5
CLO-4	Knowledge and ability to apply appropriate techniques, engineering and IT tools and technologies such as 3D body scanning, made to measure systems for creating ready to wear clothing.	Psychomotor-4	PLO-5

### **Course Contents:**

#### **Module 1: Fashion Forecasting:**

- What is fashion, Fashion trends, Fashion forecasting
- Objective of forecasting, The process of fashion forecasting
- Target market
- Fashion cycle

#### **Module 2: Conceptualization & material Selection:**

- Theme board, Mood board, Inspiration board, Sketches
- Aesthetic requirements of a product
- Functional requirements of a product, Selection of main fabrics, Selection

of trims, Selection of accessories

**Module 3: Color Selection:**

- Color selection, Color wheel, Different colors on color wheel
- Effect of different colors on clothing design
- Selecting appropriate colors for a new product

**Module 4: Style Feasibility and mass customization:**

- Style selection, Silhouette selection, intended performance of the product, cost effectiveness of the product
- Mass customization in apparel industry Current and future changes in consumer buying behavior
- Mass customization and manufacturing process in fashion industry
- Consumers, manufacturers, wholesalers and retailers
- Global supply chain, trade volumes, product categories

**Module 5: Computerized pattern making & grading:**

- Principles of pattern making, garment balance, computerized made to measure systems
- Pattern design screen, managing pieces on screen, piece drop menu, customizing pattern design screen layout, Preferences option
- Pattern grading, objective of grading, Grade points, Grading rules, Rule table
- Digitizing, working principle of a digitizing table, parts of digitizing table, placing a shape on digitizing table, process of digitizing a shape.

**Module 6: Improving apparel size and fit:**

- Key issues affecting apparel sizing and fit
- Applications of technological advancements
- 3D body scanning
- Types of body scanning technology and their application in apparel industry

**Module 7: Model making & Order making:**

- Model making
- Parts of an apparel product; Denim trouser, woven trouser, Dress shirt, Woven shirt
- Applying a rule table on a product, Base size, Selection of different sizes, Order making keeping in view the lay plan

**Module 8: Marker Making:**

- Marker, Objective of marker making, Types of marker, Marker space, Manipulating placement of pattern pieces, Material Utilization

**List of practical:**

- Development of a mood board and theme board
- Selection of materials and colours for a certain product
- To Construct Trouser block (front & back panel)
- To construct trouser derivatives, shorts
- To construct trouser derivative, pedal pusher
- To construct trouser derivative, Capri
- To Grade trouser block for 3 up & 2 down sizes (manual Grading) front panel
- To Grade trouser block for 3 up & 2 down sizes (manual Grading) back panel
- To Digitize trouser pattern
- To Digitize Shirt pattern
- Computer based grading of T-shirt in 5 different sizes (CAD)
- Making Crew Shirt Pattern in (PDS)
- Exercise on Tops & Bottom to use different functions of pattern design system
- Computerized Marker Making I
- Computerized marker Making II

**Recommended Books:**

- Textiles and Fashion: Materials, Design and Technology, Edited by Rose Sinclair, Woodhead Publishing
- Advancement in apparel production by Catherine Fair-Hurst, 2008, Woodhead Publishing Limited. Computer Aided Fashion Design using Gerber Technology by Jane D. Espinoza Alvonoda fair child publishing 2007
- Computer aided Pattern Design and product Development, Beazley and Bond, 2003, Blackwell publishing.
- Patternmaking for Fashion Design by Helen Joseph Armstrong, Pearson.
- Concept of pattern grading Techniques for manual and computer grading, K Mullet, 2nd edition Fairchild books, 2009
- Cooklin's Garment Technology for fashion designers

## TEX-314 Spinning Calculations (3+0)

### Overall Aims of the Course:

The objective of this course is to enable students to perform various kinds of calculations related with blow room, carding, drawing, combing, simplex, ring and other processes

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Ability to perform spinning calculation of different machine, calculate machine and plant output.	Cognitive-3	PLO-1
CLO-2	Ability to assess cleaning efficiency, fiber stressing index and fiber growth of spinning machine.	Cognitive-4	PLO-1
CLO-3	Ability to prepare the spinning plan for given count	Cognitive-6	PLO-3

### Course Contents:

#### Module 1 Blow-room calculations

Calculations related to raw material requirement, Blow room production, draft at scutcher running efficiency, Waste percentage, Lap CV%, Lap weight per yard, and Lap rejection percentage.

#### Module 2 Calculations on Carding Machine

Calculations related to Card production, total draft, and tension draft.

#### Module 3 Calculations on Draw frame

Calculations related to production calculations, total draft, break draft, main draft, and efficiency.

#### Module 4 Calculations on Lap Former and Comber

Calculations related to Lap former production, draft, efficiency. Calculations related to comber production, noil percentage, draft

### Module 5 Calculations on Simplex

Calculations related to simplex production and efficiency, draft calculations, twist, winding rate, deliveryrate, coil per inch.

### Module 6 Calculations on Ring Frame

Calculations related to Ring production and efficiency (OPS, pounds, bags), draft calculations, twistcalculations.

### Module 7 Calculations on Winding Machine

Calculations related to production and efficiency on winding machine

### Module 8 Calculation on Rotor Machine

Calculations related to rotor production, draft calculations, twist calculations.

### Module 9 Spin Plans

Designing of spin plans for different counts of yarns (Cotton carded Yarn, Cotton combed Yarn, BlendedYarn), Average count calculation.

### Recommended Books:

- Cotton Spinning Calculations by Scott-Taggart, Bolton
- Textile Mathematics, Vol. I, II, III by J. E. Booth
- Cotton Spinners Handbook by Gupta
- Manual of Cotton Spinning by Textile Institute

## TEX-324 Weaving Calculations (3+0)

### Overall Aims of the Course:

The objective of this course is to enable the students to make all the necessary calculations related to weaving which include yarn,fabric, machines and production calculations.

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes on completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Make all necessary calculations and measurements related to yarn, fabric, machine and production.	Cognitive 3	2
CLO-2	Execute an order by calculating the yarn requirements for the order, proper planning for production and allocation of resources.	Psychomotor 3	3

## **Course Contents:**

### **Module 1 Yarn Count Calculations**

- Yarn Count Systems: Direct and indirect
- Units of length and weight in various counting systems
- Count conversions
- Average count
- Resultant count

### **Module 2 Winding Calculations**

- Speed calculations: Winding speed, Traverse speed, Resultant speed
- Winding angle and Cone angle
- Winding machine Production calculation
- Determination of no. of machines & spindles required for winding particular yarn

### **Module 3 Warping Calculations**

- Warp set calculations
- Warp weight calculations
- Beam count
- Speed and production calculations
- Determination of the efficiency of machine
- Determination of breaks /10 MM & pound / break
- Warp yarn tension
- Beam capacity

### **Module 4 Sizing Calculations**

- Sizing set calculation and planning
- Beam capacity
- Warp yarn tensions on various sizing tension zones
- Speed, production & efficiency
- Evaluation of maximum speed of sizing machine
- Roller cover
- Determine the roll capacity of sizing machine
- size pick up % age
- Size add-on % age
- Weight of size on yarn
- Sized yarn count
- Size recipes
- Liquor concentration, water volume & condensation allowance



- Determination of size liquor requirement

### **Module 5 Fabric Calculations**

- Determination of factors affecting woven cloth contraction: Diameter of yarn, Cloth geometry, Crimp, Cover factor, GSM, Cloth setting rules
- Fabric Contraction, warp & weft contractions
- Fabric Weight, Determination of GSM and GLM of fabric, Determination of warp weight per linear meter, GSM of Knitted fabric
- Cover Factor: Derivation of a relation for cover factor, Cover factor for square constructions, Determination of fractional cover factor, relation b/w fractional cover factor & cover factor
- Weave Ability of Fabric
- Fabric relationship with yarn count & density
- Determination of relation b/w fiber & yarn density, packing coefficient of yarn, Determination of max. Picks per inch by formula & by table.
- Pile Fabric: Production of towel cloth, Pile height calculations, Total ends per width of towel & for weavers' beams.

### **Module 6 Production Calculations**

- Weight of warp and weft per running yard/meter
- Weight of warp and weft per square yard/meter
- Weight per yard when using different counts and different material
- Weight of fabric and wastage calculation
- Weight of cloth with reference to picks and ends
- Beam Space: Determination of relation for weaves beam space, Determination of weaver beam space for different loom size & qualities
- Loom Production: Determination of loom production & efficiency • Determination of average RPM density, reed space & count.
- Reed Calculations: Determination of reed space & count for fabric, Determination of total ends for fabric qualities, Total ends in weavers' beam,

### **Module 7 Production Planning**

- Yarn requirement for a particular quality and quantity of cloth
- Yarn quantity for a particular width and length of cloth
- Production planning and machinery requirements for certain quality and quantity of cloth in specific period
- Determination of requirement of warp & weft for particular quality.

### **Module 8 Cost Calculations**

- Cost of production and profitability calculation
- Material cost calculation, labour cost and total cost calculation
- Economic evaluation of different machines
- Determination of conversion cost per meter & per pick
- Determination of material cost of warp & weft per meter.
- Utility Costing, Air and Energy costing

### **Module 9 Atmospheric Conditions in Weaving Shed**

- Calculation of moisture regain and moisture content
- Relative humidity and temperature

### **Recommended Books:**

- Fabric Manufacturing Calculations: Process and Product by Yasir Nawab, (2017)
- Weaving Technology and Operations by Allan Ormsrod, (1995)
- Weaving Calculation by Sen Gupta
- Shuttle-less weaving machines by Idrich Talavasek (1981)
- Weaving Calculations: A Guide to Calculations Relating to Cotton Yarn and Cloth and All Processes of Cotton Weaving, by C. P. Brooks, (2010)
- Weaving: Machines, Mechanisms, Management. by Talukdar, Marinal Kanti, P. K. Sriramulu, and Dinkar Bapurao Ajgaonkar. Mahajan Publishers, (1998)

## TEX-334 Dyestuff Engineering (3+0)

### Overall Aims of the Course:

This course aims at developing in students an understanding about the colour and chemical constitution of different types of colorants. The main focus of the course is on the relationship of dye chemistry and its properties.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Understanding of classifications, chemistry and properties of dyes and pigments.	Cognitive-2	PLO-1
CLO-2	Ability to describe synthesis, processing, applications and testing of dyes and pigments	Cognitive-2	PLO-2
CLO-3	Ability to understand the role of chemical composition of colorants on substrate.	Psychomotor-1	PLO-4

### Course Contents:

#### Module 1: Color and Chemical Constitution

Early attempts to classify dyes and pigments, Introduction to color index classification, Color and its relation to dye chemical structure, Resonance and orbital theory of color, Development of first synthetic dye mauveine, era of synthetic manufacturing

#### Module 2: Dye Manufacturing Process

Sulphonation, nitration, amination, alkylation, hydroxylation, diazotization and coupling mechanism of various compounds and use of coupling components, Machinery involved in dyestuff manufacturing including autoclave, filter press, reactor and chillers.

#### Module 3: Dyestuff Classification

Chemical Class: Azo, anthraquinone, indigoid, polycyclic, aromatic, carbonyl, polymethine, azine, thiazine, xanthene, thiazole, quinolone, sulphur and cyanine dyes. Application Class: Direct, Reactive, Sulphur, Vat, anthraquinone and solubilized vat dyes, disperse, acid and basic dyes.

#### Module 4: Pigments

Classification and properties of pigments viz. inorganic and organic pigments

#### Module 5: Fluorescent Brightening Agents

Introduction of FBAs, Mode of action, Chemistry and application of FBA

#### Recommended Books:

- Colorants and Auxiliaries by John Shore, Vols. I & II, SDC, UK, 2002.
- Colour Chemistry by Heinrich Zollinger, Weinheim New York, latest edition
- Reactive Dyes for Textile Fibres by A. Hunter M. Renfrew, SDC, UK, latest edition

### TEX- 344 Clothing Merchandising and Sourcing (3+0)

#### Overall Aims of the Course:

This course is designed to give an in-depth knowledge of the vital function of Merchandising in a modern apparel company. Student will learn about International Marketing, Order negotiations, understanding customer requirements, Costing functions, terms and conditions, order monitoring, Merchandising process, sourcing, vendor assessments and managing logistics.

#### Course Learning Outcomes:

Students should be able to achieve following after Course Learning Outcomes completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge of advanced concepts, principles, practices, tools and techniques involved in apparel merchandizing	Cognitive-2	PLO-1
CLO-2	Ability to perform & monitor Garment costing, order execution, sampling and product development	Cognitive-6	PLO-3
CLO-3	Ability to recognize customer needs with regards to trends, upcoming fashion, quality and cost and applying this knowledge to serve customers.	Cognitive-5	PLO-2

#### Course Contents:

#### Module 1: Global Apparel Industry, Marketing, Merchandising and Sourcing

History of Apparel Industry, Sourcing Functions, Structures of apparel industry and types, Apparel industry supply chain system and global trade, Garment Production Business Models, Retailer, Manufacturers, Private Labels, Brands,

Vendors, Subcontractors, Buying agents, Evolution of Apparel Merchandising, Merchandising, Marketing, Sourcing and Buying functions, Retail Merchandising, Fashion Merchandising, Export Merchandising, Global and Internal sourcing, Market Knowledge: P's and C's of marketing

### **Module 2. Fashion and Apparel Export merchandizing**

Data collection and Survey, Markets Segmentation, stratification, Niche Market, Branding, Line development, Product Development, Range Planning, Sourcing and Costing, Forecasting, Sales Monitoring, Directional Shopping: Fashion Shows, trade Fairs and Exhibitions etc., Comparative Shopping, Responsibilities and traits of a merchandiser, Apparel Product Lifecycle Management, General Merchandising Process, Planning and control function in apparel industry, Performance Measurement Tools for Merchandising: Response time, order conversion rate etc.

### **Module 3. Style Specifications, Product development and Sampling**

Apparel product standards and specifications Package (tech Pack), Elements of Tech Pack: General Style Information, Order size, Assortment Plan and Design, Product and Performance Specifications, Bill of Materials, Process from order inquiry to file development, Production planning and control work order sheet, Different types of samples and sampling stages, Styling samples, Proto Sample, Size set samples, Advertising/Photo shoot samples, Pre-production samples, Production samples, and Shipment samples, Lab dips, Knitting, weaving, Dyeing and printing

### **Module 4. Sourcing Strategies shipping process**

Sourcing at global and domestic level, Development of sourcing strategies, Factors involved in the sourcing decisions, Designated and Non-designated suppliers, Minimum order and limitations, Internal manufacturing, offshore sourcing and domestic sourcing options, Global sourcing process, Trade and Shipping terms, Financial instruments used in sourcing, Bank Guarantees: Letter of Credit and its types

### **Module 5. Fabric sourcing**

Fabric Sourcing strategy, Fabric sampling and testing, third party accreditation, Fabric Inspection and grading systems: Four point and ten point etc.

### **Module 6: Trims**

Requirements of Trims and accessories development, Basic accessories: Buttons, Zippers, Linings, Interlinings, Ribbons, Toggles, Velcro, Elastic, Rivets, Labels, Motifs, Pocketing fabrics, Thread, Decorative accessories: Tape types, Cords, Braids, Embroidery, Lace, Piping, ribbons, Ruffles etc., Finishing accessories: Hang tag, Price tag, Poly bag, Paper, Carton, Tape, Linings and Interlinings, Zippers and

its types, Buttons and its types, Hooks, Velcro and loop fasteners, Inspection and testing of trims

### **Module 6: Quality and compliance Audits**

Sampling Plan, Statistical Process Control, Acceptable Quality Level, Rejection, Rework and risks of Air- shipments, Internal and third-party Audits, Regulations and certifications: ISO, WRAP etc., Environmental and social compliance, Hazardous chemical/dyes regulations

### **Module 7: Garment Costing**

Pricing formulas, Export order costing, Costing elements: Direct cost and overheads, Product development cost, Fabric cost, Trims and accessories cost, Production/Processing cost, Finishing cost, Freight cost, Administrative cost, Marketing cost, Costing for Men's Shirts (Long Sleeve), Costing for Men's T-Shirts (Polo)

### **Module 8. Supply Chain Management**

Evolution of supply chain management, Enterprise resource planning solutions in apparel Industry, Material procurement, Capacity and Production planning and management, Vendor and buyer order management

### **Recommended Books:**

- Fashion Merchandising by Virginia Grose, Ava Publishing
- Textiles and Fashion Materials, Design and Technology Edited by Rose Sinclair Woodhead Publishing
- Apparel Manufacturing Technology by T. Karthik, P. Ganesan & D. Gopalakrishnan CRC Press
- ERP for Textiles and Apparel Industry by R. Surjit, R. Rathinamoorthy and K. J. Vishnu Vardhini Woodhead Publishing

## TEX-302 Principles of Management (2+0)

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Learn fundamental principles of management and of managing people and organization.	Phsycomotor-4	PLO-11
CLO-2	Develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.	Affective-4	PLO-9

### Course Outline:

- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing; departmentalization, line/staff authority, commitments and group decision making
- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system, process and techniques of controlling
- Management and Society: future perspective

### Recommended Books:

- Stephen P. Robins, Mary Coulter: Management, latest edition.
- H. Koontz Odonnell and H. Weihrich: Management, latest edition.
- Mc Farland: Management: Foundation and Practice, latest edition.
- Robert M. Fulmer: The New Management, latest edition.

## TEX-304 Probability & Statistics (3+0)

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Understand the basic concept of Statistics and Probability and their need in engineering.	Cognitive-2	PLO-1
CLO-2	Describe properties and classifications of probability density functions, regression analysis and interval estimation	Cognitive-2	PLO-1
CLO-3	Apply different probability and statistics techniques in engineering problems	Cognitive-3	PLO-1

### Course Outline

#### Basic Statistics

- Statistics, Branches of Statistics, Importance of statistics, population, sample, observation, variables, measurement of variable, Data, primary data, secondary data

#### Data Presentation

- Frequency distribution (grouped, ungrouped), stem and leaf display, histogram, frequency polygon, cumulative frequency polygon, Simple & Multiple Bar diagrams

#### Measure of Central Tendency

- Arithmetic Mean (A.M), Geometric Mean (G.M), Harmonic Mean (H.M), Quantiles (Median, Quartiles, Deciles, Percentiles), Mode, Applications of Averages

#### Measure of Dispersion

- Background, Range, Quartile deviation, Mean deviation, Variance, Standard deviation, Coefficient of variation, Moments, Moments ratios, Skewness, Kurtosis
- Applications in different Engineering Disciplines

#### Simple Regression, Correlation and Curve Fitting

- Introduction to regression theory, Simple linear regression line, Line fitting by



- least square methods, Coefficient of determination,
- Simple correlation, coefficient of correlation, fitting of a first and second degree curve, fitting of exponential and logarithmic Curves, related problems.
- Principle of least squares.

### **Probability and Random Variables**

- Probability review, Laws of probability, Conditional probability, Bayesian theorem, independent, dependent events.
- Random variables, Discrete and Continuous random variables, Probability mass and density functions, Distribution functions, Mathematical expectation,
  - Variance of random variable, Bivariate distribution, Joint probability distribution, Moment generating function

### **Probability Distributions**

- Discrete distributions:
  - Bernoulli distribution, Binomial, Geometric, Negative binomial, Hypergeometric, Poisson distribution, Properties and application of these distributions.
- Continuous Distributions: Uniform Distribution, Exponential distribution, Normal distribution, Applications

### **Sampling and Sampling Distributions**

- Introduction, Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors,
- Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem.
- Applications in relevant engineering discipline

### **Statistical Inference and Testing of Hypothesis**

- Introduction to inferential statistics, Estimation, hypothesis testing of population means, proportion,
- Variance, Applications in Engineering

### **Recommended Books:**

- Introduction to Statistical theory part 1, by Sher Muhammad Chuadary (Latest Edition)
- Advanced Engineering Mathematics, by Erwin Kreyszig (Latest Edition)
- Probability and Statistics for Engineers and Scientists, by Antony Hayter.

- Elementary Statistics, by Bluman.

## **TEX-306 Manufactured and High Performance Fibers (3+0)**

### **Overall Aims of the Course:**

In this course, the students will study the second generation of manmade fibers, which became available in the last thirty years. They are high modulus, high tenacity, high thermal and chemical resistant fibers. They are extensively used in the manufacturing of technical textiles and the reinforcement of automobiles and other engineering elements.

### **Course Learning Outcomes:**

Students should be able to achieve following Course Learning Outcomes after completion of the course.

<b>Sr. No</b>	<b>Course Learning Outcomes (CLOs)</b>	<b>Taxonom y Level</b>	<b>PLO</b>
CLO-1	Discuss the properties and applications of selected highperformance fibers.	Cognitive-2	PLO-1
CLO-2	Determine the potential application areas of the selected high performance fibers by analysing their properties.	Cognitive-3	PLO-3
CLO-3	Outline the general manufacturing processes of high performancefibers.	Cognitive-2	PLO-1

### **Course Contents:**

#### **Module 1 Introduction**

Objectives, classification and distinguished properties of high performance fibers

#### **Module 2 Para-Aramid Fibers**

Introduction, trade names, types, structure, manufacturing, properties and applications

#### **Module 3 High Modulus Polyethylene Fibers**

Introduction, trade names, types, structure, manufacturing, properties and applications

#### **Module 4 Thermotropic Liquid Crystal Polymers (TLCP)**

Introduction, trade names, types, structure, manufacturing, properties and applications

#### **Module 5 P-Phenylene Benzo-bisoxazole (PBO)**

Introduction, trade names, types, structure, manufacturing, properties and applications

## **Module 6 Carbon Fibers**

Introduction, trade names, types, structure, manufacturing, properties and applications

## **Module 7 Glass Fibers**

Introduction, trade names, types, structure, manufacturing, properties and applications

## **Module 8 Ceramics Fibers**

Introduction, trade names, types, structure, manufacturing, properties and applications

## **Module 9 Chemical Resistant Fibers**

Introduction, trade names, types, structure, manufacturing, properties and applications of halogenated and aromatic polymers

Module 10 Thermally Resistant Fibers  
Introduction, trade names, types, structure, manufacturing, properties and applications of thermosets

Introduction, trade names, types, structure, manufacturing, properties and applications of oxidized acrylics

Introduction, trade names, types, structure, manufacturing, properties and applications of aromatic polyamides and polyaramids

## **Recommended Books:**

- High-performance Fibers by John W. S. Hearle, 2001
- High Performance Synthetic Fibers for Composites, National Research Council U. S. A, 1992
- Carbon and High-Performance Fibres by Pammac Directories, 1995
- Aramid Fibers - An Overview by M Jassal & S Ghosh, In Journal of Fiber and Textile Research, Vol 27, Sep 2002, pp 290 – 306
- Advances in High Performance Fibers by Satish Kumar, In Journal of Fiber and Textile Research, Vol 16, Mar 1991, pp 52 – 64

## TEX-308 Smart Textiles (2+0)

### Course learning outcomes:

Students should be able to achieve following Course Learning Outcomes after completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO 1	Identify the need for the smart textile in daily life	Cognitive 4	PLO-2
CLO 2	Chose smart elements and processes for producing smart textiles according to needs.	Cognitive 5	PLO-4
CLO 3	Design smart textile for the different application	Cognitive 6	PLO-3

### Course content

#### Introduction:

Definition smart material and smart textile ,Scope, Applications, Products Classification

Intelligent Textile: Key Functions, Sensor, Actuator, External communication, Functions, Materials

#### Electroconductive textile materials:

Theory of conduction, Intrinsic conductive materials, Composite conductive materials, Coatings and inks

#### Shape Memory Material:

Temperature sensitive (SM) polymers, SM alloy for composites, SM polymer films, Shape change material for aesthetics and engineering Smart dyes

#### Microcapsules Technology and its applications:

Introduction on microcapsule technology, PCM-based self thermoregulating, Smart clothing, Other smart uses in advanced garment (cosmetotextiles, health, insect repellent)

#### Smart and Adaptive Polymers:

Photo-sensitive materials, Thermo-sensitive materials, Chemically sensitive materials, Mechanically sensitive materials

#### Displays:

Emissive textile, Reflective devices, Embedding LED (def, types, use in garments), Soft circuit (use of adafruit flora, circuit through sewing, and fixed components),Chromic materials

Textile Based Electronic Sensors: Types, Design and Manufacturing

**Heating Textiles:**

Types (fibre, strip, fabric), Design and Manufacturing

Integrating electronic smart textile: Yarn to component connection, Solder/glue/expoxy/sew joining, Connection to micro-controller, Design Manufacturing

**Energy harvesting:**

Thermo electric, Tribo electric, Photovoltaic, Piezo electric

**Smart Protection:**

Protective clothing for firefighter and rescue worker, Protective textile for older people, firefighters Technical textiles for smart material

**Smart Textile System in medical:**

protective and sport clothing, Characteristics, Medical, protective clothing, Sports

**Product Design and Development of Smart Textiles:**

smart system design and product development, Modern smart textile development, Textile ergonomics (definition, factors, safety and health consideration), Creative textile and fashion

**Mini Project on Group Work:**

Create prototype of smart product, Design, material, Integration, measurement, presentation

**Reference books:**

- Smart Textiles and Their Applications by VladanKoncar
- Handbook of Smart Textiles by Xiaoming Tao
- Smart Textiles for Medicine and Healthcare: Materials, Systems and Applications by L Van Langenhove

**7<sup>th</sup> Semester**

**TEX-411 Advanced spinning techniques (3+1)**

**Overall Aims of the Course:**

In this course students will acquire detailed knowledge of new spinning techniques like rotor spinning, air-jet spinning, friction spinning etc. Latest innovations in the machines will be discussed in detail.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Ability to realize the need for alternative ways to manufacture short staple yarns and alternative methods / techniques of yarn manufacture.	Cognitive-2	PLO-3
CLO-2	Knowledge and understanding of basic working principles of variety of alternative yarn manufacturing schemes.	Cognitive-2	PLO-1
CLO-3	Ability to identify parts of different advance spinning machines like rotor, TNT, Bobtex ABS, Friction spinning, Air jet spinning etc.	Psychomotor-1	PLO-2

### Course Contents:

#### Module 1 Introduction

Fiber characteristics requirements for different leading spinning technologies, possibilities and limitations of different spinning technologies

#### Module 2 Rotor Spinning

The principle of rotor spinning, structure and operation of the rotor spinning machine, spinning box, package formation, yarn waxing device, operating and monitoring, quality control systems. Machine and transport automation, automatic piecing, automatic package change, Selection and influence of draft and yarn twist. Economics of rotor spinning, new developments in rotor spinning, Optimum process atmospheric conditions

#### Module 3 Air-jet Spinning

Principle of operation, raw material requirements, drafting unit, spinning nozzle, winding, automation, yarn structure and properties. False twist and its structure, downstream processing and end products; Economics. Comparison of air-jet and vortex spinning systems. Optimum process atmospheric conditions

#### Module 4 Friction Spinning

Principle and raw material preparation, process and machine parameters affecting product quality. Assessment of DREF-II and DREF-III yarn structures and properties. Optimum process atmospheric conditions.

#### Module 5 Other Spinning Techniques

Wrap spinning, Siro spinning, solo spinning, hollow spindle spinning, and self-twist spinning.

### List of Practical:

### As per Course Contents

### Recommended Books:

- Fundamentals of Spun Yarn Technology by C. A. Lawrence, 2003.
- The Rieter Manual of Spinning by W. Klein, 2008
- Advances in yarn spinning technology by C. A. Lawrence, 2010.

## TEX-421 Fabric Design and structure (3+1)

### Overall Aims of the Course:

The objective of this course is to enable the students to understand the concepts of fabric structure and weave designs, to analyze the construction and woven design of a fabric and to reproduce it.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes on completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To examine and differentiate jacquard, dobby and simple designs, as well as different categories of woven fabrics.	Cognitive- 4	4
CLO-2	To draw and sketch weave architecture and construction of a fabric.	Psychomotor -3	3
CLO-3	To identify and quantify the key factors affecting the fabric structure, properties and its weave-ability limits.	Cognitive-3	2
CLO-4	To develop and reproduce a fabric with desired weave architecture and construction to achieve the targeted structure for particular properties.	Psychomotor -6	3

### Course Contents:

#### Module 1 Woven Design Fundamentals

- Weave presentation
- Basic elements of woven design
- Weave repeat (repeat size), Peg Plan, Drafts, Denting plan

#### Module 2 Basic Weaves

- Introduction to basic weaves

- Plain weave and its derivatives
- Twill weaves and its derivatives
- Satin & sateen weaves and derivatives

### **Module 3 Dobby Design**

- Dobby designs
- Wavy twills (Pointed twill, Herringbone), Skip twill, Huck a back weave, Mock leno weaves, Honey comb weaves, Bedford cord design, High-low cords, Pique weaves

### **Module 4 Jacquard Designs**

- Jacquard designs
- Figured and floral designs, design of large repeats. Single thread jacquard designs.

### **Module 5 Crepe Weaves & Crepe Effect**

- Introduction to crepe weaves and crepe effect
- Methods of producing crepe effect
- Different types of crepe weaves and their designing

### **Module 6 Pile Fabrics**

- Pile fabrics and their classification
- Warp pile structure: velvet, terry and wire piles
- Weft pile structures: velveteen

### **Module 7 Multi-Layer Fabrics**

- Multilayer fabric
- Types of multilayer fabrics: open width, tubular, double, triple, and four layer fabrics
- Weave presentation of multilayer designs.
- Stitching techniques of multilayer fabrics, Extra stitch, raiser and sinker stitch.
- Double cloths and their types

### **Module 8 Color and Weave Effect**

- Color and weave effect
- Classification of Color and weave effect
- Effects produced by simple Color and weave effect: Hairline effect, Step effect, Bird eye and spot effect, Continuous Line effect, Hound's tooth effect and All over effect
- Compound color and weave effects.

### **Module 9 Fabric Structure**

- Elements of fabric structure:
- Weave architecture,



- Yarn (warp and weft) density
- Yarn counts; Pierce yarn diameter
- Cloth geometry models
- Cloth cover and its determination
- Crimp and its determination
- Structure-properties-relationship

#### **Module 10 Woven Fabric properties:**

- Fabric weight and thickness
- Crimp
- Tensile strength
- Tear resistance
- Fabric bow and skew method
- Air permeability
- Void Volume
- Abrasion resistance
- Burst and impact resistance
- Flexibility and stiffness
- Drape and hand
- Flame resistance
- Cloth cover and its relation to its properties
- Use of software to weave Dobby and Jacquard Design
- Fabric faults

#### **Recommended Books:**

- Textile design and color by Watson
- Advance Weaving Design by Watson
- Woven Cloth Construction by R. Marks & A.T.C. Robinson
- Fabric Structure and Design by N. Gokarneshan, 2005
- Tensile Fabric Structures: Design, Analysis and Construction by Craig G. Huntington, (2013)
- Elementary Textile Design and Fabric Structure by John Read
- Textile design pure and applied by E.B. Berry
- Designing woven fabrics by Janet Phillips 2008
- Manual of Scot Weave

## TEX-431 Textile Printing (3+1)

### Overall Aims of the Course:

In this course students will study principles and practice of different methods and styles of printing including block printing, flat screen printing, rotary screen printing, direct style, resist style, discharge style, burn-out printing, flock printing, transfer printing and ink-jet printing. The course covers print design studio, screen making, print paste preparation & rheology, printing process and fixation. The students learn printing of fabrics of natural, manmade and blended fibers with pigments and other dyestuffs, role of auxiliaries and the working principles of machinery used for printing and fixation. The course also includes lab practice.

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To understand different methods and styles of printing including print design studio, screen making, print paste preparation, printing process and fixation	Cognitive-2	PLO-1
CLO-2	Detailed description of working principles of machinery used for printing and fixation.	Cognitive-2	PLO-1
CLO-3	Design and asses different printed products by selecting appropriate printing technique in a particular situation	Psychomotor -4	PLO-4

### Course Contents:

#### Module 1: Introduction

History of Textile Printing, Essential definitions and terms used in printing and their explanation, Theory of textile printing. Pretreatment requirements of the substrate to be printed like singeing, desizing, scouring, bleaching, mercerization etc. & their effect on the final printed goods.

#### Module 2: Textile Printing Methods

Block printing, Roller printing, Hand screen printing, Semi-automatic flat screen printing, Fully automatic flat screen printing, Rotary screen printing

#### Module 3: Print Design Studio & Engraving

Introduction to print design studio, CAD/CAM, Rotary screen engraving

#### **Module 4: Rotary Screen Printing Machines**

Mechanical aspects of rotary printing machines, Design registration, blanket & screen synchronization concepts

#### **Module 5 Production & Properties of Printing Pastes**

Stock printing paste preparation & dispensing, Properties of ideal thickeners, Types of thickeners, Manual dispensing techniques, IPS (Integrated paste preparation & dispensing systems), Print Paste Rheology

#### **Module 6 Printing with Different Colorants**

Pigment printing, Reactive printing of cotton, Vat printing of cotton, Disperse Printing of Polyester

#### **Module 7 Textile Printing Styles**

Direct printing, Resist printing, Discharge printing, Burn out printing, Transfer printing,

#### **Module 8 Print Fixation & After-treatment Processes**

Print paste fixation mechanisms & equipment, Curing, Ageing, Flash Ageing, Steaming, washing off process & washing off equipment.

#### **Module 9 Digital Textile Printing**

Image capture & display, Screen making using digital pattern data, Digital control systems, Ink-jetprinting, Variables affecting reproducibility

#### **Module 10 Printing Faults & their Countermeasures**

A study of the faults that may occur during and/or after printing and their countermeasures

#### **List of practical:**

- Preparation of flat printing screen
- Stock paste preparation for pigment printing and its viscosity optimization
- Pigment printing of P/C fabric by flat screen printing
- Pigment printing of P/C fabrics by rotary screen printing
- Comparison of direct and over-printing of p/c fabric with pigments
- Stock paste preparation for reactive printing and its viscosity optimization
- Printing of cotton lawn with reactive dyes by steaming fixation
- Printing cotton fabric by roller printing method
- Comparison of direct and over-printing of cotton fabric with reactive dyes
- Printing p/c fabric with disperse/reactive dyes
- Printing p/c fabric with disperse/vat dyes
- Printing 100% polyester fabric
- Printing acrylic fabrics with cationic dyes
- Printing silk fabric with acid dyes

- Discharge printing
- Resist printing
- Burnout printing
- Flock printing

**Recommended Books:**

- Textile Printing by W. C. Miles, Society of Dyers and Colorists, 2003
- Digital Printing of Textiles by H. Ujiie, 2006.
- Novel processing in special finishing and printing of textile by F. Uddin and M. Lomas, 2010.

**TEX-441: Clothing Production process and Machinery (3+1)**

**Overall aims of the Course:**

The aim of the course is to understand student to the detail working processes involved in the Industrial cutting, sewing, garment dry, wet processing, finishing and packing departments of any apparel industry including machinery. To familiarizes the students with the role of different supporting department. To introduce student to the basic working mechanisms of the related machinery and understand the effective use of these machine in production process.

**Course Learning Outcomes:**

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Ability to comprehend the function, scope and importance of each production and supporting department, their working and synergic relationships with each other or otherwise.	Cognitive-2	PLO-1
CLO-2	Ability to design and select adequate mix of resources for any new product order or facility planning. Ability to run and undertake performance improvement in apparel factory by a mix of theoretical knowledge, Engineering and IT tools.	Cognitive-3	PLO-3
CLO-3	Knowledge and understanding of basic applications, working principles, operation and theoretical aspects of garment machinery mechanisms.	Cognitive-2	PLO-1
CLO-4	Ability to identify and investigate the synchronization of different machine parts and timing.	Psychomotor-4	PLO-4

## **Course Contents:**

### **Module 1: Cutting room operations:**

Initial preparation and quality control of textile materials in cutting room, Storage, registration and inspection of materials, Sorting fabrics by shade, shrinkage and size, Storage of textile materials, Final stages of cutting operations

### **Module 2: Textile spreading:**

General characteristics of the spreading process, Fabric spreading modes and their application, dealing with different kinds of spread, Fabric quality issues, Manual Vs. Automatic Spreading Process, advantages and disadvantages, Effect of fabric width on fabric consumption of garments

### **Module 3: Textile cutting processes:**

General characteristics of the cutting process flow, Advantages and Disadvantages of manual and automatic cutting, Notches and cloth marking drills

### **Module 4: Handling Cutting room equipment, Fusing Cut and Quality control:**

Placement of manual spreading and cutting equipment/workstations in the cutting room, Placement of automated spreading and cutting equipment/workstations in the cutting room, Lay storage systems for automated cutting processes, Fusing/Interlinings cutting, fusing presses and their main parts, Accuracy problems in cutting process and in cut components, Re-cutting faulty components, Numbering cut components, Sorting and bundling cut components

### **Module 5: Cutting of patterned fabrics:**

Spreading and cutting of striped fabrics, Spreading and cutting materials with check patterns, Marker making, spreading and cutting fabrics with motif patterns, Marker making, spreading and cutting fabrics with border patterns

### **Module 6: Cutting of pile, narrow lace and intricate fabrics:**

Spreading and cutting fabrics with pile, Marker making, spreading and cutting of narrow lace, Marker making styles directly on Intricate fabrics, Problems in spreading and cutting intricate fabrics

### **Module 7: Sewing room operations:**

Introduction to sewing room operations and process flow, receiving of goods from cutting room with feeding reports and material storage, Handling cut parts, feeding process to sewing line and work in progress, Role of management on the sewing floor

**Module 8: Stitches and Seams, Sewing thread:**

Stitch and Seam classification, numerical expressions and applications, sewing threads, Sewing Thread Size, Ticket Numbering, Stitch/Inch, Sewing Thread Consumption and applications

**Module 9: Sewing Mechanics:**

Construction of different stitches: lock stitch, chain stitch, over-lock stitch, safety stitch, Principle of sewing, Concept of sewing equilibrium, extensibility of sewing threads, relaxation and seam fault manifestation, Sew-ability of fabric and thread, Kawabata's Evaluation System for Fabric

**Module 10: Adhesive bonding and heat-sealing:**

Adhesive bonding of textiles: principles, types of adhesive and methods Bonding requirements in coating and laminating of textiles, Coating and laminating process, use of heat sealing, hot air and hot wedge to join textile materials Ultrasonic and dielectric welding of textiles, Laser seaming of fabrics, Techniques for joining nonwoven materials

**Module 11: Seam performance:**

Quality and performance of sewn seams, Seam strength, Seam extensibility, recovery, drape and bending, seaming quality problems causes and prevention, Seam slippage, Seam grinning/gaping, Seam failure, Seam pucker, Degradation etc.

**Module 12: Stitching faults and Sewing supported departments:**

Problems in stitch formation, Thread breakage, needle breakage, Slipped/missed stitching etc., Efficiency of sewing room, Role of supporting departments on sewing productivity, Types of sewing floor reports: absenteeism, hourly production, critical operation, daily production and monthly production reports etc.

**Module 13: Garment Dry Process:**

Garment Dry Process (GDP) workflow, operations and their applications, Mechanical fading methods: Whiskers, Scraping, Grinding, Brushing, Distress/Destruct, Sand blasting, Tagging and tying, Laser beam, Resin applications, 3D crush effects, GDP machines

**Module 14: Garment Washing:**

Garment Wet Process (GWP) operations and their applications, Washing Process Flow and requirements, Factors affecting washing effect, De-sizing, Bleaching, stone washing, Tinting/Dye, Neutralization, Bio-techniques: Enzymes for jeans washing, Washing Process recipes, Spray Processes, KMnO<sub>4</sub> application, Types of

Garment washes: Single/Double Stone Wash, Acid wash, Garment washing and finishing chemicals and auxiliaries: dyes, Enzymes, Fixer & Softeners, Denim and jeans washing machines, Washing quality control issues, Back-staining, Reduced water washing of denim garments: ozone fading, Garment Wet and Dry combined process

### **Module 15: Garment Pressing Technology**

Garment Pressing operations and their applications, Pressing Elements: heat, steam, pressure, and time, Pressing equipment and types, Under pressing and top pressing Machines, Technological advancement in the pressing equipment.

### **Module 16: Finishing and Packing:**

Printing and embroidery of garment cut panels before stitching, Laser engraving of Jeans, Embossing and other finishing effects, Trimming, Buttoning and Riveting process and machines, Kinds of stains and their removal, packing types, packing material and packing machines

### **Module 17 Garment machinery**

Garment Preparatory machines, Sewing Machines' Elements of Sewing Machines, Auxiliary Mechanisms for Industrial Sewing Machines, automation in Sewing Machines, Finishing & Packing Machinery, garment washing and dry process Machines, Maintenance of Garment Machinery

### **Recommended Books:**

- Industrial cutting of textile materials by I V Nemes, Woodhead Publishing 2012
- Joining textiles: principles and applications by I Jones, TWI and G. Stylios.
- Apparel Manufacturing Technology by T. Karthik, P. Ganesan & D. Gopalakrishnan CRC Press
- Denim Manufacture, Finishing and Applications Edited by Roshan Paul Woodhead Publishing
- Apparel Machinery and Equipments by R.Rathinamoorthy and R. Surjit (Woodhead Publishing)
- Industrial cutting of textile materials by I V Nemes, Woodhead Publishing 2012
- The Art of Modelling with spread sheets, Stephen. Powel, Kenneth R. Baker
- Manuals related to Garment Machines

**List of Practical:**

As per contents

**TEX-413 Specialty Yarns (3+1)****Overall Aims of the Course:**

In this course students will study different types of fancy yarns, their production, properties and enduses.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To apply manufacturing techniques for production of various specialty yarns.	Pschomotor-2	PLO-3
CLO-2	To evaluate effect of various factors on cost of Manufacturing of various fancy yarn manufacturing techniques.	Cognitive-5	PLO-1
CLO-3	Ability to design fancy yarn	Cognitive-6	PLO-2

**Course Contents:****Module 1 Introduction**

Introduction and background, Historical development, market for fancy yarns, Manufacturing attitudes and the applications of fancy yarns for weaving and knitting

**Module 2: Manufacturing of Melange Yarns:**

Introduction, preparation of fibres for melange yarns, mixing of different colour fibres, blending of different colour fibres on draw frame, spinning melange yarn on ring and rotor spinning.

**Module 3 Fancy Yarn Structures**

Fancy yarn structures, and analysis of fancy yarns, Types of fancy yarns (Marl yarn, Spiral yarn, Gimp yarn, Diamond yarn, Eccentric yarn, Bouclé yarn, Loop yarn, Snarl yarn, Mock chenille yarn, Knop yarn, Slub yarn, Neppy yarn and fleck yarn, Tape yarn, Chainette yarn, Chenille yarn, Cover yarn, Metallic yarn)



#### Module 4 Manufacturing Techniques

Ring spindle system, hollow spindle system, combined systems, doubling system, condenser system, open-end spinning system, friction spinning system, Air texturing. Chenille yarn production, flocking.

#### Module 5 Design and Applications

The design of fancy yarns using computers, designing fabrics using fancy yarns and fancy doubled yarns, uses for fancy yarns, potential of fancy yarns (apparel fabrics, furnishing fabrics)

#### List Of Practicals

As per course contents

#### Recommended Books:

- Fancy Yarns: Their Manufacture and Application by R. H. Gong and R.M. Wright, 2002
- Hand Spinners' Workbook: Fancy Yarns by Mabel Ross, 1989
- The Spinner's Book of Yarn Designs: Techniques for Creating 80 Yarns by Sarah Anderson, 2013

### TEX-423 Advance Weaving (3+1)

#### Overall Aims of the Course:

This course is designed to make the students understand and learn about the new advances, developments, automation and control systems in weaving. Moreover, they should learn the specialty fabric forming methods.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes on completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Domain	Taxonomy Level	PLO
CLO-1	To demonstrate the latest developments in weaving and the related monitoring and control systems.	Cognitive	3-Apply	1
CLO-2	To understand and explain various specialty fabric forming methods.	Cognitive	2-Understand	1

#### Course Contents:

##### Module 1 Shed Settings

- Shed staggering
- Symmetric and a-symmetric shed

- Shed settings

### **Module 2 Dobby and Jacquard Shedding System**

- Dobby Systems: Terry Dobbies, Rotary Dobbies, Electronic Dobbies,
- Electronic Jacquard Basic, Jacquard Harness Types and its parts

### **Module 3 Air-Jet Weaving Machine**

- Weft yarn accumulator
- Principals of Air jet filling insertion
- Fluid Dynamics, Air drag Theory
- Air flow through nozzles, Jet flows, Air flow in air guiding system/ channel
- Air supply and energy consumption, Air consumption/pick, Machine operating pressure, Machine with onboard air compressor, Economics of air jet weaving.
- Influence of air flow on yarn characteristic on pick insertion
- Effect of yarn properties (structure, count and twist) on the speed of yarn
- Air-jet nozzles: main, tandem and sub-nozzles. Ultrasonic cleaning of nozzles.
- Multi-color weft insertion system/ Weft mixer system
- Double pick insertion
- Inching speed
- Design feed in loom interface
- Servomotor let off and take up
- Easing motion, Back rest Rollers

### **Module 4 Selvedge Formation on Shuttle-less Weaving Machine**

- Internal and external Selvedge
- Tuck-in selvedge: needle tuck-in selvedge in projectile and pneumatic tuck-in air jet weaving. Limitation of tuck-in selvedge against machine speed and warp threads density at the selvedge etc.
- Leno selvedge: half and full leno selvedge formation, Rotary leno selvedge, Necessity of dummy selvedge for leno, Setting for dummy and leno yarns, Leno waste, Elsy system
- Cordless weaving

### **Module 5 Automation and Control in Weaving**

- Automatic Drawing-In, Automatic Knotting, Quick Style Change,
- Automatic Warp Creel filling, Automatic Leasing,

- Auto-leveling, Pick finding motion, loom reverse
- Weft stop motion in Air-jet looms
- Loom Drives: Loom control and breaks,
- Fabric control: Fabric width and Selvedge

### **Module 6 Water Jet Weaving**

- Water-jet weaving machine, mechanism, its merits and demerits

### **Module 7 Advancements in Weaving Techniques**

- Sample weaving machine, its requirement and use
- Multi-phase and multi-shed weaving,
- Circular weaving, working of circular weaving and uses of circular woven fabrics.
- Frame less weaving
- E-Shedding
- On loom inspection

### **Module 8 Specialty Weaving**

- Terry Weaving:
- Terry fabrics, terry towel designs
- Machine settings for terry towels.
- Calculation for contraction of pile warp threads, pile warp beam settings.
- Sear Sucker Fabrics:
- Machine settings for sear-sucker fabrics.
- Calculation for contraction of crimp warp threads,
- Warp beam settings and heald frame priority for low and high crimp warp threads.
- Gauze and leno weaving
- Narrow width fabrics, machine, mechanism and uses of such fabrics
- Carpet weaving, basics of carpet weaving techniques
- Lace weaving
- 3D weaving:
- The 2D and 3D weaving concepts
- Textile preforms (2D and 3D) used in composites
- 3D woven fabrics
- Multilayer fabrics
- Modifications in conventional weaving machines to weave 3D weaving machines
- Different possible axes in a 3D fabric

- Fukuta's 3D-3axes weaving machine and fabric
- M. H Mohammad's 3D-5-axes model and fabric
- Circular and non-circular 3D fabrics
- Concept of spacer fabrics

### List Of Practicals

As per course contents

### Recommended Books:

- Principles of Weaving by R. Marks and A.T.C. Robinson
- Handbook of Weaving by SabitAdanur, (2000)
- Weaving: Technology and Operation by Omerod, A. and Sodhelm
- Weaving Mechanism Volume 1 10th Edition by J. E. Fox
- Mechanisms of Flat Weaving Technology, by Choogin, Valeriy V., PalithaBandara, and Elena V. Chepelyuk.. Elsevier, (2013)
- Principles of Fabric Formation by Banerjee, Prabir Kumar. CRC Press, (2014)
- Textile Design Pure and Applied by E. B. Berry
- Hand book of composites by S. T. peters 1998
- Fundamentals of composites manufacturing: materials, A. Brent Strong – 2008
- Polymer matrix composites by Wang, Zheng 2011
- Weaving of 3D Fabrics: A Critical Appreciation of the Developments by Gokarneshan, N., and R. Alagirusamy. Textile Progress 41.1 (2009)
- 3D-Weaving: Theory and Practice. by Khokar, N. Journal of the Textile Institute 92.2 (2001)
- Woven Textile Structures by B.K. Behra and Hari, 1st Wood head publishing (2010)
- Textile - Reference Book for Weaving Fondazione ACIMIT Pub, (2000)
- Fetterly C. L. "Woven fabric" US Patent: 975940, (1910).
- Fukuta K. "Three-dimensional fabric, and method and loom construction for the production thereof" US Patent: 3834424, (1974)
- Mohamed M. H. "Multi-layer three-dimensional fabric and method for producing" US Patent: 5465760, (1995).
- Kadir B. A. "Multiaxial three-dimensional (3D) circular woven fabric" US Patent: 6129122, (2000).
- Cheeseman B. A., Bogetti T. A. "Ballistic impact into fabric and compliant composite laminates" Composite structures, Volume 61, Issues 1-2, pp 161-173, (2003)

## TEX-433 Textile Finishing & Coating (3+1)

### Overall Aims of the Course:

In this course, the students will study the classification, rationale, principles, mechanisms, and methods of different mechanical and chemical finishing processes. The students will cover finishes like chemical softening, hand-building finishes, drying and setting, easy-care finishes, water- and oil- repellent finishes, flame retardant finishes, soil release finishes, anti-static finishes, UV protection finishes, antimicrobial finishes, finishes for color fastness improvement, calendering, emerizing, raising, compressive shrinkage, bio-polishing and other novel finishes. The course also includes lab practice.

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Analyse the chemistry and mechanism of various chemical and mechanical finishes.	Cognitive-4	PLO-1
CLO-2	Evaluate any issues faced during and after the application of finish.	Cognitive-5	PLO-2
CLO-3	Apply various methods of coating, materials used for coating and the application areas of the coated textiles	Cognitive-3	PLO-1
CLO-4	Carry out the tests for the assessment of the fabric properties after the application of finish.	Psychomotor-2	PLO-4

### Course Contents:

#### Module 1: Introduction to Textile Finishing

Textile finishing and its classification, Explanation of primary and secondary effect of finishing  
Flow chart of different routes adopted in the finishing of woven and knitwear fabrics

#### Module 2: Introduction to Mechanical Finishing

Need and importance of mechanical finishing, Different types of processes used in mechanical finishing with respect to end results and customer requirements, Calendering, Sueding/Emerizing/Peaching, Raising, Sanforizing, Compressive shrinkage

#### Module 3: Application of Chemical Finishes and Coatings

Calculation required for the application of chemical finishes, Explanation of methods involved in the application of chemical finishes and coatings like dip and nip method, low wet pick up application method, saturation removal method, spray application method, Knife coating, foam application method and system, wet on wet application method. Coating with screens.

#### **Module 4: Chemical Softening**

Objective and need for chemical softening, Classification of softeners w.r.t. their functionality, Classification of softeners w.r.t. their nature, Chemistry of different softeners and their mechanism of application on textiles, Application methods involved in the processing of substrate with softeners, Exhaust and continuous application of softeners, Evaluation of softeners by subjective and objective methods.

#### **Module 5: Hand Building Finishes**

Definitions and terms involved in hand building finishing, Objective and need of hand building finishes, Hand building effect and example of textiles with hand building finishes, Chemistry of hand building finishes and their mechanism, Evaluation of substrate and troubleshooting for hand building finishes

#### **Module 6: Easy care and Durable Press Finishes**

Objective and need for easy care finishes, mechanism of easy care and durable press finishes, Chemistry involved in durable press finishes, Application method for resin finishing, Compatibility of resin with other finishes, Evaluation of substrate by different testing methods

#### **Module 7: Oil and Water Repellent Finishes**

Objective and need for oil and water repellency, Mechanism of repellency, Chemistry of oil and water repellent finishes, Application method for oil and water repellent finishes on textiles, Evaluation of textiles treated with repellent finishes

#### **Module 8: Soil Release Finishes**

Objective and need for soil release substrate, Mechanism of soil release, Chemistry of soil release finishes, Application method for soil release finishes on substrate, Evaluation method of soil release treated substrate, Troubleshooting for soil release finishes

#### **Module 9: Flame Retardant Finishes**

Objective and need for flame retardancy, Mechanism of flame retardancy, Chemistry of flame retardant finishes, Application of flame retardant on different type of textiles like cotton, polyester, nylon etc., Evaluation of flame retardants, Troubleshooting for flame retardant finishes

#### **Module 10: Anti-pilling Finishes**

Objective and need for anti-pilling finishes, Mechanism involved in the formation of pills, Mechanism of anti-pilling finishes, Chemistry of anti-pilling finishes, Evaluation of anti-pilling finishes, Troubleshooting for anti-pilling finishes and compatibility

#### **Module 11: Antimicrobial Finishes**

Objective and need for antimicrobial finishes, Properties of an effective antimicrobial finishes, Mechanism of antimicrobial finishes, Chemistry of antimicrobial finishes, Evaluation of antimicrobial finishes, Troubleshooting for antimicrobial finishes

#### **Module 12: UV Protection and Bio Finishes**

Objective and need for UV protection and bio finishes, Mechanism of UV protection and bio finishes, Different type of enzymes used for textile in finishing, Chemistry of UV and bio finishes, Evaluation of substrate applied with UV protection and bio finishes, Troubleshooting for UV protection and bio finishes

#### **Module 13 Polymeric Materials for Coating**

Natural and synthetic rubbers, Polyvinyl chloride coatings, Polyurethane coatings, Acrylic coatings

#### **Module 14 Coating with Functional Materials and their Applications**

Coating with phase change materials, Coating with flame retardants, Coating for chemical protection, Coating with microcapsules containing fragrance, anti-microbial, etc., Coating with conductive materials, Coating with smart polymers and nano materials. Breathable water-proof fabrics, Artificial leather, Architectural textiles, Automotive textiles.

#### **Module 15 Coating Rheology**

Rheological behavior of fluids, Rheological behavior of plastisols.

#### **Module 16 Properties of Coated Fabrics**

Tensile strength and elongation, Adhesion, Tear strength, Weathering behavior, Yellowing, Microbiological degradation

#### **List of practical:**

- Application of cationic softener on knitted fabric by exhaust method
- Application of cationic, non-ionic, and silicone softeners by pad method, and compare the properties of the finished fabrics
- Application of hand building stiff finish using starch, PVA and acrylates, and compare the properties of the finished fabrics
- Application of DMDHEU-based wrinkle recovery and durable-press finish
- Application of melamine-based resin
- Application of formaldehyde-free crease recovery finish based of polycarboxylic acids

- Application of different water-repellent finishes
- Application of water and oil repellent finishes
- Application of antimicrobial finish
- Application on non-durable and semi-durable flame-retardant finish
- Application of durable flame-retardant finish
- Simultaneous pigment dyeing and crease-recovery finishing
- Application of soil-release finish
- Simultaneous application of multiple finishes
- Bio-polishing of cellulosic and p/c blended fabrics
- Comparison of different denim washes (e.g. with amylases, cellulases, pumice stones, hypochlorite, lacchases, potassium permanganate)

**Recommended Books:**

- Textile Finishing by Derek Heywood, Society of Dyers and Colorists, 2003
- Chemical Finishing of Textiles by W. D. Schindler and P. J. Hauser, Woodhead Publishing, 2004
- Chemistry and Technology of Fabric Preparation & Finishing by Charles Tomasino, 1992
- Coated Textiles – Principles and Applications, 2<sup>nd</sup> Edition by Asish Kumar Sen (CRC Press, 2008)
- Coatings Technology Handbook, 2<sup>nd</sup> Edition by D. Satas, (MARCEL DEKKIENRC, 2001)

**TEX-443 Sewn Product Engineering (3+1)**

**Overall Aims of the Course:**

This course aims at introducing students to different industrial engineering concepts including productivity, work-study, layout planning, Line balancing, operation bulletins, costing, ergonomics and method study.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge and practice of time and method study of different apparel products for improving productivity, quality and wage calculation.	Cognitive-5	PLO-2
CLO-2	Practice of garment flow analysis, plant layout design, costing and line balancing	Psychomotor-2	PLO-4
CLO-3	Ability to design style bulletins and ergonomically safe work environment in an apparel unit.	Cognitive-6	PLO-3



## **Course Contents:**

### **Module 1: Industrial Engineering**

Industrial engineering, Role of IE in manufacturing industry, History of IE, Importance of IE, Basic terminologies of IE

### **Module 2: Work, Method & Time Study**

Work Study, Importance of Work Study, Method study, Factors involved in method study, Recording techniques of method study, Work measurement, Advantages and purpose of work measurement, Techniques of work measurements, Time study, Basic time study equipment, Steps in making time study, Standardization of measured operation time, Motion Study, Motion economy in apparel unit, PDTMS for work measurements, Importance of PDTMS, the advantages of PDTMS, Recording techniques of PDTMS

### **Module 3: Learning Curves, Dexterity & Ergonomics**

Learning curves, History of learning curves, Different approaches of calculating time, producing learning curves and setting standards, Calculate and determine time required to do a job, learning rates of an Organization, process or individual using learning curves. Dexterity, Benefits & Implementation of Dexterity, Dexterity tests for evaluation of worker/Operator, Ergonomic, Method Assigned for Identification of Ergonomic Hazards, Problems faced due to work place ergonomic design in sewing and cutting, 5 S its importance use and application in apparels

### **Module 4: Layout & Material Handling**

Layout Planning, Layout Types and Flexibility at work, designing process and Product Layouts, Material handling, Principles of material handling, Selecting material handling methods, Progressive Bundle System, Unit Production system, Modular production system

### **Module 5: Operation Breakdown**

Operation Breakdown, Considerations for making operation breakdown bulletin and machine selection, Techniques and tools used for operation breakdown, Operation breakdown making of different Top garment products Exercises: T-Shirt, Polo-Shirt, Dress-Shirt, Exercise of making operation breakdown of different Bottom garment products: Slacks, Boxer Short, Trousers, Exercise of making operation breakdown of different Made-ups products: Overall, Box Pleated Curtin

### **Module 6: Calculations of Industrial Engineering**

Thread consumption calculation, Capacity Calculation, Production Target Calculation, Productivity Calculation and Performance Calculation

Efficiency Calculation, WIP Calculation in cutting, sewing and finishing, Manpower

Calculation, Machine Calculation

### **Module 7: Time Based Costing**

Process costing and pricing strategies, Logics for costing of apparel products, General steps & sequence of apparel costing (Procedures), Yarn and fabric requirements for different products of knits/Woven, Computation of Cost of different finishing processes I. Dying Process ii. Printing Process iii. Embellishments, Cutting and sewing operations cost, Computation of cutting and sewing costs, Analyze the difference between different sewing operation costs, Trims and accessories cost calculations, Packaging and shipment of Cargo cost

### **Module 8: Line Balancing**

Line Balancing, Line balancing using Operator Skill History, reduce line setting time for assembly line

#### **List of Practical:**

- Method study of different operations of cutting, sewing and finishing
- Time study of different operations of cutting, sewing and finishing
- To calculate the cutting room fabric wastages
- Identification of different stitch classes and
- Identification of different seam classes
- Study the learning curve of an operator (different operations)
- Use of dexterity tests for the evaluation of the candidates for selection in sewing
- Designing a layout for a specific product i.e. shirt, denim trouser, jacket, home textile products, footwear, football etc.
- Preparing operation breakdown for different types of trousers
- Preparing operation breakdown for different types of shirts
- Preparing operation breakdown for different types of jackets
- To determine the target for an operator
- To calculate the efficiency of a process
- To calculate the required amount of sewing thread for a sewn product
- To calculate the required amount of fabric for a sewn product
- To conduct an exercise on line balancing in a sewing line

#### **Recommended Books:**

- Industrial Engineering in Apparel Production by V. R. Babu, Woodhead publishing 2011.
- Introduction to Clothing Production Management, by A. J. Chutter. 2001.

- Production Control Tools for Garment Industry, Sewing research institute Juki. 2004.
- Sewn Product Analysis by Ruth. E. Glock 2007.

## TEX-401 Technical textiles manufacturing (3+0)

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO 1	Identify the need for the technical textiles in daily life	Cognitive 4	PLO-2
CLO 2	Chose technical textile elements and processes for producing technical textiles to solve engineering problems.	Cognitive 5	PLO-4
CLO 3	Design technical textile for the different application	Cognitive 6	PLO-3

### Course content

#### Introduction:

Technical Textiles, Definition, Classification: Buildtech, Agrotech, Clothtech, Geotech, Hometech, Indutech, Medtech, Oekotech, Packtech, Protech and Sportech. Examples, Technical vs non-technical.

Fabric Manufacturing for Technical Textiles: Types, machines, 2-D and 3-D fabrics, woven, knitted, non-woven, biaxial and multi-axial, braiding, 3D preform (knit/woven)

#### Braiding:

Introduction, classification, manufacturing techniques, applications

Narrow Width Fabrics: Introduction, classification, manufacturing techniques, applications.

#### Electrospinning:

The technique, types, examples

Automotive textiles: Tires,airbag, belt,hoses and filter, upholstery, carpet, testing for automotive fabric

#### Composite 1:

Textile for composite, textile composites, textile reinforcement, structures, textile preforms.

**Composite 2:**

Composite manufacturing, machines, software simulation, composite manufacturing.

**Composite 3:**

Applications of composites: general applications, aircraft - space modules etc.

**Coating:**

General overview, materials and chemistry, methods of coating, testing standards.

**Laminating:**

General overview, materials and chemistry, methods of laminating, fusible interlinings, testing standards.

**Nano Technology:**

Introduction, history, classification, synthesis, application.

**Plasma Technology:**

Introduction, chemistry, biomedical application.

**Non-Woven 01:**

Introduction, definition, manufacturing processes, properties, applications, the industry and trade.

**Non-Woven 02:**

Raw materials and process technology: fiber types, fiber waste as source, quality, adhesive and binder, using granules, stages, dry-lay process, wet-lay, web bonding, micro and nano non-woven (melt blow, dry-spinning, centrifugal, electro-spinning).

**Non-Woven 03:**

Characteristics and applications, medical sector, upholstery, cleaning, apparel, technical uses.

**Recommended Books:**

- Handbook of technical textiles by A Richard Horrocks, Subhash C. Anand, 2016
- Handbook of medical textiles. V. T. Bartels, 2011.
- Handbook of tensile properties of textile and technical fibres, A. R. Bunsell, 2009.
- Applications of nonwovens in technical textiles by R. A. Chapman, 2010.

- Technical textile yarns R. Alagirusamy, A. Das, 2010.
- Polymeric Protective Technical Textiles by Brian J. McCarthy, Smithers Rapra, 2013
- Medical and healthcare textiles by J.F. Kennedy, S.C. Anand, M. Mirafteb, S. Rajendran 2010.
- Composite Materials: Design and Application by Daniel Gay, 2014
- Braiding Technology by Yordan Kyosev, 2014

## **TEX-403 Technical Writing and presentation skills (3+0)**

### **Overall Aims of the Course:**

This course is designed to give students an experience in organizing and writing a variety of technical documents. This course focuses on the writing skills necessary for writing information of a technical nature. The course involves organizing and presenting written data with an emphasis on clear, precise, objective thinking and writing as demonstrated through a series of written documents. Assignments will include audience analysis, purpose, and format appropriate for letters, memos, reports, and other documents used in technical areas.

### **Course Learning Outcomes:**

Students should be able to achieve following course learning outcomes during completion of the course.

<b>Sr. No</b>	<b>Course Learning Outcomes (CLOs)</b>	<b>Taxonomy Level</b>	<b>PLO</b>
CLO-1	Knowledge and understanding of format and style layouts of different business documents and evaluate them for their completeness, conciseness, and clarity.	Cognitive-2	PLO-10
CLO-2	Design different technical documents in their required formats and Produce documents using computing technology.	Cognitive-5	PLO-10
CLO-3	Develop Expertise in composing effective business and academic communication.	Psychomotor-3	PLO-10

### **Course Contents:**

#### **Module 1: Technical Writings:**

- Basic Principles in Technical Writing: Audience, Purpose, Organization, Flow, Style and Presentation

#### **Module 2: Workplace related communications:**

- Communicating in the Workplace, Job Application Materials and Processes, Application

letter, Professional resume, E-mail, letters, portfolios, reference, cover letters and memos.

### **Module 3: Essay Writing**

- Essay types; Descriptive, narrative, discursive, argumentative. Essay structure, ideas presentation, grammar, punctuation.
- Introduction to intellectual property, Citations and Plagiarism, Referencing, different referencing styles, Numerical referencing style, Ethics

### **Module 4: Academic Writing**

- How to write a proposal for research paper/term paper
- How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)
- Writing a research paper proposal: brainstorming topics, narrowing the scope, finalizing the decision using library resources, research techniques, and proposal writing.

### **Module 5: Technical Report Writing**

- Presenting Graphical and Quantitative Information
- Charts & Illustrations
- Proofread and edit documents for professional presentation

### **Module 6: Progress Report Writing**

- Structure, parts of progress report. application areas. Types and examples, graphic aids in technical reports, Writing Collaboratively, Templates and Samples

### **Recommended Books:**

- Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992.
- College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
- Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.
- The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharon.
- Johnson-Sheehan, Richard. (2004). Technical Communication Today. Longman.
- Markel, Mike. (1996). Technical Communication Essentials. Martin's Press, Inc.
- Cite Them Right: The Essential Referencing Guide (9th edition) by Richard Pears and Graham Shields 2013

## TEX-405 Final Year Project-I (0+3)

### Overall Aims of the Course:

Application of Textile Engineering Principles in designing new textile products/processes, improving existing products/processes or providing innovative solutions to textile industry problems.

Student should learn Project design fundamentals, Engineering design process, Statistical software, Design of experiments, Introduction to factorial, Taguchi robust and optimum designs, Literature Surveying, gap analysis, Project Planning, Referencing, Data Analysis, Thesis Write Up, Formats and Submission from the instructor of the course.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To perform an in-depth literature on specific area of research and analyze weakness and strengths of processes, technologies, techniques, testing & materials etc.	Cognitive-4	PLO-4
CLO-2	To develop a critical analysis skill after an in-depth analysis of existing work currently available in chosen area of research.	Cognitive-6	PLO-2
CLO-3	To synthesize a novel proposal as a team on sound logical premise, finding its viability keeping in view of time and other resources required.	Affective-2	PLO-9
CLO-4	To learn various experimental design, graphing, referencing, write up and statistical data analysis techniques employed.	Psychomotor-4	PLO-10
CLO-5	To be desired of originality of work by avoiding plagiarism	Affective-2	PLO-8

**Note:** During Semester 7, the project synopses must have been finalized including a thorough literature review and detailed research plan as per schedule developed by Project Coordinator in consultation with thesis committee of the college. Project Coordinator may collect evaluation reports of student progress from the supervisor periodically who would maintain attendance and project file. Project coordinator would devise and maintain a timeline of milestones during project progress e-g Literature review submission, Synopsis submission, Synopsis

Presentation etc. All the submissions should be plagiarism free and must be checked through a central account on turnitin by Project Coordinator as per the HEC policy.

**Recommended Books:**

Literature provided by Course Instructor and respective Supervisors

**8<sup>th</sup> Semester**

**TEX-402 Engineering Management (3+0)**

**Overall Aims of the Course:**

To understand the engineering management in textile operation unit to improve the management system.

**Course Learning Outcomes:**

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	TaxonomyLevel	PLO
CLO-1	Knowledge and understanding of Engineering, Project and Process Management tools and solutions for effective management.	Cognitive-2	PLO-11
CLO-2	Comprehend and analyze the needs of materials, inventory and human resource planning for improving productivity and quality of product	Cognitive-4	PLO-11
CLO-3	Application and practice of Different engineering and IT tools such as Enterprise Resource Planning, Materials Requirement Planning in the textile industry.	Cognitive-3	PLO-5

**Course Contents:**

**Module 1 Introduction**

What is engineering? What is Management? What is Engineering Management? Management functions, Textile Engineering Management.

**Module 2 Project and Process Management**

What is a Project? Textile Mill project management, Project management phases (Planning, Construction of Building, Installment of Machines, and Running of Machines)



Process Management Definition, Generic process elements (Inputs, Transformation, and Outputs), Process Management in Spinning, Weaving, Textile Processing, and Garment Manufacturing

### **Module 3 Maintenance Management**

Maintenance, Types of Maintenance Systems, Scope of Preventive Maintenance, Cost of Maintenance, Development of Checklist (Main Indicators like Abnormal Sound, Vibrations etc), Advantages of centralized facilities for Maintenance, Store Management, Spare parts control, Decision making in Maintenance, Manpower Planning for Maintenance, Energy Conservation & Maintenance (Short Term and long-term Measures).

### **Module 4 Human Resource Management**

Human Resource Management Definition, Human Resource Management Role in textile Organizations, Recruitment, Selection, Performance Management, Employee Relations, Labor Relations.

### **Module 5 Inventory Management**

Inventory Management Definition, inventory functions, inventory types, Inventory Management Systems, effective and efficient inventory management, Inventory Management in textile industry.

### **Module 6 Material Management**

Effective Materials Management techniques, Setting comprehensive inventory goals & objectives, Materials Management Challenges, Benefits.

### **Recommended Books:**

- Engineering Management: Challenges in the New Millennium by C. M. Chang, 2004
- Engineering Management: Creating and Managing World Class Operation by W. Dale Compton, 1997
- Engineering Management by Fraidon Mezda, 1997
- Essentials of Manufacturing Engineering Management by Peter Pang, 2004
- Engineering Project Management by N. J. Smith, 2002
- Basic Cost Engineering by Kenneth K. Humphreys, 1995
- Cost Analysis and Estimating for Engineering and Management by Phillip F. Ostwald, 2003
- Hand Book of Industrial Engineering: Technology and Operations Management by Gavriel Salvendy, 2001

## TEX-404 Environment, Health and Safety (3+0)

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Knowledge and understanding of different types of pollution generated and abatement procedures along with national and international laws related to pollution.	Cognitive-2	PLO-7
CLO-2	Ability to describe the changes occurring in environment and its effect on human health and textile industry.	Cognitive-4	PLO-7
CLO-3	Ability to measure the different types of pollution parameters and their techniques to control.	Psychomotor-2	PLO-7

### Course Outline:

- Safety concerns with respect to textile industry
- Impact protection, noise protection
- Chemical protection, thermal (heat & fire) protection, respiratory protection, worker safety regulations, fire safety, and personal protective equipment.
- Social compliances in textile industry, zero discharge of hazardous chemicals (ZDHC),
- Eleven toxic priority chemicals for textile industry, sustainable technologies, manufacturing restricted substance list (MRSL), brand restricted substance list (RSL).
- Wastewater quality, textile effluent treatment methods: physical; chemical; biological,
- Solid textile waste management, textile audit protocol and textile toxic free chemical research, data disclosure and training.
- Introduction to blue sign, OSHA, ISO 14000, OEKO-TEX- 100.

### Recommended Books:

- M. I. T. Rohr, Handbook of Sustainable Textile Production, 2011
- K. Slatter, Environmental Impact of Textile: Production Processes and Protection, 2003
- Gerard Kiely, Environmental Engineering, 2007
- ZDHC Manuals, 2015, 2017

## TEX-406 Textile industry Utilities & Services (3+0)

### Overall Aims of the Course:

Textile industry consists of different machines and electrical and electronic equipment. The study of lighting systems, humidifiers, air conditioners, compressors and steam and water energy conservations systems will be discussed in detail in this course.

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To understand the working of various utility/ support department like air compressor, boilers, chillers and OHSC.	Cognitive-2	PLO-1
CLO-2	To design utilities department as per process requirement.	Cognitive-6	PLO-3
CLO-3	To learn how conservation techniques can be applied for water, energy and environment saving.	Cognitive-3	PLO-7

### Course Contents:

#### Module 1: Compressors

- History of compressed air
- Compressed air applications
- Compressor types
- Compressed air dryers
- Support components
- Compressors maintenance

#### Module 2: Humidification and air conditioning

- Need for humidity
- Types of humidification
- Air humidity units
- Concept of total air control
- Maintenance of humidity
- Air conditioning units

#### Module 3: Industrial lighting

- Benefits of good industrial lighting
- Lighting for good industrial tasks
- Lighting and color
- Installation design
- Maintenance of lighting installations
- Calculations for interior general lighting
- Economics of good industrial lighting

#### **Module 4: Steam generation systems**

- Introduction to steam
- industrial steam systems
- Boiler room combustion and ventilation air
- Industrial steam system equipment
- Steam plant pipe sizing and design considerations

#### **Module 5: Fire protection systems**

- Basics of fire
- Fire preventive systems
- Fire alarm and detection systems
- Water-based fire protection systems
- Fire suppression systems and agents

#### **Recommended Books:**

- Compressed Air Operations Manual by Brian S. Elliott, 2006 Mc Graw-Hill
- Humidification and Ventilation Management in Textile industry by B. Purushothama, 2009 Woodhead Publishing
- Industrial Steam systems by Mojtaba Sabet, 2015 CRC Press
- Fire Protection Systems by A Maurice Jones, Jr., 2009 Delmar, Cengage Learning
- Fundamentals of Fire Protection by Arthur E. Cote, 2004, National Fire Protection association, Inc.

## TEX-408 Denim Manufacturing and Processing (3+0)

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Learn the different technologies involved in denim manufacturing	Cognitive-2	PLO-1
CLO-2	Knowledge of different washing techniques of denim processing	Cognitive-2	PLO-1
CLO-3	Learn how waste of denim industry will be treated and its impacts on environment	Affective-3	PLO-7

### Course Outline:

- Cotton yarn manufacturing for denim, Indigo dye and reduction techniques,
- Indigo dyeing technology for denim yarns, dyeing of denim yarns with non-indigo dyes,
- Weaving technologies for denim manufacturing, finishing of denim fabric, stitching of denim fabric.
- Washing techniques for denim jeans, dyeing technologies for denim garments,
- Bio washing of denim jeans, reduction of water in washing of denim garments,
- Finishing of jeans and quality control, role of denim and jeans in the fashion industry,
- Novel varieties of denim fabrics, recovery and recycling of denim waste,
- Effluent treatment in denim and jeans manufacturing, environmental impacts of denim manufacturing.

### Recommended Books:

- R. Paul, Denim: manufacture, finishing and applications, 2015
- S.S. Muthu, Sustainability in Denim, 2017
- Piero Turk, A Life With Denim Vol.2, 2017

## TEX-410 Recent Trends in Textiles (2+0)

### Course Learning Outcomes:

Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	Learn different ways to keep updated with the innovations in textile industry	Cognitive-2	PLO-12
CLO-2	Effectively apply the knowledge of the recent technology advancements to fulfill environmental obligations	Affective-5	PLO-7
CLO-3	Apply modern tools to create and solve complex engineering challenges	Cognitive-5	PLO-5

### Course Outline:

#### Module 1: Conventional Textile Products and Markets:

- Local and global production in garments, home textiles, denim products, towels and other conventional textile items. Exports of textile products from Pakistan. Global and local market trends.

#### Module 2: Non-conventional Textile Products and Markets:

- Local and global production of technical textile products, nonwovens, textile composites, high performance fibers and non-conventional textile items. Exports of textile products from Pakistan. Global and local market trends. Potential of Pakistan Textile Industry for producing non- conventional textiles

#### Module 3: Challenges faced by Textile Industry:

- Current challenges of cutting the cost of production, energy conservation, productivity, environmental protection. Challenges faced by the industry at global level.

#### Module 4: Innovations in Textile Industry:

- Innovations in the fields of conventional textiles i.e. denim, towel, home textiles and garment industry. Innovations in the field of non-conventional textiles i.e. technical textiles, nonwovens, composites and raw materials

#### Module 5: Nano Technology:

- History of nano materials, classification of nano materials, synthesis & characterization of nano materials, applications of nano materials

## Module 6: Plasma Technology:

- Introduction, chemistry of plasma processing, biomedical applications

### Recommended Books:

- Roshan Paul, High Performance Technical Textiles, 2019.
- K.L. Mithel, Textile Finishing Recent Development and Future Trends, 2017.
- V. S. Gajveile, Recent Trends in Sustainability and Management Strategy, 2017.
- Recent research papers and material published in the above fields

## TEX-412 Final Year Project-II (0+3)

### Overall Aims of the Course:

Application of Textile Engineering Principles in designing new textile products/processes, improving existing products/processes or providing innovative solutions to textile industry problems.

**Note:** At the end of Semester 8, the project theses must have been completed. All the submissions should be plagiarism free and must be checked through a central account on turnitin by Project Coordinator as per the HEC policy and guidelines.

**Course Learning Outcomes:** Students should be able to achieve following course learning outcomes during completion of the course.

Sr. No	Course Learning Outcomes (CLOs)	Taxonomy Level	PLO
CLO-1	To perform an in-depth literature on specific area of research and analyze weakness and strengths of processes, technologies, techniques, testing & materials etc.	Cognitive-6	PLO-4
CLO-2	To carry out project as a team	Affective-4	PLO-9
CLO-3	To manage and conduct the project according to the project timeline and available resources	Psychomotor- 4	PLO-11
CLO-4	To be able to communicate research findings effectively with integrity	Affective-2	PLO-10
CLO-5	To be desired of originality of work by avoiding plagiarism	Affective-2	PLO-8

### Recommended Books:

Literatures and studies on your topic