M.D. UNIVERSITY, ROHTAK

(NAAC Accredited 'A+' Grade)

SCHEME OF STUDIES AND EXAMINATION

B.TECH (Textile Technology)

SEMESTER 5th AND 6th

Scheme effective from 2020-21

COURSE CODE AND DEFINITIONS:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
Pr	Practical

General Notes:

1. Mandatory courses are non credit courses in which students will be required passing marks in internal assessments.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

Scheme of Studies and Examination
B.TECH (Textile Technology) – 5th Semester
w.e.f. 2020-21

Sr. No.	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L	T	P			Internal Assessment	External Examination	Practical	Total	
1	PCC-TT-301G	Yarn Manufacture-III	3	0	0	3	3	25	75	-	100	3
2	PCC-TT-302G	Advanced Weaving Technology-I	3	0	0	3	3	25	75	-	100	3
3	PCC-TT/TC/FAE-303G	Textile Testing	3	0	0	3	3	25	75	-	100	3
4	PEC-I	Elective-I	3	0	0	3	3	25	75	-	100	3
5	OEC-I	Open Elective-I	3	0	0	3	3	25	75	-	100	3
6	OEC-II	Open Elective-II	3	0	0	3	3	25	75	-	100	3
7	LC-TT-301G	Spinning Practical-III	0	0	2	2	1	25	-	25	50	3
8	LC-TT-302G	Weaving Practical-III	0	0	2	2	1	25	-	25	50	3
9	LC-TT/TC/FAE-303G	Textile Testing Practical	0	0	2	2	1	25	-	25	50	3
10	LC-TT-304G	Wet Processing Lab.	0	0	2	2	1	25	-	25	50	3
Total							**22**				**800**	

Note:

1. Choose any one from Elective-I
2. Choose any one from Open Elective-I
3. Choose any one from Open Elective-II

ELECTIVE-I

Sr. No.	Course Category	Course Code	Course Title
1	Professional Elective Course (PEC-I)	PEC-TT/TC-301G	Post Extrusion Operations
2	Professional Elective Course (PEC-I)	PEC-TT-302G	Total Productive Maintenance in Textile Industry
3	Professional Elective Course (PEC-I)	PEC-TT-303G	Waste Management & Pollution Control

OPEN ELECTIVE-I

Sr. No.	Course Category	Course Code	Course Title
1	Open Elective Course (OEC-I)	OEC-TT-301G	Textile Chemical Processing
2	Open Elective Course (OEC-I)	OEC-TT-302G	Chemical Processing of Natural Fibres
3	Open Elective Course (OEC-I)	PEC-TC-302G	Chemical Processing of Unconventional Textile Materials

OPEN ELECTIVE-II

Sr. No.	Course Category	Course Code	Course Title
1	Open Elective Course (OEC-II)	OEC-TT/TC-303G	Garment Manufacturing Technology
2	Open Elective Course (OEC-II)	OEC-TT/TC-304G	Apparel Quality Evaluation and Standards
3	Open Elective Course (OEC-II)	OEC-TT/TC-305G	Introduction to Fashion and Apparel Industries

Scheme of Studies and Examination
B.TECH (Textile Technology) – 6th Semester
w.e.f. 2020-21

Sr No.	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L	T	P			Internal Assessment	External Examination	Practical	Total	
1	PCC-TT-303G	Unconventional Systems of Yarn Formation	3	0	0	3	3	25	75	-	100	3
2	PCC-TT-304G	Advanced Weaving Technology-II	3	0	0	3	3	25	75	-	100	3
3	PEC-II	Elective-II	3	0	0	3	3	25	75	-	100	3
4	PEC-III	Elective-III	3	0	0	3	3	25	75	-	100	3
5	OEC-III	Open Elective-III	3	0	0	3	3	25	75	-	100	3
6	HSMC-TT/TC/FAE-301G	Merchandising and Export Management	3	0	0	3	3	25	75	-	100	3
7	LC-TT-305G	Spinning Practical-IV	0	0	2	2	1	25	-	25	50	3
8	LC-TT-306G	Weaving Practical-IV	0	0	2	2	1	25	-	25	50	3
9	LC-TT-307G	Pattern Making and Garment Construction Lab.	0	0	2	2	1	25	-	25	50	3
Total							**21**				**750**	

NOTE: 1. At the end of 6th semester each student has to undergo Practical Training of 6 weeks in an Industry/Mill/ Professional Organization and submit typed report along with a certificate from the organization & its evaluation shall be carried out in the 7th Semester under the course 'Mill Practice' (Course Code PROJ-TT-401G).

2. Choose any one from Elective-II
3. Choose any one from Elective-III
4. Choose any one from Open Elective-III

ELECTIVE-II

Sr. No.	Course Category	Course Code	Course Title
1	Professional Elective Course (PEC-II)	PEC-TT-304G	Mechanics of Textile Machinery
2	Professional Elective Course (PEC-II)	PEC-TT-305G	Structure and Properties of Fibres
3	Professional Elective Course (PEC-II)	PEC-TT-306G	Wool Technology

ELECTIVE-III

Sr. No.	Course Category	Course Code	Course Title
1	Professional Elective Course (PEC-III)	PEC-TT-307G	Engineering of Textile Structures
2	Professional Elective Course (PEC-III)	PEC-TT-308G	Modeling and Simulation of Fibrous Assemblies
3	Professional Elective Course (PEC-III)	PEC-TT-309G	Sustainable Textile Production

OPEN ELECTIVE-III

Sr. No.	Course Category	Course Code	Course Title
1	Open Elective Course (OEC-III)	OEC-TT-306G	Advanced Textile Testing
2	Open Elective Course (OEC-III)	OEC-TT-307G	Statistics for Textile Engineers
3	Open Elective Course (OEC-III)	OEC-TT-308G	Total Quality Management and Six Sigma

PCC-TT-301G Yarn Manufacture-III

Course code	PCC-TT-301G				
Category	Professional Core Course				
Course Title	Yarn Manufacture-III				
Scheme and Credits	L	T	P	Credits	Semester–V
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Yarn Manufacture-I; Yarn Manufacture-II

Course Objectives:

- To familiarize the students with objectives of conventional system of single and double yarn formation viz. ring spinning and doubling
- To make the students understand basic mechanisms involved in conventional system of yarn formation and doubling viz ring frame and doubling machine
- To make students learn calculations related to ring spinning and doubling.
- Introduce about different yarn according to application viz. fancy yarn, core spun yarn, sewing thread etc.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-1

Objective, principle and mechanism involved in drafting, twisting and winding. Function of different drafting elements, Design and construction of spindle, Types of spindle drive, Ring and its type, Design and construction of traveler. Different combination of ring and traveler,

UNIT-II

Concept of twist multiplier and yarn contraction, Factors affecting twist in a yarn, Building mechanism, Importance of spinning geometry and its elements, Control of yarn tension in ring frame, Mechanism of package formation. Types of spinning waste and system of waste collection, Compact spinning- its types and advantages,

UNIT-III

Limitation of ring spinning and factors responsible for loss in efficiency, Processing of manmade fibre on ring-frame, Concept of average count and 20s conversion, Yarn faults and their remedies, Causes of end breakage and its control, Limitations of large package spinning, Calculation related to ring spinning, Recent developments in ringframe.

UNIT-IV

Objective of doubling, Different systems of doubling, Study of ring doubler and TFO (Two for one) machine, Calculations related to yarn doubling, Fancy yarns, Sewing threads, Core spun yarn and other specialty yarns, Objective of reeling, Types of reeling, Construction and working of reel, Yarn bundling.

Suggested Reading List:

Title	**Author**
Engineering Techniques of Ring Spinning	Shaikh & Bhattacharya
Short Staple Spinning Volume-I, II, III & IV	W. Klein
Cotton Spinning	W. S. Taggart
Manual of Cotton Spinning	De
Barr & Catling Essential Elements of Practical Cotton Spinning	T.
K. Pattabhiram Spinning of Manmade and their blends on cotton system	K. R. Salhotra

Course Outcomes:

At the end of the course, the students will:

- have the detailed knowledge including the function of each part of ring frame and doubling machine for processing different materials;
- have learnt the principle and working of ring frame and doubling.
- be able to calculate various parameters like draft, waste, production and efficiency related to ring frame and doubling.
- have the basic knowledge end use of different yarns like fancy yarns, sewing threads, core-spun yarns etc.

PCC-TT-302G Advanced Weaving Technology-I

Course code	PCC-TT-302G				
Category	Professional Core Course				
Course Title	Advanced Weaving Technology-I				
Scheme and Credits	L	T	P	Credits	Semester–V
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Fabric Manufacture-I; Weaving Preparation

Course Objectives:

- To familiarize the students about the shortcomings of shuttle looms
- To familiarize the students about different shuttleless weaving machines and their application area
- Understanding the principle, design and mechanism of modern shedding, beat up, take-up and let- off mechanisms
- Understanding the principle, design and mechanism of projectile weaving machines
- Understanding the principle, design and mechanism of rapier weaving machines

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Principle and working of modern shedding mechanisms - crank, matched cam, electronic dobby, electronic jacquard, e-shedding.

Principle and working of Beat up mechanisms - Matched cam beat up, Multi link crank beat up.

UNIT-II

Principle and working of take up (mechanical & electronic take up) and let off (mechanical & electronic let off) mechanisms used in shuttleless looms.

Introduction to Shuttleless weaving: Restrictions as well as merits of Shuttle weaving; types of shuttleless looms, their development, typical speeds, production rates and application domain.

UNIT-III

Projectile weaving machine: Principle of weft insertion, typical specification & features of modern projectile looms. Merits, demerits and standard application domain; Torsion bar picking - construction, working, settings, mechanics; Path of weft, function of each component, projectile types, projectile circulation, weft transfer to projectile, projectile brake; Sequence of weft insertion, typical timings, projectile velocity calculation. Types and features of shedding, beat up, take up and let off motions used in projectile looms; standard manufacturers.

UNIT-IV

Rapier Weaving Machine: Principle of weft insertion, typical specification & features of modern rapier looms; Merits, demerits and standard application domain; Classification of rapier looms, brief description of each type under classification. Gabler and Dewas system of weft insertion and their comparison; Path of weft in modern rigid and flexible rapier looms, function of each component in the path, sequence of weft insertion; Rapier heads, negative and positive weft transfer at shed center, their comparison; Typical timings, synchronous and asynchronous rapier movement, calculation of rapier/weft velocities, figure of merit; Rapier drives: Eccentric and cam drive systems, working of some standard drive mechanisms. Types and features of shedding, beat up, take up and let off motions used in rapier looms; standard manufacturers.

Suggested Reading List:

Title	**Author**
Handbook of Weaving	S. Adanur
Weaving: Technology & Operations	A. Ormerod
Weaving: Machines, Mechanisms, Management	Talukdar,
Sriramulu, Ajgaonkar Principles of Weaving	R. Marks & A. T.
C. Robinson	
Woven Fabric Production – I & II	NCUTE Publications

Course Outcomes:

After completion of the course, students will be able to:

- understand the concept of shuttleless weaving and the principle of different shuttleless weaving machines
- comprehend the design and mechanism of projectile and rapier weaving machines
- comprehend the design and mechanism of modern shedding, beat up, take-up and let-off mechanisms

PCC-TT/TC/FAE-303G Textile Testing

Course code	PCC-TT/TC/FAE-303G				
Category	Professional Core Course				
Course Title	Textile Testing				
Scheme and Credits	L	T	P	Credits	Semester–V
	3	0	0	3	
Branch	Textile Technology, Textile Chemistry, Fashion and Apparel Engg.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic knowledge of textile fibres, yarns and fabrics.

Course Objectives:

- To familiarize the students about the importance, concept and techniques of sampling
- To familiarize the students about important fibre, yarn and fabric dimensions and characteristics and their measurement techniques
- Comprehending the mechanical behavior of textile materials and its evaluation methods
- To familiarize the students about the evaluation methods of colour fastness
- To familiarize the students about common types of garment testing

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Introduction to textile testing - aim and scope. Sampling and Sampling techniques: General requirements; fibre, yarn and fabric sampling techniques.

Measurement of fibre dimensions and characteristics, viz. length, fineness, cotton maturity, neps and trash including principle and operation of equipment in common use.

Relation between R.H. and moisture regain of textile materials; equilibrium regain, hysteresis. Measurement of moisture regain. Official regain and concept of correct invoice weight.

UNIT-II

Measurement of yarn dimensions and characteristics: yarn count/diameter, twist and hairiness including principle and operation of equipment in common use.

Yarn evenness: Terms and definitions, nature of irregularities. Principles and methods of evenness testing, variance-length curves and their interpretation.

Test methods for fabric dimensional and other physical properties like, thickness, weight, crimp, bending and drape including principle and operation of equipment in common use.

UNIT-III

Mechanical behaviour of textiles: Terms and definitions, expression of results, quantities and units. Experimental methods: Principle of CRL, CRT and CRE type tensile testing machines. Fibre strength testing – single fibre strength and bundle strength. Yarn strength testing – single yarn strength and lea strength. Fabric strength testing - tensile, tearing and bursting strength tests. Principle and operation of equipment in common use.

Measurement of fabric abrasion resistance and evaluation of results; measurement of fabric pilling and crease recovery.

UNIT-IV

Measurement of fabric air permeability and water vapour permeability. Introduction to fabric handle.

Introduction to fastness properties of dyed and printed textiles - evaluation methods of colour fastness to Laundering, Crocking, Sunlight, Perspiration, Dry-cleaning and Hot Pressing.

Garment Testing: Testing of Seam Strength, Seam Slippage, Seam Puckering, Button Strength and Zipper or Closer Strength.

Suggested Reading List:

Title	**Author**
Principles of Textile Testing	J. E. Booth
Physical Testing of Textiles	B. P. Saville
Fabric Testing	Jinlian Hu
Physical Properties of Textile Fibres	W. E. Morton & J. W. S. Hearle
Textile Fibres, Yarns and Fabrics	E. R. Kaswell

Course Outcomes:

After completion of the course, students will be:

- able to understand the concept of sampling and sampling techniques for testing of textile materials.
- familiar with the important fibre, yarn and fabric dimensions and characteristics and their measurement techniques.
- familiar with the mechanical behavior of textile materials, different related terms and principles, and its evaluation methods.
- familiar with the evaluation methods of colour fastness
- familiar with the common types of garment testing

PEC-TT/TC- 301G Post Extrusion Operations

Course code	PEC-TT/TC-301G				
Category	Professional Elective Course (PEC-I)				
Course Title	Post Extrusion Operations				
Scheme and Credits	L	T	P	Credits	Semester–V
	3	0	0	3	
Branch	Textile Technology, Textile Chemistry				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Man-made fibre production

Course Objectives:

The course is designed to impart the following:

- Basic concept of drawing of filaments
- Basic concept of setting
- Basic concept of texturizing

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Drawing: Objectives, neck drawing of filaments, NDR, MDR and LDR; Drawing of polyester and nylon; Spin-draw process; Various parameters of drawing and their effects on structure and properties of filaments.
Heat setting process: Nature of set, mechanism of setting; Various parameters of heat-setting and their influence on structure and properties of filaments; Thermal healing; Settability and measurement of degree of set.

UNIT-II

Texturing process: Principle of texturing; Types of texturing processes; Principle and brief description of stuffer box crimping, Edge crimping, Knit-de-knit texturing; Manufacturing of BCF and Hi-bulk yarns.

UNIT-III

Twist texturing principle; Material, machine and process variables affecting structure and properties of twist textured yarns; Faults in twist textured yarns and their remedies; Evaluation of twist textured yarns.

UNIT-IV

Air-jet texturing: Principles and mechanism of air-jet texturing; Material, machine and process variables affecting structure and properties of the air-jet textured yarn; Different types of jets, baffle elements and their description; Properties of air-jet textured yarns and their importance; Evaluation of air-jet textured yarns.

Suggested Reading List:

Title	**Author**
Manufactured Fibre Technology	Gupta & Kothari
Modern Yarn Production	G R Wray
Yarn Texturing Technology	Hearle, Hollick & Wilson

Course Outcomes:

After completion of the course, students will be able to:

- understand the essential requirements for drawing of filaments.
- comprehend the basics of temporary and permanent setting.
- get familiarised with manufacturing techniques of texturizing.

PEC-TT-302G Total Productive Maintenance in Textile Industry

Course code	PEC-TT-302G				
Category	Professional Elective Course (PEC-I)				
Course Title	Total Productive Maintenance in Textile Industry				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic concepts of textile production equipment and their functions.

Course Objectives:

The objectives of this course is to

- familiarize the students about various activities pertaining to maintenance of textile machineries.
- give an idea on utility services requirements in textile industry
- familiarize the students about total productive maintenance
- give an overview on importance of maintenance activities on the productivity, quality of output and life span of machines.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Maintenance: definition and objectives. Importance of maintenance in an industry. Type of maintenance: Planned and unplanned maintenance. Activities involved in planned and unplanned maintenance. Functions of maintenance management: maintenance planning and execution, scheduling, inventory management of spare parts and accessories, record keeping and analysis. Maintenance audit.

UNIT-II

Bearing; Type of bearing and their uses in textile machineries; Identification of bearing through numbering. Reason for failure of bearing; lubrication of bearing; type of lubricants used in textile machineries. Characteristics of lubricant; selection and application of lubricants. Brief idea on different types of utility service in textile industries and their importance.

UNIT-III

Evolution of concept of Total Productive Maintenance (TPM); Definition of maintenance and its benefits. Components of TPM: predictive maintenance, condition based monitoring, corrective maintenance, Role of machine designer, production and maintenance department in T.P.M. Implementation of T.P.M. Autonomous maintenance. Determination of R.P.N and idea on F.M.E.A. Brief idea on occupational safety and health hazard in textile industry.

UNIT-IV

Idea on preventive maintenance activities in textile industries. Brief description, frequency and effect of quality, productivity and life of important maintenance activities in spinning machineries – card wire mounting and grinding, card setting, cot mounting, buffing and treatment, ring-spindle centering, roller truing, spindle oil replacement etc. Brief idea on replacement frequency of important spare parts like card wire, cots, ring, spindle, cradle etc. Brief description, frequency and effect of quality, productivity and life of important maintenance activities in preparatory and weaving machineries like, periodic lubrication schedule, size box cleaning and setting, roller alignment in weaving machines, different settings in weaving machines, etc. Brief idea on replacement frequency of important spare parts in weaving machines like, air jet/water jet nozzles, projectiles in projectile weaving machines, rapier heads and rapier rod/tapes, reed, heald wires, etc.

Suggested Reading List:

Title	**Author**
Maintenance of spinning machineries	S. Nihajan

Course Outcomes:

After completion of the course, students will be able to:

- understand the activities involved in maintenance.
- understand the various maintenance activities of textile machines and their impact on quality, productivity and life of the machines.
- understand the concept of total productive maintenance and its implementation methodology.

PEC-TT-303G Waste Management and Pollution Control

Course code	PEC-TT-303G				
Category	Professional Elective Course (PEC-I)				
Course Title	Waste Management and Pollution Control				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic concepts of textile production.

Course Objectives:

- To familiarize the students about various wastes and pollutants from textile production.
- To familiarize the students about the importance of waste management and pollution control.
- To familiarize the students different textile effluents and their recovery/recycling.
- To give an overview on toxicity of bleaching, dyeing, printing and finishing auxiliaries and their analysis and minimization.
- To give an overview on water, air and noise pollution due to textile production, their control, standards and acts.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Definition of Waste and Pollutant: Classification of wastes and pollutants; Importance of waste management and pollution control. Environmental impact assessment, definition & need, introduction to environmental impact assessment methodology, unit processes.

UNIT-II

Textile effluents and their characterization, methods of effluent treatment, disposal of effluents, reuse of water in a process house, fiber and polymer waste, recovery and recycling of monomer. Modifications of polymer waste. Recovery and recycling of monomers, Modifications of polymer waste and its utilization, Waste Management approaches, Statistical interpretation of data on waste of different sections of textile industry.

UNIT-III

Toxicity of intermediates dyes, processing aids-bleaching, dyeing, printing and finishing auxiliaries etc. Analytical methods for various pollutants. Formaldehyde, Pentachlorophenol, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Minimization, Optimization and Standardization of waste in textile industry.

UNIT-IV

Source of water pollution: Factors contributing water pollution and their effect, water pollution parameters, physical, biological, chemical standards for quality of treated water. Effluent treatment methods and control, basic principles - Unit operations (sedimentation, precipitation, filtration, and incineration), specific pollutants. Pollution of air, causes, effect, monitoring and control. Source of noise pollution, its effect and control. Legislation- salient provisions of water act, Air act, Environment protection act, Environment Impact Assessment: Basic principles, purpose, components, methodology and constraints.

Suggested Reading List:

Title	**Author**
Basic course in environmental studies Deswal.	S. Deswal & Anupama
Environment impact Assessment	L.W. Caeter
Environment Pollution & Control	H. S. Bhatia
Textile management	V. D. Dudeja.
Water and effluent in textile mills	P. B. Jhala

Course Outcomes:

After completion of the course, students will be:

- familiarized with various wastes and pollutants from textile production.
- able to comprehend the importance of waste management and pollution control.
- familiarized with different textile effluents and their scope of recovery/recycling.
- have an idea on toxicity of bleaching, dyeing, printing and finishing auxiliaries and their analysis and scope of its minimization/optimisation.
- have an idea on water, air and noise pollution due to textile production, their control, standards and acts.

OEC-TT-301G Textile Chemical Processing

Course code	OEC-TT-301G				
Category	Open Elective Course (OEC-I)				
Course Title	Textile Chemical Processing				
Scheme and Credits	L	T	P	Credits	Semester–V
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic knowledge of fiber chemistry and their properties; fundamental knowledge of fabric manufacturing.

Course Objectives:

- To provide basic knowledge of basic concept of chemical processing of textiles.
- To familiarize students with the various pre-treatments involved in natural and man-made fiber processing.
- To introduce students about dyeing and printing of various textile materials.
- To introduce students to the various types of finishing treatments associated with textile materials.
- To familiarize students with the machinery involved in textile chemical processing.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Introduction: Sequence of chemical processing of textiles. Natural and added impurities in textiles. Preparatory Processes: Singeing, Desizing, Scouring and Bleaching in context to natural, man-made and blended textiles; objectives, types, methods, mechanism, recipe and machine associated with each process. Brief introduction to Mercerization, Heat setting and Degumming of Silk.

UNIT-II

Introduction to the dyeing of natural & synthetic fibres/fabrics with different dye classes: Direct, Reactive, Vat, Sulphur, Acid, Basic, Metal-complex, Disperse etc. Introduction to dyeing machineries: Yarn package dyeing machines, Jigger, Winch, Jet dyeing machines and Padding mangles.

UNIT-III

Printing: Introduction to printing methods Block, screen and roller printing. Advantages and disadvantages of each method. Introduction to various styles of printing like Direct, Discharge and Resist styles on natural, man-made and blended textiles. Ingredients of print paste with details on classification of thickeners. Introduction to Transfer Printing and Pigment Printing: Mechanism and recipe details of pigment printing.

UNIT-IV

Introduction to finishing of textiles with their classification and elementary idea of various mechanical and chemical finishes: Calendaring, Sanforizing, Sueding/Napping, Decatising etc. Chemical Finishes: Anti-crease finish on cotton. Introduction to water repellent and Flame proofing finishes on cotton. Basic idea of Softeners and their application.

Suggested Reading List:

Title	**Author**
Technology of Textile Processing Vol-2, 3, 4	V. A. Sehnai
Textile Technology and Dyeing of Textile Fibres	E. R. Trotman
Principle and practice of Dyeing	V. A. Sehnai
Chemical processing of Synthetic Fibres and Blends	K. V. Datye
& A. A. Vaidya Fundamentals and Practices in Coloration of Textiles	J. N. Chakraborty
Silk Dyeing, Printing and Finishing	M. L. Gulrajani
Technology of Printing	V. A. Shenai
Textile Printing	L. W. C. Miles
Chemical Finishing of Textiles	W. D. Schindler & P. J. Hauser
An Introduction to Textile Finishing	J. T. Marsh

Course Outcomes:

After completion of the course, students will:

- have knowledge of chemical processing of textile fibers.
- be able to elaborate the various pre-treatments involved in the chemical processing of different fibres.
- be familiar with application of different types of colorants to natural and manmade fibers.
- be familiar with the various finishing treatments involved in the textile processing.
- be able to explore the machinery involved in the chemical processing of textiles.

OEC-TT-302G Chemical Processing of Natural Fibres

Course code	OEC-TT-302G				
Category	Open Elective Course (OEC-I)				
Course Title	Chemical Processing of Natural Fibres				
Scheme and Credits	L	T	P	Credits	Semester–V
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic knowledge of fiber chemistry and their properties; fundamental knowledge of fabric manufacturing.

Course Objectives:

- To provide basic knowledge of basic concept of chemical processing of textiles.
- To familiarize students with the various pre-treatments involved in natural fibres.
- To introduce students about coloration of natural fibre textile materials.
- To introduce students with the various types of finishing treatments associated with natural textile materials.
- To familiarize students with the machinery involved in textile chemical processing.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Introduction to chemical processing of textiles. Natural and added impurities in textiles. Sequence of chemical processing of textiles. Preparatory Processes for cotton textiles: Singeing, Desizing, Scouring, Bleaching and Mercerization.

UNIT-II

Chemical Processing of Wool and Silk: Desizing, Scouring/Degumming, Bleaching, Milling, Decatising, Silk Weighting etc.

Chemical Processing of Bast Fibres (Jute, Flax Ramie etc.):
Retting/Degumming/Scouring, Bleaching etc.

UNIT-III

Dyeing of natural fibres/fabrics with different dye classes: Direct, Reactive, Vat, Sulphur, Acid, Basic, Metal-complex etc. Introduction to dyeing machineries: Yarn package dyeing machines, Jigger, Winch, Jet dyeing machines and Padding mangles.

UNIT-IV

Introduction to printing methods Block, screen and roller printing. Introduction to various styles of printing like Direct, Discharge and Resist styles on natural fibre/fabrics.

Introduction to finishing of textiles with their classification and elementary idea of various mechanical and chemical finishes: Calendaring, Sanforizing, Sueding/Napping etc. Chemical Finishes: Anti-crease finish on cotton, Biopolishing. Basic idea of Softeners and their application.

Suggested Reading List:

Title	**Author**
Technology of Textile Processing Vol-2, 3, 4	V.
A. Sehnai Textile Technology and Dyeing of Textile Fibres	E.
R. Trotman Principle and practice of Dyeing	V.
A. Sehnai Fundamentals and Practices in Coloration of Textiles	J.
N. Chakraborty Silk Dyeing, Printing and Finishing	M.
L. Gulrajani Technology of Printing	V. A. Shenai
Chemical Finishing of Textiles	W. D. Schindler & P. J. Hauser
An Introduction to Textile Finishing	J. T. Marsh

Course Outcomes:

After completion of the course, students will:

- have knowledge of chemical processing of textile fibers.
- be able to elaborate the various pre-treatments involved in the chemical processing of natural fibres.
- be familiar with application of different types of colorants to natural fibers.
- be familiar with the various finishing treatments involved in the natural fibre processing.
- be able to explore the machinery involved in the chemical processing of textiles.

PEC-TC-302G Chemical Processing of Unconventional Textile Materials

Course code	PEC-TC-302G				
Category	Open Elective Course (OEC-I)				
Course Title	Chemical Processing of Unconventional Textile Materials				
Scheme and Credits	L	T	P	Credits	Semester–V
	3	0	0	3	
Branch	Textile Technology, Textile Chemistry				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic knowledge of textile raw materials and elementary idea of textile chemical processing.

Course Objectives:

- To discuss the chemical processing of Knit goods with technical details of machinery.
- To explain the chemical processing Denim fabric including dyeing and finishing.
- To explain process and machines used for terry towel and carpet products.
- To discuss processing of Jute and Linen fabrics.
- To discuss the processing route of spandex containing materials.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Basic concept of knitting: warp knits, weft knits, courses, wales, stitch and loop density. Factors to be considered in knit processing. Process sequences in tubular and open width form processing. Pre- treatment like singeing, scouring, bleaching and mercerization. Dyeing with direct, reactive, vat and sulphur using winch and soft flow dyeing machines. Finishing of knit goods: Hydro-extraction and slitting, drying and compacting. Faults in knit goods.

UNIT-II

Processing of Denim: Introduction to denim, types of Denim fabrics, chemistry and process of warp dyeing with indigo. Indigo dyeing equipments. Dyeing with mixture of indigo and other dyes. Finishing of Denim Fabrics and Garments. Quality and process control in wet processing.

UNIT-III

Terry Towel Processing: Process sequence and machines used for terry towel manufacturing, essential properties of terry towel fabrics like pile properties, water absorbency. Type and application of terry fabrics. Different stages of towel processing and finishing. Common defects in terry fabrics.

Carpet Processing: Different fibres suitable for carpets, types of carpets, essential properties of carpet fabric. Dyeing and printing of carpets. Mechanical and chemical finishing of carpets.

UNIT-IV

Jute and Linen Processing: General properties and uses of jute and linen fibres. Their pre-treatment and dyeing processes. Woollenisation of jute.

Processing of Fabric containing spandex: Brief introduction of properties and uses of spandex fibres and blends. Wet processing of Cotton/ Spandex, Viscose/Spandex, Nylon/Spandex, Polyester/Spandex fabrics. Finishing of warp knits containing spandex fibres.

Suggested Reading List:

Title	Author
Processing of cotton knitted fabrics	M. Chakraborty, Amit Dayal
and M L Gulrajni Denim: A Fabric for all	M. S. Parmar
Manufacturing of Terry Towel	Subhash J. Patil
Textile Floor covering	G. H. Crowshaw, Textile Progress, Vol. 9, No. 2
Interior Furnishing	Mortimer O'shea, Textile Progress, Vol. 11, No. 1
Carpet Surface	H. Pointon, Textile Trade Press
Textile Printing	L. W. C. Miles

Course Outcomes:

After completion of the course, students will be able to:

- explain processing, precaution and details of Knit goods
- explain processing and finishing of Denim fabric and garments
- explain the processing of terry towel and carpet product
- explain the complete chemical processing of jute and linen fabrics
- understand the chemical processing of Spandex containing textile materials.

Course code	OEC-TT/TC-303G				
Category	Open Elective Course (OEC-II)				
Course Title	Garment Manufacturing Technology				
Scheme and Credits	L	T	P	Credits	Semester–V
	3	0	0	3	
Branch	Textile Technology, Textile Chemistry				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Textile raw materials, yarn formation, woven & knitted fabrics.

Course Objectives:

- To familiarize the students with the role of Fashion in Apparels.
- To understand the marker planning, spreading and cutting processes in Garment Industries.
- To familiarize with the contribution of various entities of sewing in Apparel production.
- To understand the pressing procedure followed in Garment industries.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Concepts of Fashion: various terms used- fashion cycle, fad, style etc. Fashion Theories, Consumer identification with different phases of Fashion Cycle. Introduction to Garment Manufacturing process. Introduction of merchandising and retail concepts. Future prospects for engineers in garment sector.

UNIT-II

Planning, drawing and reproduction of the marker, requirements of marker-planning, marker efficiency, methods of marker planning and marker use – normal marker, planning and computerized marker planning, requirement of spreading process, nature of fabric packages, Objectives and methods of cutting straight knife, band knife, notches, drills, computer controlled knives, Die cutting, Laser cutting, Plasma cutting, Microprocessor based machinery in pattern construction and planning, marking and cutting processes.

UNIT-III

Sewing: Properties of seams, seam types, stitch types, sewing machine feed mechanism, sewing machine needles, sewing threads, sewing problems. Introduction to Sewing Machinery: Basic sewing machines and associated work aids. Automation in Garment Industry, Information Technology in Garment Industry.

UNIT-IV

Pressing: Purpose of pressing, pressing equipment and methods General description to alternative methods of joining materials and the use of components, trimmings to care labeling in garment manufacturing.

Suggested Reading List:

Title	**Author**
Fashion from Concept to Consumer	Emilio Puc
The Technology of Clothing Manufacture	Harold Carr & B. Latham
The Apparel Industry in India	I. L. A. Kanti
Garment Manufacturing Technology	Nayak & Padhey
Apparel Manufacturing Analysis	Jacob Solinger
Apparel Manufacturing Handbook	Jacob Solinger
Apparel Manufacturing Technology	Karthik, Ganeshan, Goplakrishnan

Course Outcomes:

After completion of the course, students will be able to:

- relate fashion concepts in garment industries.
- analyse marker planning and efficiency, spreading and cutting processes in Garment Industries.
- work and relate sewing parameters in Apparel products.
- develop pressing procedure in Garment industries.

Course code	OEC-TT/TC-304G				
Category	Open Elective Course (OEC-II)				
Course Title	Apparel Quality Evaluation and Standards				
Scheme and Credits	L	T	P	Credits	Semester–V
	3	0	0	3	
Branch	Textile Technology, Textile Chemistry				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Textile raw materials, yarn formation, woven & knitted fabrics

Course Objectives:

- To familiarize the students with the role of Quality in Apparels and its categorization.
- To create clarity regarding the Inspection systems and tools of Quality Control.
- To familiarize with the contribution of various entities in Apparel organizations towards Quality.
- To understand the sampling procedure followed in Garment industries.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Meaning of quality, testing and standards and their importance in apparel industry; Quality terminologies; Sources of international standards. Quality Parameters of fabric and garment.

Quality – definition, classification of defects, Quality loop, inspection loop, stages of inspection, how much to inspect-arbitrary, statistical sampling, AQL, zones in garment evaluation, Quality function. Evaluation of quality cost, categorisation of quality costs, objectives of quality cost evaluation.

UNIT-II

Role of quality management for Fashion Buyer - Role of fashion Buyer, Buying team, buying cycle - comparative shopping, directional shopping. Principles of TQM – Deming's PGDCA Cycle - KAIZAN concepts – 5 „S" applications in apparel industry. Application of seven QC tools in apparel industry.

UNIT-III

Inspection- purpose, inspection manuals, how much to inspect, random sampling etc. Quality standards- ISO-9000 series of standards, Quality assurance, Six Sigma. various care labelling symbols, different stages at which inspection is carried out and its effect on overall garment quality like raw material inspection- Fabric Inspection system : 4 point,10 point system and in process inspection.

UNIT-IV

Understanding procedures in sampling and sample development, different stages of samples and their requirements from Proto to Shipment sample Proto, fit, size set, pre-production, TOP, sealer etc. Inspection: Incoming and raw material inspection: Fabric inspection – 4-point system. In process/ online inspection: Advantages – On line inspection during spreading, pattern making, cutting, sewing and ironing. Final inspection: Sampling plans and AQL charts – Level of final inspection. Packing & packaging quality tests. Care labeling and international care symbols.

Suggested Reading List:

Title	**Author**
Hand book of Quality Control	Joseph Juran
Total Quality Management: A pictorial guide for manager	John Oakland
Statistical Quality Control	G. Eugene & Lavenworth Richard
Managing Productivity in Apparel Industry	Rajesh Bheda
Productivity through Quality	Rajesh Bheda,
Fashion Buying	Halen Goworek
Evaluating Apparel Quality	Stamper
ISO 9000 Quality Management System.	D. L. Shah
Managing the Quality in Apparel Industries	Pradeep V. Mehta
Principles of Textile Testing	J. E. Booth
Testing and Quality Management	V. K. Kothari

Course Outcomes:

After completion of the course, students will be able to:

- implement the Quality parameter in Apparel industry.
- utilize the various tools of Quality control and Inspection systems.
- evaluate the sampling procedure being followed in Garment Industries.
- analyze the contribution of different entities towards Quality control.

Course code	OEC-TT/TC-305G				
Category	Open Elective Course (OEC-II)				
Course Title	Introduction to Fashion and Apparel Industries				
Scheme and Credits	L	T	P	Credits	Semester–V
	3	0	0	3	
Branch	Textile Technology, Textile Chemistry				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Textile Raw Materials, Yarn and Fabric Formation, Apparel Production, Colour & Design Concepts

Course Objectives:

- To understand the elementary knowledge of Indian and global apparel industries.
- To learn the concept of fashion, components of fashion, fashion cycle, fashion theories.
- To gain knowledge of fashion centres, fashion brands.
- To develop skills for application of fashion promotion, information services and communications

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Introduction to Apparel Industry, Indian Apparel industry scenario and its SWOT Analysis, Status of Structure and working flowchart of various departments of a garment production house. Apparel manufacturing countries: their features, level of technology, product mix. Indian apparel industry- challenges & global scenario.

UNIT-II

Fashion terminology, components of fashion, fashion cycle – its phases, Style classification based on fashion cycle - fad/classic, recurring & interrupted cycles, Consumer identification with fashion cycles
- leaders, innovators, followers, victims & laggards. Motives of consumer buying & factors affecting fashion growth & declination. Fashion adaptation theories.

UNIT-III

Major fashion centers of the world: Brief introduction to world fashion centers – Millan, Italy, Paris, Rome, American, European, and Japanese. Who's who of fashion world - national & international designers, their private labels, Luxury brands of apparels & accessories.

General introduction to careers & future opportunities in fashion & apparel sector - export & buying houses, design houses etc.

UNIT-IV

Fashion information services, trend forecasting and auxiliary services. Importance of fashion seasons & fashion calendar in apparel industry.

Introduction to fashion forecasting – significance, purpose of forecasting trends, forecasting tools & techniques and role of fashion forecasters. Fashion promotion and communications - Trade fairs, Fashion shows, exhibitions & promotional events.

Suggested Reading List:

Title	**Author**
The Theory of Fashion Design	H. L. Brockman
Fundamentals of Men's Fashion Design	Masaaki Kawashima
The Clothing Factory, The Clothing Institute	H. C. Carr
Inside the Fashion Business	J. A. Jarnow and B. Judelle
Advertising Handbook	Roger A. Barton
Merchandising of Fashion	Swinney, B. John
Garment Manufacturing Technology	Nayak & Padhey
The Technology of Clothing Manufacture	Carr & Latham
Apparel manufacturing analysis	Jacob Solinger
Apparel manufacturing Handbook	Jacob Solinger
Apparel Manufacturing Technology	Karthik, Ganeshan, Goplakrishnan

Course Outcomes:

After completion of the course, students will be able to:

- understand the fundamentals of fashion and apparel industries.
- analyse the fashion cycles, fad and different styles and fashion theories.
- apply the work of fashion leaders and brands into practice.
- develop fashion promotion and communication skills.

Course code	LC-TT-301G				
Category	Laboratory Course (Professional Core Course)				
Course Title	Spinning Practical-III				
Scheme and Credits	L	T	P	Credits	Semester–V
	0	0	2	1	
Branch	Textile Technology				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic knowledge of drafting, twisting and winding.

Course Objectives:

The objective of this course is to make the student acquainted with,

- passage of material through ring frame, different parts of ring frame and their function.
- transmission of drive to the various parts.
- effect of various process and machine parameters on the performance of ring frame in terms of productivity and quality.
- factors need to be considered for setting of process parameters.
- important parts like ring traveller, spindle, top roller, bottom roller, top arm cradle etc.
- setting and fine tuning of ring frame.
- passage of material through ring twister , different parts of ring twister and their functions

List of Experiments:

1. To study the different zones in a ring frame and passage of material through various zones.
2. Detailed study on different parts of ring frame and their function
3. To study effect of various process and machine parameters on the performance of ring frame in terms of productivity and quality.
4. To study the transmission of drive in ring frame and determination of total draft and distribution of draft, tpi, winding length and delivery speed.
5. To study the drafting system and Top arm of ring frame (K2) PK-235 and roller setting for various fibres.

6. Draw and study the drafting system and Top arm of ring frame G5/1 (R2P X) and roller setting for different type of fibres.
7. Study of various change places in a ring frame K2 and G5/1.
8. Study on adjustment of various setting of ring frame.
9. Study on trouble shooting pertaining to quality and productivity in ring frame.
10. Study on selection of ring and traveller.
11. Draw the passage of material through various zones of ring doubling frame and study functions of various parts of ring doubling frame.
12. Study on trouble shooting pertaining to quality and productivity in doubled yarn.

Course Outcomes:

After completion of the course, students will be able to,

- identify the various parts of ring frame and their functions.
- get an idea regarding the various process and machine parameters of ring frame and their effect on quality and productivity.
- get an idea regarding the setting and fine tuning of ring frame.
- identify the various parts of ring twister and their functions
- understand the working of stop motions in ring twister.
- understand the sources of troubles and their remedial measures in ring frame and ring twister.

Course code	LC-TT-302G				
Category	Laboratory Course (Professional Core Course)				
Course Title	Weaving Practical-III				
Scheme and Credits	L	T	P	Credits	Semester–V
	0	0	2	1	
Branch	Textile Technology				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Fabric Manufacture-I

Course Objectives:
This practical is designed to impart first-hand experience of the features, layout and different motions of shuttleless weaving machines and their settings. It also gives a first-hand experience of in-depth working of projectile weaving machines. It serves as a bridge between theory and practice.

Contents: Study of construction, working and related calculation/settings of shedding (matched cam, electronic dobby and jacquard), beat-up (matched cam, multi-link crank), let-off (positive) and take-up mechanisms used in shuttle-less looms. Projectile loom: study of salient features, construction & working of torsion bar picking mechanism, path of weft, different components in the path and their working, weft transfer, projectile circulation, sequence of weft insertion, timings, related calculations, shedding, beat-up, secondary and auxiliary motions, selvedge mechanism, settings/operation.

List of Experiments:

1. Salient features and layout of different shuttleless weaving machines, production calculations

2. Study of construction, working and related calculation/settings of shedding mechanisms (matched cam, electronic dobby and jacquard) used in shuttleless weaving machines

3. Study of construction, working and related calculation/settings beat-up (matched cam, multi-link crank) used in shuttleless weaving machines

4. Study of construction, working and related calculation/settings take-up mechanisms used in shuttleless weaving machines

5. Study of construction, working and related calculation/settings let-off (positive) mechanisms used in shuttleless weaving machines

6. Projectile Weaving Machine: study of salient features, construction & working of torsion bar picking mechanism, path of weft, different components in the path and their working, weft transfer, projectile circulation, sequence of weft insertion, timings, related calculations, settings/operation.

Course Outcomes:

After completion of the course, students will be able to:

- correlate between theory and practice of the concept of shuttleless weaving
- visualise the layout and structure of shuttleless weaving machines along with their primary components
- visualise the mechanisms of different motions of shuttleless weaving machines and comprehend their settings
- visualise the working of projectile weaving machine and comprehend its settings and operation
- develop practical skills relevant to industrial practice

Course code	LC-TT/TC/FAE-303G				
Category	Laboratory Course (Professional Core Course)				
Course Title	Textile Testing Practical				
Scheme and Credits	L	T	P	Credits	Semester–V
	0	0	2	1	
Branch	Textile Technology, Textile Chemistry, Fashion and Apparel Engg.				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic knowledge of textile fibres, yarns and fabrics, Textile Testing.

Course Objectives:

- To impart first-hand experience of the procedures of basic testing of fiber, yarn, fabric and garment.
- To learn presentation of test results in a suitable manner.
- To impart first-hand experience of test result analysis.
- It serves as a bridge between theory and practice.

List of Experiments:

1. Measurement of trash content in raw cotton
2. Measurement of fiber fineness by whole fiber method
3. Measurement of fiber fineness by airflow method
4. Measurement of fiber length parameters by Baer Sorter
5. Determination of fiber bundle strength using Pressley fiber bundle strength tester
6. Determination of fiber bundle strength using Stelometer
7. Measurement of yarn twist
8. Measurement of linear density of sliver, roving and yarn
9. Measurement of C.S.P value of yarn
10. Measurement of fabric tensile properties
11. Measurement of fabric tearing strength

12. Evaluation of washing and rubbing fastness properties of dyed fabrics

13. Evaluation of seam properties (Seam strength and Seam Slippage)

Course Outcomes:

After completion of the course, students will be able to:

- correlate between theory and practice of the concept of textile testing.
- conduct basic testing of fiber, yarn, fabric and garment.
- present the results in graphical and tabular manner.
- analyze the results from the tests.
- develop practical skills relevant to industrial practice.

Course code	LC-TT-304G				
Category	Laboratory Course (Professional Core Course)				
Course Title	Wet Processing Lab				
Scheme and Credits	L	T	P	Credits	Semester–V
	0	0	2	1	
Branch	Textile Technology				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic knowledge of fibres and their properties

Course Objectives:
This practical is designed to understand the chemical processing (pre-treatment, dyeing/printing and finishing) of various textile materials.

List of Experiments:

1. Desizing of cotton fabric using various types of desizing agents.

2. Scouring of natural fibres in the form of yarn and fabric and find the scouring loss.

3. Scouring of Polyester/ Cotton blend and Wool.

4. Degumming of Silk and calculation of weight loss percentage.

5. Bleaching of natural fibres namely Cotton, Wool with: (a) Hyperchloride Bleaching (b) Peroxide Bleaching

6. Bleaching of Polyester /Cotton blended Fabric.

7. Determination the pH value of a given material.

8. Dyeing of cotton fabric with direct dyes followed by after-treatment.

9. Dyeing of cotton fabric with reactive dyes using different techniques.

10. Dyeing of cotton fabric with sulphur and vat dyes.

11. Dyeing of wool/silk with acid and metal-complex dyes.

12. Dyeing of polyester fabric with Disperse dye.

13. Printing of cotton fabric with direct style of printing using dye.
14. Printing of cotton fabric with resist style of printing.
15. Printing of cotton fabric with discharge style of printing.
16. To do softener finishing of all type of materials using different chemicals.
17. To apply water repellent finish to textile materials.
18. To apply flame retardant finish to textile materials.

Course Outcomes:

After completion of the course, students will be able to:

- perform chemical pre-treatment of various textile materials.
- perform dyeing/printing of various textile materials.
- perform finishing of various textile materials.

PCC-TT-303G Unconventional Systems of Yarn Formation

Course code	PCC-TT-303G				
Category	Professional Core Course				
Course Title	Unconventional Systems of Yarn Formation				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Textile Raw Materials; Yarn Manufacture-I; Yarn Manufacture-II; Yarn Manufacture- III

Course Objectives:

- To familiarize students about the causes for invention of unconventional systems of yarn production
- To familiarize students about classifications of unconventional systems of yarn production
- To make students understand the working principle and engineering design of various parts of rotor spinning
- To make students understand the mechanism of yarn formation on friction and air-jet spinning
- To make students understand the mechanism of yarn formation on other non-conventional systems
- To make students understand comparison of yarn structure and properties spun on different systems
- To make students understand the applications of yarns spun on different systems

NOTE: Examiner will set 9 questions in total, with two questions from each unit and one question covering all sections which will be Q.1. This Q.1 is compulsory and will have 06 parts of 2.5 marks each. The remaining eight questions each of 15 marks are to be set by taking two questions from each unit. Students have to attempt 5 questions in all selecting at least one question from each unit.

UNIT-I

Causes leading to the advent of unconventional systems of spinning; Basic Principle of Open end Spinning systems; Variables for classification of unconventional methods of yarn production; Different Classifications of unconventional methods of yarn production; Principle involved in each group of classification. Introduction to Rotor Spinning

UNIT-II

Principle and Engineering design of various parts of rotor spinning, effect of rotor machine variables and fibre properties on the properties of rotor spun yarns. Limitations of rotor spinning, advances in rotor spinning,

UNIT-III

Study of other spinning systems, viz. Friction and Air-jet etc; Mechanism of yarn formation, Structure, properties and end-uses of yarns spun on these systems, Various developments in these systems

UNIT-IV

Electrostatic, air-vortex, Wrap, Twist less, Self-twist and other non-conventional methods of yarn production: Structure, properties and end-uses of these yarns, Potential and limitations of various spinning technologies

Suggested Reading List:

Title	**Author**
Spinning in 70's	P. R. Lord
Spun Yarn Technology	E. Oxtoby
Short Staple Spinning	W. Klein
Textile Research Journal	
Journal of Textile Institute	
Textile Progress	
NCUTE Publications	

Course Outcomes:

After completion of the course, students will:

- have comprehensive knowledge of various unconventional systems of yarn production
- be able to differentiate the yarns spun on various unconventional systems
- be able to understand the effects of process parameters on structure and properties of yarns spun on unconventional systems
- be able to understand the applications of yarns spun on unconventional systems

Course code	PCC-TT-304G				
Category	Professional Core Course				
Course Title	Advanced Weaving Technology-II				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Advanced Weaving Technology-I

Course Objectives:

- To familiarize the students about the types, mechanism and features of selvedges employed in shuttleless weaving machines
- Understanding the principle, design and mechanism of air jet weaving machines
- Understanding the principle, design and mechanism of water jet weaving machines
- Understanding the concept of multiphase weaving, its advantages and shortcomings
- Understanding the principle, design and mechanism of weft-directional and warp-directional multiphase weaving machines

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Selvedges - Types, mechanism, features

Airjet weaving machine (Part-I): Principle of weft insertion, typical specification & features of modern air jet looms; Merits, demerits and standard application domain; Path of weft, function of each component, sequence of weft insertion, typical timings Types, design, working of accumulators and main nozzles.

UNIT-II

Airjet weaving machine (Part-II): Types of air-guide systems, their design and comparison; Types, spacing, arrangement, blowing action of relay nozzles; stretch nozzle; Air supply to nozzles, blowing sequence and timing control (Automatic Pick Control systems); Calculation of weft velocity, number

of relay nozzles and timings of different nozzles; Quality of air required; Air drag theory, factors affecting air drag force Weft breaks in air jet looms - reason and control devices. Types and features of shedding, beat up, take up and let off motions used in modern air jet looms; standard manufacturers

UNIT-III

Water jet weaving machine: Principle of weft insertion, typical specification & features of modern water jet looms; Merits, demerits and standard application domain; Path of weft, function of each component, sequence of weft insertion, typical timings, calculation of weft velocity; Nozzle and jet pump design, working and settings; Quality of water required, water extraction from fabric in loom. Types and features of shedding, beat up, take up and let off motions used in modern water jet looms; standard manufacturers.

Developments in shuttle less weaving as applicable from time to time

UNIT-IV

Multiphase weaving: Classification: Warp- and weft-directional multiphase looms and their principle

Weft-directional multiphase looms: different methods of shedding, picking and beat-up, advantages and disadvantages; Circular looms – classification, working, uses and limitations.

Warp-directional multiphase looms: Principle of drum type weaving machines; Sulzer M8300 – specification, features, working, advantages and limitations.

Suggested Reading List:

Title	**Author**
Handbook of Weaving	S. Adanur
Weaving: Technology & Operations	A. Ormerod
Weaving: Machines, Mechanisms, Management	Talukdar,
Sriramulu, Ajgaonkar Principles of Weaving	R. Marks & A. T.
C. Robinson	

Course Outcomes:

After completion of the course, students will be able to:

- understand the types and mechanism of selvedges formed in shuttleless weaving machines
- comprehend the design and mechanism of air jet and water jet weaving machines
- comprehend the concept, design and mechanism of multiphase weaving machines

Course code	PEC-TT-304G				
Category	Professional Elective Course (PEC-II)				
Course Title	Mechanics of Textile Machinery				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic mathematics, basic physics, yarn manufacture-I and fabric manufacture-I.

Course Objectives:

- To familiarize the students about the basic elements used in textile machinery.
- To familiarize the students about the basic functioning of textile machinery.
- Understanding the principle of design of textile machinery

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Simple harmonic motion: Properties of S.H.M. Simple Pendulum, Laws of simple pendulum, Compound Pendulum, Centre of Percussion. Application of S.H.M in textile machinery.

Flexible drives: Types of belts, Material used for belts, Velocity ratio of belt drive, Length of belt drive, Power transmitted by a belt, Chain drives.

Toothed Gearing and gear trains: Classification of gears, Terms used in gears. Types of gear trains, Velocity Ratio of gear trains, Applications of epicyclic gear trains in textile machinery.

UNIT-II

Machine Balancing: Concept of static and dynamic balancing, balancing of rotating masses, balancing of reciprocating masses.

Machine vibration: Introduction. Terms used in vibratory motion, Types of vibratory motion, Types of free vibrations, Natural frequency of free longitudinal, transverse and torsional vibrations, Effect of inertia of the constraint in longitudinal and transverse vibrations.

The physics and theory of spinning balloon, Yarn tension in ring spinning

UNIT-III

Introduction to Brakes and clutches: Types of brakes and clutches for the use in textile machinery.

Bearings: Sliding contact bearings, friction in journal bearings, Classification and use of ball and roller bearings, Equivalent bearing load and load-life relationship, Type of Bearings used in various stages of textile machinery

Types of cams and followers, cam terminology, types of motion of the follower, analysis of motion of the follower for cams with specified contours, Design of cam and tappet profiles for textile machinery.

UNIT-IV

Mechanics of Winding tension and tension variation and other weaving preparatory mechanisms, Velocity profile of shuttle during acceleration and retardation, picking force, Kinematics of sley for shuttle and shuttle less looms, Warp and Fabric Tension under Normal and Bumping conditions and their measurement, Excess tension theory, Power requirements for operating various motion and for machines as a whole, at various stages of weaving.

Suggested Reading List:

Title	**Author**
Theory of machines	R. S. Khurmi
and J. K. Gupta Textile Mathematics Vol. 1, 2 and 3	J. E. Booth
Principles of Mechanism	F. Dyson
Mechanics for Textile Students	W. A. Hanton
Principles of Weaving	Marks & Robinson
Mechanisms of Weaving	W. T. Fox

Course Outcomes:

After completion of the course, students will be able to:

- understand the concept of basic machine functioning
- able to design the basic machine elements
- comprehend the maintenance of textile machinery

Course code	PEC-TT-305G				
Category	Professional Elective Course (PEC-II)				
Course Title	Structure and Properties of Fibres				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology, Textile Chemistry				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic knowledge of fibres

Course Objectives:

After completion of the course, students will be able to:

- understand the morphological structure of fibre
- get familiarized with the properties of the fibre to suit their applications
- appreciate mechanism of absorption of moisture in fibres and their effects
- understand thermal and optical properties of fibre

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Theories of fine structure of fibres; Methods of determination of molecular structures, crystallinity and orientation, crystal size etc. by X-Ray methods; Stress-strain, creep and stress-relaxation of fibres, Simple spring and dashpot models simulating fibres.

UNIT-II

Absorption of moisture in fibres, hysteresis. Quantitative theories of absorption, Pierce's theory, Fick's laws of moisture diffusion; Retention of liquid water; Swelling; Heat of sorption.

UNIT-III

Optical properties: Polarization and refractive index, Birefringence and its measurement.

Thermal properties: Molecular motions and transition phenomenon, First order and second order transition phenomenon, Concept of heat setting and pleating, Measurement of specific heat of fibres

UNIT-IV

Electrical properties: Di-electric properties and its measurement, Effect of frequency and temperature on dielectric constant, Electrical resistance of fibres and its measurement, Static electricity and measurement of static charge in fibres.

Frictional properties of fibres – nature and measurement.

Suggested Reading List:

Title	**Author**
Physical properties of fibres	Morton and Hearle

Course Outcomes:

After completion of the course, students will be able to:

- understand the fine structure of the fibres which is an essential tool to predict properties of fibres.
- assess various aspects of structure of fibre.
- blend different fibres to suit for various uses.
- understand the scope and limitations to improve structure and properties of synthetic fibres.

Course code	PEC-TT-306G				
Category	Professional Elective Course (PEC-II)				
Course Title	Wool Technology				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Textile Raw Material, Yarn Manufacture-I; Yarn Manufacture-II: Yarn Manufacture- III

Course Objectives:

- To familiarize the students with an understanding of the basic structure, physics and chemistry of the wool fibre.
- To make the students understand basic mechanisms involved in woolen and worsted system of yarn formation.
- To make students learn about new and innovative product with wool and their application.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-1

Wool Fibre Science - Wool and other animal fibre, Process of harvesting wool (shearing, classing, baling and transport), Testing procedures carried out on raw wool to determine its value, Structure of wool fibre, Physics and chemistry of wool fibre, Setting of wool fibre, Shrinkage of wool products, Benefits of wool.

Wool scouring - Aims and objectives of scouring, Characteristics of wool contaminants, The machinery used for scouring, the issues affecting product quality, Recovery of wool grease, impact of scouring quality on downstream processing.

UNIT-II

Various systems of wool fibre spinning - woollen, semi worsted and worsted system - Flow chart. Woolen spinning system - woolen cards, woolen ring frame. Semi worsted spinning system - sequence of machines and their operations.

UNIT-III

Worsted top making - Worsted carding, Drafting and Gilling, Combing, Quality assurance of wool top, Treatment of wool top.

Worsted spinning system - Preparation of top for worsted spinning, Worsted ring spinning, Variation and alternatives for worsted ring spinning, Post spinning operations. Quality assurance in worsted and woolen spinning operations.

UNIT-IV

New wool products and applications, Improving the whiteness and photostability of wool, Enhancing wool products using nanotechnology, Wool performance apparel for sport, High-performance wool blends; Intelligent wool apparel, Application of wool keratins ranging from industrial materials to medical devices.

Suggested Reading List:

Title	**Author**
Wool Hand Book Vol. II	Werner Von Bergei
British Wool Manual	H. Spibey
Advances in Wool Technology	N. A. G. Johnson and I. M. Russell
Woollen Spinning	C. Vickerman
Wool: Science and Technology	W. S. Simpson and G. H. Crawshaw
Woollen and Worsted Spinning	Abhishek Publications, Chandigarh-17
Wool Spinning Vol. I, II.	Ya. Lipenkov

Course Outcomes:

At the end of the course, the students will:

- understand the structure, physics and chemistry of wool fibre and the relationship between the structure and properties of the fibre.
- have detail knowledge about how wool is manufactured from a greasy raw fibre into worsted and woollen yarns.
- be aware about innovations in wool and how these can be used to design different products made from wool.

Course code	PEC-TT-307G				
Category	Professional Elective Course (PEC-III)				
Course Title	Engineering of Textile Structures				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Yarn Manufacture-I and II, Fabric Manufacture-I, Weaving Preparation

Course Objectives:

- To familiarize the students about the utility of yarn geometry.
- To familiarize the students about yarn performance for designing.
- Understanding the basic aspects of fabric designing.
- Understanding the principle, design and mechanism of fabric response to mechanical forces.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Yarn Geometry- Idealized yarn geometry, relationship of yarn number and twist factor. Twist contraction, Limit of twist.
Ideal packing of fibers in a yarn: Open Packing, Hexagonal packing and deviations from ideal forms.

Fiber Migration- Mechanism of migration, Condition for migration to occur, Characterization of fiber migration and experimental set up for study of migration.

UNIT-II

Theory of the extension of continuous filament yarns: Simplest analysis of tensile behavior, Analysis of large extension, analysis with transverse forces and lateral contraction, Prediction of yarn breakages.

Strength of yarn spun of fiber blends: Strictly similar yarns, Hamburger model.

UNIT-III

Elements of fabric geometry: Ashenhurst's theory and its application, The geometry of Plain woven fabrics (Peirce's model), Peirce's approximation theory, Jammed structures, Fabric cover, cover factor and their significance, Relationships between cover and mass per unit area of fabric, Crimp interchange equation.

UNIT-IV

Geometrical changes during tensile loading: Determination of Poisson's ratio and modulus.

Fabric geometry of non-circular cross-sections: Kemp's Race track theory, Peirce's elliptical model.

The yarn path in woven fabrics and inter-yarn forces (Peirce's rigid thread model) and Application of Peirce's geometry for other weaves.

Suggested Reading List:

Title	**Author**
Structural mechanics of fibers, yarns, and fabrics	J. W. S. Hearle, P. Grosberg, S. Backer
The structure of yarn	W. Zurek
Structure and Mechanics of textile fibrous assemblies	P. Schwartz
Cloth Geometry	F. T. Peirce, J. R. Womersley (Journal of the Textile Institute Transactions, 1937, pp. T45- T112)
Woven textile structure, Theory and applications	B. K. Behera, P. K. Hari

Course Outcomes:

After completion of the course, students will be able to:

- understand the concept of yarn geometry and the arrangement of fibers inside the yarn
- predict the mechanical response of yarn
- comprehend the design of fabric using fabric geometry

Course code	PEC-TT-308G				
Category	Professional Elective Course (PEC-III)				
Course Title	Modeling and Simulation of Fibrous Assemblies				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Mathematics-I**,** Applied statistics and operation research, Fabric Manufacture-I, Yarn Manufacture-I.

Course Objectives:

- To familiarize the students about the utility of models
- To familiarize the students about the simulation techniques for fibrous assemblies.
- Understanding the basic aspects of probability theory and its application in random fibrous assemblies
- Understanding the principle and mechanism of heat and fluid flow in fibrous assemblies

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

The Modeling and Simulation Process: Opening Perspectives, Role of modeling and simulation, Nature of a model, Types of models, Concept of simulators. The observation interval, Entities and their interactions, Time and other variables. Poisson's process, Markov process and Markov chain.

UNIT-II

Stochastic Model: Basics of probability tools; Stochastic independence; Expectations of random variables; Probability distribution functions; Application for random fibrous assemblies, anisotropy characteristics in fibrous assemblies, two and three dimensional fibrous assemblies.

Curve fitting techniques: Linear and nonlinear curve fitting techniques; Prediction of mechanical properties of fibrous assemblies, process-structure-property relationship of fibrous structures.

UNIT-III

Fluid Dynamics: Fluid and its characteristics; One, two and three dimensional flows; Concept of Newtonian and Non-Newtonian Fluids and their applications in extrusion processes; Concept of fluid flows through porous materials, heat and mass transfer in fibrous assemblies; Concept of basic flow analysis techniques.

Finite Element Analysis: Basic concept of the finite element and finite difference method; A general procedure for finite element analysis; Application of one dimensional conduction problem.

UNIT-IV

Simulation: Simulation models; Monte Carlo simulation and its application for random fibrous assemblies; Application of simulation using Matlab.

Multiscale Modeling: Geometrical modeling of textile structures; Prediction of properties of fibrous assemblies. Predictions of fabric drape using polar co-ordinate model.

Suggested Reading List:

Title	**Author**
Structure and Mechanics of textile fibrous assemblies	P. Schwartz 3-D fibrous
assemblies	Jinlian Hu
Engineering textiles	Y. E. Ei Mogahzy
Probaility, Random variables and stochastic processes	A.
Papoulis, S. U. Pilai The structure of yarn	W.
Zurek	
Cloth Geometry	F. T. Peirce & J.
R. Womersley (Journal of the Textile Institute Transactions, 1937, pp. T45- T112)	
Woven textile structure, Theory and applications	B. K. Behera & P. K. Hari

Course Outcomes:

After completion of the course, students will be able to:

- understand the concept of models and the application in fibrous assemblies
- predict the mechanical response of fibrous assemblies
- comprehend the fabric design using simulation

Course code	PEC-TT-309G				
Category	Professional Elective Course (PEC-III)				
Course Title	Sustainable Textile Production				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Textile Raw Material, Yarn Manufacture, Fabric Manufacture, Garment Manufacturing

Course Objectives:

- This subject will aware on the varied environmental challenges of our time and develop practical and sustainable solutions.
- This subject will also help to understand the consumption of energy at different levels of textile production.
- This subject will helps to learn the environmental aspect of energy sources developed, leveraged, regulated, and financed while assessing trends in energy and cultivating sound environmental policies.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Sustainability: Definition, Overview of energy consumption pattern and its assessment, Assessment of environmental impacts, Concept of greenhouse gas emission and its impact on environment.

Renewable energy: Fossil fuel based energy and its impact on environment, Renewable energy sources and its future prospect.

UNIT-II

Sustainability in yarn manufacturing: Environmental impact of yarn manufacturing, Sustainable practices at different stage of yarn manufacturing, Sustainability for ring, rotor and air-jet spinning system, Waste management in spinning, recent trends in energy usages.

Sustainability in fabric manufacturing: Energy consumption in fabric manufacturing, Energy conservation techniques in fabric manufacturing, Noise pollution and its control in fabric manufacturing, Solid waste problem, Wastewater generation and its control in fabric manufacturing.

UNIT-III

Sustainability in textile chemical processing: Textile dyes used in the textile chemical processing and its impact on environment, Energy consumption in textile chemical processing, Sustainable approaches in effluent treatment.

Sustainability in garment manufacturing: Energy consumption in different phase of garment manufacturing, circular economy in fashion, Garment life cycle.

UNIT-IV

Recycling of textile products: Quantity of waste generated from the textile industry, Textile waste management, Current situation of textile recycling (global scenario), Textile recycling technologies, Factors influencing fabric waste recycling process, Fabric wastes valorization, Challenge of textile recycling.

Sustainable raw materials: Ecological footprint of the fibers, Sustainable raw materials, Recycling of plastics into textile raw materials and products.

Suggested Reading List:

Title	**Author**
Sustainable Technologies for Fashion and Textiles, Woodhead	R. K. Nayak
Principles of Sustainable Energy, CRC Press, 2011.	F. Kreith
and J. Kreider Sustainable Fibres and Textiles, Woodhead, UK	S. Muthu

Course Outcomes:

After completion of the course, students will be able to:

- understand the concept of environmental problems due to the manufacturing of textile products.
- learn the power consumption pattern in different stages in apparel production.
- comprehend the waste management skills and recyclability of the textile products.

Course code	OEC-TT-306G				
Category	Open Elective Course (OEC-III)				
Course Title	Advanced Textile Testing				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Textile Testing.

Course Objectives:

- To familiarize the students about statistical techniques relevant to testing and quality control.
- To familiarize the students about commonly used advanced testing equipment related to fibre and yarn testing.
- Comprehending the concept of fabric handle and clothing comfort and their assessment methods.
- To familiarize the students about specific tests like fabric dimensional stability, water absorbency and repellency, and flammability.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Significance testing of means and dispersion, determination of number of tests, test of goodness of fit. Analysis of Variance: Introduction, One-way and Two-way analysis of variance.

Statistical quality control: concept of control chart, definition of limits, interpretation of control charts; $\bar{X}$-chart, R-chart, np-chart, p-chart and c-chart.

UNIT-II

Principle and working of advanced testing instruments related to fibre and yarn testing.

Flammability testing of fabrics: importance, terms and definitions related to flammability properties of textile materials, standard test methods.

UNIT-III

Fabric dimensional stability: Types of fabric dimensional changes and measurement methods.

Fabric Handle: Concept of fabric handle; Subjective evaluation of fabric handle – Primary Hands and Total Hand Value; Objective evaluation of fabric handle: Kawabata Evaluation System for Fabrics – different instruments, parameters measured and analysis of data, primary hand values and total hand value; FAST system – different instruments/method and measured/calculated parameters.

UNIT-IV

Thermo-physiological clothing comfort: Concept and different aspects of thermo-physiological comfort. Thermal properties of fabrics – terms and definitions, principle of operation of standard instruments like togmeter, guarded hot plate, sweating guarded hot plate, thermal and sweating thermal manikins. Liquid moisture transport through fabrics – concept and importance of wicking, longitudinal and transverse wicking and their measurement methods.

Water absorption and water repellency: importance and common measurement methods.

Suggested Reading List:

Title	**Author**
Physical Testing of Textiles	B. P. Saville
Fabric Testing	Jinlian Hu
Advanced Characterization and Testing of Textiles	Dolez,
Vermeersch & Izquierdo Principles of Textile Testing	J. E. Booth

Statistics for Textile Engineers J. R. Nagla Practical Statistics for the Textile Industry, Vol-I & II G. A. V. Leaf

Course Outcomes:

After completion of the course, students will:

- be able to apply common statistical methods to analyse test data.
- be familiar with the working of common advanced testing instruments related to fibre and yarn testing.
- be familiar with the concept of fabric handle and clothing comfort and their assessment.
- be familiar about specific tests like fabric dimensional stability, water absorbency and repellency, and flammability.

Course code	OEC-TT-307G				
Category	Open Elective Course (OEC-III)				
Course Title	Statistics for Textile Engineers				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Applied Statistics & Operation Research, Textile Testing.

Course Objectives:

- To familiarize the students about the application of statistics in textile industry.
- To familiarize the students about statistical quality control.
- Understanding the basic aspects of sample collection for fabric development.
- Understanding the principle of statistics for the experimental designs.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Basic Statistics: Nature of textile industry, Need for SQC techniques, Methods of data collection, Classification and graphical representations, Measures of central tendency, Measures of dispersion.

Population and Sample: Sampling, Random Samples, Random Numbers, Population Parameters, Sample Statistics, Sampling Distributions, The Sample Mean, Sampling Distribution of Means, Sampling Distribution of Proportions, Sampling Distribution of Differences and Sums, The Sample Variance, Frequency Distributions, Relative Frequency Distributions.

UNIT-II

Curve Fitting, Regression, And Correlation: The Method of Least Squares, The Least-Squares Line, The Least-Squares Regression Line in Terms of Sample Variances and Covariance, Standard Error of Estimate, The Linear Correlation Coefficient, Generalized Correlation Coefficient, Correlation and Dependence.

UNIT-III

Probability Distributions: Multinomial Distribution, Hypergeometric Distribution, Uniform Distribution, Cauchy Distribution, Gamma Distribution, Beta Distribution, Chi-Square Distribution, Student's t Distribution, F Distribution, Relationships among Chi-Square, t, and F Distributions

Analysis of Variance: Introduction, One-way analysis of variance, Two-way analysis of variance.

UNIT-IV

Design of Experiments: Concept of Design of Experiments, Completely randomized design, Randomized block design, Latin square design, Factorial experiments.

Statistical Quality Control: Significance of Control Charts, Process control, Control chart, Interpretation of control chart, Specification limits, X chart, R Chart, np Chart, p Chart, c chart; applications of control chart in textile industry.

Suggested Reading List:

Title	**Author**
Statistics for Textile Engineers	J. R. Nagla Practical Statistics for the Textile Industry, Vol-I & II G. A. V. Leaf
Applied Statistics and Probability for Engineers	D. C. Montgomery
& G. C. Runger Modern Engineering Statistics	Thomas P. Ryan

Course Outcomes:

After completion of the course, students will be able to:

- understand the concept of statistical methods used in quality control.
- design experiments for collection of data.
- comprehend the statistical approach for product development and design.

Course code	OEC-TT-308G				
Category	Open Elective Course (OEC-III)				
Course Title	Total Quality Management and Six Sigma				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Branch	Textile Technology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic concept of management and statistics

Course Objectives:

The objective of this course is to

- impart knowledge about quality management system standard and its requirements.
- familiarize the student on quality audit and preparation of audit report.
- familiarize the student on concept of TQM and TQM tools.
- impart knowledge on Six Sigma and its statistical implication.
- make the student understand the methodology in Six Sigma implementation through D.M.A.I.C approach.
- impart knowledge about Failure Modes and Effects Analysis (F.M.E.A) and determination of R.P.N.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Concept of Quality and Quality Management System (Q.M.S); Overview of Quality Management System Standards. Formulation of Quality Plan in textile industry. Implementation procedure of Q.M.S in an industry. Documentation of quality management system and preparation of Quality manual. Definition of Quality Audit. Procedure of conducting quality audit; Preparation of Audit Report. Benefits of implementing Quality Management System in an organization.

UNIT-II

Concept of Total Quality Management (T.Q.M.). Evolution of T.Q.M. Different views on TQM. Importance of cost of quality. T.Q.M tools example, Quality circle, 5S, J.I.T, Kaizen Concept of Environment Management System (EMS) and its importance in an organization. Method of implementing E.M.S.

UNIT-III

Evolution of Six Sigma concept in industry. Statistical concept of Six Sigma. Key Concepts of process management. Measurement of Process Performance. Causes of variation of output of a process. Determination of Potential process capability index (Cp) and Process capability index (Cpk). Relationship between Cp, Cpk and Sigma level. Idea on C.T.Q. Unified quality level for multi- characteristics rolled throughput yield (RTY). Determination of CTQ. Determination of defects per unit *(*DPU) and defects-per- million opportunities (DPMO).

UNIT-IV

Elements of the Six Sigma framework. Importance of top management commitment and stakeholder's involvement in six sigma. Important methodology in Six Sigma management D.M.A.I.C approach. Activities designing for six sigma. Flow chart and process mapping. Quality function deployment (Q.F.D). Failure modes and effects analysis (F.M.E.A) and determination of R.P.N. Keys for Six Sigma Success.

Suggested Reading List:

Title	**Author**
Total Quality Management	P. N. Mukherjee
Total Quality Management	B. Vijaya Ramnath & R. Kesavan,
Six Sigma for Quality and Productivity	Sung H. Park
ISO series of Standard on Quality management system	International Organization for Standardization

Course Outcomes:

After completion of the course, students will be able to:

- understand the concept of Quality and Quality management system requirements
- understand the concept of Total Quality Management
- get an idea on Six Sigma and its methodology to implement
- understand the methodology in Six Sigma implementation through .D.M.A.I.C approach
- carry out Failure Modes and Effects Analysis (F.M.E.A) and determination of R.P.N

Course code	HSMC-TT/TC/FAE-301G				
Category	Humanities and Social Sciences including Management Courses				
Course Title	Merchandising and Export Management				
Scheme and Credits	L	T	P	Credits	Semester–VI
	3	0	0	3	
Branch	Textile Technology, Textile Chemistry, Fashion and Apparel Engg.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Basic concept of management

Course Objectives:

- To make the students acquainted with various concepts of marketing and different aspects pertaining to marketing which include market segmentation, product life cycle, various stages involved in new product development.
- To make them understand the various pricing strategy and functions of distribution channel.
- To make them understand the importance of export.
- To familiarize them on export procedure, export terms of payment and final assistance provided by government.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 06 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Fundamental idea and basic terms and definition in marketing. Definition of marketing. Explanation of various concept of marketing with examples. Types of Marketing: Target marketing and Mass Marketing. Market segmentation. Classification of market based on size. Various stages of new product development and product life cycle.

UNIT-II

Concept and definition of Marketing mix. Variables of market mix: 4Ps Product, Price, Promotion and Place. Distribution channels and various functions performed by the distribution channel. Logistics and its relevance. Promotion mix: various kinds of promotion mix; their scope of applications and their

relative merits and demerits. Various factors need to be considered while deciding the price. Pricing decision and strategy.

UNIT-III

Export Management–importance of export. Risk involved in export and remedial measures. Various kind of terms of payment and their relative merits and demerits. Various kinds of document to be prepared and maintained for export. Various steps involved in Export Assistance given for export. Pre shipment and post shipment finance. Common incoterms.

UNIT-IV

Concept and definition of Merchandising. Utility and obsolescence factors in merchandising. Essential qualification criteria of a merchandiser. Types of merchandising. Roles of a merchandiser in an apparel industry. Various activities involved in merchandising: Line Planning, Line Development and Line presentation. Different types of sampling and their importance. Visual Merchandising. Elements of interior, exterior window display, store planning and layout-fixtures, location. Different types of sampling and their importance in merchandising. Brand building: Introduction, strategies, brand expansion, global trends. Introduction to customer relationship.

Suggested Reading List:

Title	**Author**
Marketing Management	Phillip Kotlar
Nabhi's Publication on Export	Govt. Handbook
International Marketing	Hess and Cateora
Export Management	B. S. Rathore

Course Outcomes:

After completion of the course, students will understand:

- the concept of marketing and marketing mix
- the importance and functions of distribution channel
- the use of different promotional tools and their scope of applications
- the various documents required for commercial and legal purpose
- financial assistance provided by government to the exporters and different modes of terms of payment in export business.

Also, the students will be exposed to different components of fashion merchandising and activities involved in product line planning, development and presentation and use of different types of samples during merchandising.

Course code	LC-TT-305G				
Category	Laboratory Course (Professional Core Course)				
Course Title	Spinning Practical-IV				
Scheme and Credits	L	T	P	Credits	Semester–VI
	0	0	2	1	
Branch	Textile Technology				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Yarn Manufacture-III, Spinning Practical-III

Course Objectives:
This practical is designed to impart first-hand experience of change places/features of the latest machineries. This course will also enable to comprehend issues as regards increasing realisation % of output material by controlling waste, determining workload of workers, improving efficiency of machines. The course is also designed to make the students help to understand the causes of faults and their remedies.

Contents: Study of drafting, twisting and winding operations of rotor and air-jet spinning machines; Familiarity with established processing parameters for producing carded, combed, blended, folded and fancy yarns.

Case studies pertaining to waste analysis, estimation of the total productivity, actual efficiency levels and causes of loss of efficiency in different spinning preparatory departments, viz. blowroom, card, comber, draw-frame and simplex; Study of blow-room and card performance; Nep count in card web; Checking of comber waste.

Assessment and control of variability before yarn formation, Practice in handling and setting of the various spinning preparatory machines; Workload measurements in spinning preparatory; Oiling and maintenance schedules; Idea of time and motion study.

List of Experiments:

1. To calculate the number of spinning preparatory machine, workers & accessories required to produce a given quantity of yarn per day.
2. To find out the waste % & its distribution being extracted in a blow-room line in any mill.

3. What is meant by nep count? To find out nep count for two different materials running on four different cards.

4. To estimate the performance of a card in terms of fibre breakage rate.

5. To set the comber for a given noil %.

6. Study of drafting, twisting & winding of Rotor and Airjet spinning machines.

Course Outcomes:

After completion of the course, students will be able to:

- develop ideas to solve burning issues in mills.
- set up machine and process parameters to handle the real problems on shop floor.
- enhance quality of the output material along with productivity.

Course code	LC-TT-306G				
Category	Laboratory Course (Professional Core Course)				
Course Title	Weaving Practical-IV				
Scheme and Credits	L	T	P	Credits	Semester–VI
	0	0	2	1	
Branch	Textile Technology				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Fabric Manufacture-III; Weaving Practical-III

Course Objectives:
This practical is designed to impart first-hand experience of the features and in-depth working of rapier, air jet and water jet weaving machines. It also imparts first-hand experience of different selvedge mechanisms. It serves as a bridge between theory and practice.

Contents: Rapier loom: study of salient features, path of weft, different components in the path and their working, weft transfer at shed center, timings, rapier displacement curves, related calculations, colour mixing, rapier drive, settings/operation.

Air jet loom: study of salient features, path of weft, different components in the path and their working, air supply, timings, related calculations, settings/operation.

Water jet loom: study of salient features, path of weft, different components in the path and their working, jet pump and nozzle, timings, related calculations, settings/operation.

Different selvedge mechanisms used in shuttleless weaving machines and their construction, working and structure.

List of Experiments:

1. Rigid Rapier weaving machine: study of salient features, path of weft, different components in the path and their working, weft transfer at shed center, timings, rapier displacement curves, related calculations, colour mixing, rapier drive, settings/operation.

2. Flexible Rapier weaving machine: study of salient features, path of weft, different components in the path and their working, weft transfer at shed center, timings, rapier displacement curves, related calculations, colour mixing, rapier drive, settings/operation.

3. Air jet weaving machine: study of salient features, path of weft, different components in the path and their working, air supply, timings, related calculations, settings/operation.

4. Water jet Weaving Machine: study of salient features, path of weft, different components in the path and their working, jet pump and nozzle, timings, related calculations, settings/operation.

5. Study of construction, working and structure of selvedge mechanisms used in shuttleless weaving machines.

Course Outcomes:

After completion of the course, students will be able to:

- correlate between theory and practice of the concept of rapier, air jet and water jet weft insertion mechanisms.
- visualise the working of rapier, air jet and water jet weaving machines and comprehend their settings and operation.
- visualise the mechanisms of different selvedge formation techniques.
- develop practical skills relevant to industrial practice.

Course code	LC-TT-307G				
Category	Laboratory Course (Professional Core Course)				
Course Title	Pattern Making and Garment Construction Lab.				
Scheme and Credits	L	T	P	Credits	Semester–VI
	0	0	2	1	
Branch	Textile Technology				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Pre-requisites: Textile raw materials, yarn formation, woven & knitted fabrics.

Course Objectives:
This Laboratory course is designed to impart first-hand experience of features, layout, mechanisms of pattern making, and sewing machines their settings. It also helps students practically understand in- depth working of basics of sewing operations and stitching of garments.

Contents: Introduction to garment manufacturing steps, different work aids, tools and equipments commercially used in pattern making &garment construction– functions and applications.

Overview of different pattern types – sloper, design pattern, production pattern & drafting of patterns - child's basic block, adult bodice blocks, sleeves as set-in, puff, raglan, flared,leg'o'mutton, & collars as peter-pan, sailor, mendarin and shirt collars.

Preparation of pattern layout for different fabric types- directional, symmetrical, asymmetrical and plaids.

Functions and components of sewing machineries, thread passage, sewing elements – needle, sewing thread and packages, practice working of SNLS machine on paper & fabric.

Identification of different seam & stitch classes & sample preparation. End article development using machine stitches & seams.

Application of different trims and components - identification & designing using different trims & notions.

An overview of fusing and pressing equipment in apparel industry.

List of Experiments:

1. Study of sewing machines.

2. Study of different sewing machine parts.
3. Study of sewing machine setting, SPI.
4. Study of Basic blocks.
5. Developing basic blocks.
6. Adapting basic blocks.
7. Identification of fitting problems.
8. Drafting of flat patterns.
9. Construction of flat patterns of different sizes.
10. Designing of different garments.
11. Construction of garments – men's wear, women's wear, kid's wear.
12. Handling of different fabrics.
13. Analysis of different garments.
14. Study of different parts of garments.
15. Study of different operational stitches of garments.
16. Study of Sleeves.

Course Outcomes:

After completion of the course, students will be able to:

- understand practically the concepts of basic blocks and developing blocks.
- prepare patterns for garment construction.
- analyse garments and different parts of garments.