DKTE Society's

TEXTILE & ENGINEERING INSTITUTE

Rajwada, Ichalkaranji - 416115

(An Autonomous Institute)

DEPARTMENT: TEXTILES

CURRICULUM

M. Tech. (Textile Technology)

First Year

With Effect From

2017-18

DKTE

Promoting Excellence in Teaching
Learning & Research

M. Tech. (Textile Technology) Semester-I – Structure

Sr. No.	Course Code	Name of the Course	Group	Teaching Scheme				Credit
				Theory Hrs / week	Practical Hrs / week		Total	
1	TTL530	Yarn Manufacturing Technology -I	D	3			3	3
2	TTL531	Fabric Manufacturing Technology -I	D	3			3	3
3	TTL532	Theory of Textile Structures	D	3			3	3
4	TTLEL1	Elective- I	D	3			3	3
5	TTLEL2	Elective - II	D	3			3	3
6	TTD541	Mini Project -I	F		7*		7	7
Total				15	7		22	22

* Mini project involves field trials, trial and error, experimental work, hence it is considered as full credit

List of Electives -I

TTL533 Textile Reinforced Composites Materials (TRCM)
TTL534 Engineering of Apparel Fabrics and Garments
TTL535 Nano Fibre Technology
TTL536 High Performance Fibres

List of Electives -II

TTL537 Advanced Computer Programming and Applications
TTL538 Polymer and Fibre Chemistry:
TTL539 Specialty Yarns
TTL540 Technical Textiles

M. Tech. (Textile Technology) Semester - II – Structure

Sr. No.	Course Code	Name of the Course	Group	Teaching Scheme				Credit
				Theory Hrs / week	Practical Hrs / week		Total	
7	TTL542	Yarn Manufacturing Technology -II	D	3			3	3
8	TTL543	Fabric Manufacturing Technology -II	D	3			3	3
9	TTL544	Design of Experiments & Statistical Applications in Textiles	A	3			3	3
10	TTLEL3	Elective - III	D	3			3	3
11	TTLEL4	Elective - IV	D	3			3	3
12	TTD553	Mini Project -II	F		7*		7	7
Total				15	7		22	22

* Mini project involves field trials, trial and error, experimental work, hence it is considered as full credit

List of Electives -III

TTL545 Geo-Textiles &geo-synthetics
TTL546 Advanced Textile Material Engineering
TTL547 Clothing Science
TTL548 Project Preparation, Appraisal & Implementation

List of Electives -IV

TTL549 Smart Textiles
TTL550 Narrow Fabrics
TTL551 Non Woven Technology
TTL552 Computer Aided Fabric Manufacturing:

M. Tech. (Textile Technology) Semester - III – Structure

Sr. No.	Course	Name of the Course	Group	Teaching Scheme				Credit
				Theory	Tutorial	Practical		
				Hrs / week	Hrs / week	Hrs / week	Total	
1	TTD601	Dissertation Phase 1	F	--	--	20*	20	20
Total				--	--	20	20	20

* Dissertation involves field trials, experimental work, hence it is considered as full credits

M. Tech. (Textile Technology) Semester - IV – Structure

Sr. No.	Course	Name of the Course	Group	Teaching Scheme				Credit
				Theory	Tutorial	Practical		
				Hrs / week	Hrs / week	Hrs / week	Total	
1	TTD602	Dissertation Phase 2	F	---	---	28*	28	28
Total				---	--	28	28	28

* Dissertation involves field trials, experimental work, hence it is considered as full credits

M. Tech. (Textile Technology)
Differences in the University and Autonomy syllabus-structure

Shivaji University Subject Name	**Autonomy Subject Name**	**Remarks/ Major changes in Syllabus**
First Year Semester-I		
Advances in Yarn Manufacturing Technology-I	Yarn Manufacturing Technology-I	This subject consists of research and developmental concepts of basic yarn manufacturing process, which is important for imparting advanced knowledge in the subject. Therefore, same subject is maintained in autonomy structure with minor modification in the nomenclature.
Advances in Fabric Manufacturing Technology-I	Fabric Manufacturing Technology -I	This subject consists of research and developmental concepts of basic Fabric manufacturing process, which is important for imparting advanced knowledge in the subject. Therefore, same subject is maintained in autonomy structure with minor modification in the nomenclature.
Theory of Textile Structures – I	Theory of Textile Structures	In the university syllabus of this subject, emphasize was on the basic concepts of fiber and yarn structures, which generally was studied by students at undergraduate level. So,in autonomy structure, to impart higher and more relevant level of knowledge of textile structures in one subject, majority of content of part two of this subject(second sem) is combined and introduced as a single subject.
Elective-I 1. High Performance Fibres 2. Technical Textiles	Elective –I 1. Tex. Reinforced Composite Materials 2. Engg of Apparel Fab and Garments 3. Nano Fibre TECH 4. High Performance Fibres	In university structure, number of electives were limited to only two. But, in autonomy structure, four subjects will be available for students to choose. The more relevant subjects such as composites, nano fibres and garment tec. are also introduced in the electives of autonomy structure.
Advanced Computer Applications In Textiles	Elective –II 1. Advanced Computer Programming and Applications 2. Polymer and Fibre Chemistry:	In university syllabus, there was no concept of elective – II, and students were required to study Advanced Computer Applications In Textiles subject compulsorily. However, in autonomy structure, more options are available for students in elective –II. In elective –II also, earlier important subjects such as comp. programming

	3. Speciality Yarns 4. Technical Textiles	and technical textiles are retained.
Seminar-I	Mini Project -I	Mini project concept is introduced in autonomy structure and has replaced earlier seminar. Mini project imparts more exposure to the experimental work and students will have good knowledge of conducting experiments. Earlier seminar was giving only theoretical exposure to students.
First Year Semester-II		
Advances In Yarn Manufacturing Technology-I	Yarn Manufacturing Technology-I	This subject consists of research and developmental concepts of basic yarn manufacturing process, which is important for imparting advanced knowledge in the subject. Therefore, same subject is maintained in autonomy structure with minor modification in the nomenclature.
Advances In Fabric Manufacturing Technology-I	Fabric Manufacturing Technology -I	This subject consists of research and developmental concepts of basic Fabric manufacturing process, which is important for imparting advanced knowledge in the subject. Therefore, same subject is maintained in autonomy structure with minor modification in the nomenclature.
Statistics For Textile Mill Management	Design of Experiments & Statistical Applications in Textiles	As statistical techniques knowledge is essential for the students to analyse the data obtained for experiments, this subject is retained in autonomy structure also.
Theory Of Textile Structures – II	Elective –III 1. Geo Textiles and Geo synthetics 2. Textile Product Engg 3. Clothing Science 4. Project Preparation, Appraisal & Implementation	As the major content of Theory Of Textile Structures – II is included in Theory Of Textile Structures of semester –I, Theory Of Textile Structures – II is discarded in autonomy structure. In the place of this subject Elective –III group is introduced. Therefore, students will have more subjects to choose.
Elective-II 1. Project Preparation, Appraisal & Implementation	Elective –IV 1. Smart Textiles 2. Narrow Fabrics 3. Nonwoven Tec 4. Comp. Aided Fabric Manufac.	Earlier elective –II was having only two subjects. However, in autonomy structure, elective –IV is introduced with more subject. Therefore, students will have more subjects to choose as per their choice.

2. Management of Textile Production		
Seminar-II	Mini Project -II	Mini project concept is introduced in autonomy structure and has replaced earlier seminar. Mini project imparts more exposure to the experimental work and students will have good knowledge of conducting experiments. Earlier seminar was giving only theoretical exposure to students.
Second Year Semester-I		
Seminar-III	----------	Seminar-III is discarded from the autonomy structure as students will be undertaking literature review and presentation as part of dissertation phase-I
Dissertation	Dissertation Phase 1	Dissertation is retained in autonomy structure also. However, evaluation of progress of work will be done by external examiner, provision of which was not in the university syllabus.
Second Year Semester-II		
Seminar-IV	----------	Seminar-IV is discarded from the autonomy structure as students will be undertaking dissertation presentation as part of dissertation phase-I
Dissertation	Dissertation Phase 2	Dissertation is retained in autonomy structure also as earlier dissertation and new dissertation phase –II are related to experimental work of project, project completion and final evaluation

M. Tech. (Textile Technology) Semester-I
TTL530: YARN MANUFACTURING TECHNOLOGY –I

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives:

1. To explain opening and cleaning aspects of modern blow room machinery and process parameters involved in it.
2. To describe design aspects of different zones of modern card to process parameters involved in it.
3. To describe design aspects of various components of a comber & theories of drafting.
4. To describe fibre blending and process parameters involved in it.

Course Outcomes:
At the end of the course students will be able to

1. Critically analyze various aspects of opening and cleaning in modern blow room machinery and also process parameters involved in it
2. Critically analyze design aspects of different zones of modern card and process parameters involved in it.
3. Critically analyze design aspects of various components of a comber & theories of drafting.
4. Critically analyze fibre blending and process parameters involved in it.

Course Contents

Unit 1. Opening and cleaning. 8 Hrs.

Evolution of opening and cleaning process. A critical study of factors affecting opening, cleaning and blending in blowroom. Role of air currents in blowroom. Critical design aspects and principles of modern blowroom machinery.

Unit 2. Carding 8 Hrs.

Basic theories of carding. Critical design aspects in different zones of modern card. Role of air currents in card. Design developments of card wires. Conditions of fibre transfer. Transfer efficiency and quality. Factors affecting transfer efficiency. Configuration and disorder of fibres in a card sliver. Nep formation / removal in card.

Research Papers.

Unit 3. **combing** **6Hrs.**

Importance of combing preparation. Critical design aspects in various components of a comber. Researches on combing preparation. Fibre fractionation at comber, factors affecting fractionation in a comber. Design developments in modern comber. Evolution of combing process and technology

Unit 4. **Drafting** **4 Hrs.**

Theories of drafting. Causes for irregularity in drafted strand. Role of fibre friction in drafting – Drafting force – Definition, Measurement and study of factors affecting drafting force.
Design significance of modern draw frames.
Auto leveling: - Concept and necessity. Types of auto levellers, their applications and evaluation

Unit 5. **Speed frame** **4 Hrs.**

Evolution of speed frame machines and process Design significance of modern Speed frames.

Unit 6. **Fibre Blending** – Importance – Methods of blending and analysis. **4 Hrs.**
Blend intimacy and measures of blend variation, significance of developments in blending techniques and machines.

Reference Books

1 The Textile Institute Publication - Manual of Textile Technology – Short Staple Spinning Series
2 Vol.I – The Technology of short staple spinning by W. Klein.
3 Vol.-II – A Practical Guide to Opening & Carding by W. Klein.
4 Vol.III – A Practical Guide to Combing & Drawing – W. Klein.
5 Vol.VI - Man-made fibre spinning – W.Klein
6 Series publications of NCUTE Training Programs
7 'Fundamentals of Spun Yarn Technology' by Carl A. Lawrence.
8 'Spun Yarn Technology' by Eric Oxtoby.
9 Yarn Production-Teoratical Aspects by P.Grosberg & C.Iype.
10 Textile Progress Series by Textile Institute,Manchester.
11 Reiter manual on Auto levellers and setting

Research Papers –

1. Survey of blow room practice – F. T. Peirce ETAL. Journal of Textile Institute – 1954
2. The development of cleaning ranges in adoption to changing properties of

raw materials – F Leifield, ITB 1/90

3. Effect of hooks in laps on fractionation on cotton combing – R. G. Owalekar – TRJ 1969. 2.
4. Fractionating efficiency of comber - R. G. Owalekar – 7th Joint Technological Conference – P-108
5. Some theoretical and experimental data relating to the design of high sped cards –V. V. Krylov, Tech. of Textile industry USSR 1962 No. 2.
6. Fibre arrangement in card sliver – W. E. Morton and R. S. Summers – JTI 1949
7. Fibre motion in roller drafting – GarFaster – JTI 1956.
8. A study of the theory of drafting force in roller drafting process – Ismail Dogu – TRJ - 1971.
9. A measure of fibre distribution in blended yarns and its application to the determination of the degree of mixing achieved in different processes – AE DE barr & P. G. Walker – JTI1957.

M. Tech. (Textile Technology) Semester-I
TTL531: FABRIC MANUFACTURING TECHNOLOGY –I

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives:

1. To explain technological significance in the design development of automatic winding machine and process parameters involved in it.
2. To explain technological significance in the design developments of beam and sectional warping machine and process parameters involved in it.
3. To explain technological significance in the design development of sizing machine.
4. To describe design, functional and constructional aspects of different zones of circular knitting machines.

Course Outcomes:
At the end of the course students will be able to

1. Critically analyze technological significance in the design development of automatic winding machine and process parameters involved in it.
2. Critically analyze technological significance in the design developments of beam and sectional warping machine and process parameters involved in it.
3. Critically analyze technological significance in the design development of sizing machine.
4. Critically analyze design, functional and constructional aspects of different zones of circular knitting machines

Course Contents

Unit 1: Technological significance in the design development of automatic winding machine with respect to unwinding accelerator, auto speed, yarn tensioners, various splicers, clearers & fault removal, contamination clearers, yarn guide drum & winding unit, length & diameter measurement etc. **6 Hrs.**

Unit 2. Influence of winding process on yarn quality, package build. Various package quality for different application such as weaving, knitting, dyeing etc. Research articles based on unwinding yarn tension, yarn clearers, **6 Hrs.**

package build, speed & its variation, changes in yarn quality during winding.

Unit 3. Modern electronic control system & their role in optimizing quality & productivity. Techno-economical aspects of winding. **4 Hrs.**

Unit 4. Technological significance in the design developments of beam and sectional warping machine with respect to creels, design, tensioners, drum design, Drive, geometrical aspects of machines. Modern Electronic control systems. **6 Hrs.**

Unit 5. Influence of warping process on yarn quality, beam build. Research articles based on yarn tension, speed, beam build etc. **4Hrs.**

Unit 6. Technological significance in the design development of sizing machine with respect to creel saw box, pre-drying, drying, and headstock. Modern quality control systems such as temperature, size pick up, stretch control, moisture control, PLC Drive etc. Synthetic ingredients & their suitability. Influence of process parameters on yarn quality and processing behaviour **10 Hrs**

Automation in sizing process, size recipe formulation & re-circulation. Modern electronic control systems. Research articles based on tension, stretch, size recipe & machine design etc.

Knitting: Study of design, functional and constructional aspects of different zones of circular knitting machines, such as yarn feeding zone, loop forming zone and fabric takedown zone. Effect of machine and material parameters on fabric quality. Geometrical aspects of knitting fabrics. Such as wale and coarse density, stitch length, Run in ratio, Tightness factor. Study of research articles on robbing back, yarn tension, Spiriality, dimensional stability, fibre fly generation, barriness, shrinkage, effect of yarn quality parameters, yarn lubrication, Prediction of fabric dimensional properties, effect of processing on fabric dimensional characteristics.

Reference Books

1. Modern Preparation & Weaving Machinery by A. Ormerod.
2. Manual of Non Woven by Dr. Radko Krima.
3. Geotextiles by N.W.M. John.
4. Warp Sizing by J.B. Smith.
5. Textile Maths Vol-III by J.E. Booth.
6. Circular Knitting – by Chandra sekhar Iyer. Circular Knitting Technology – IIT, Delhi, Publi

M. Tech. (Textile Technology) Semester-I
TTL532: THEORY OF TEXTILE STRUCTURES

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives

1 To describe the fibre structure and morphology
2 To explain the Tensile properties of fibres
3 To illustrate the Theories of mechanical properties with numerical examples
4 To explain the Characteristics of different yarn structures

Course Outcomes

At the end of the course students will be able to

1 Describe the fibre structure and morphology
2 Explain the technical details of Tensile properties of fibres
3 Illustrate the theories of mechanical properties with numerical examples
4 Evaluate the performance & Characteristics of different yarn structures with suitable test methods

Course Contents

Unit 1: A brief review of fibre structure and morphology, Structures of different fibres and their effect on fibre properties. **4 Hrs.**

Unit 2. **Tensile properties of fibres –** Effects of variability – Elastic recovery – Time effects – fibre stress and deformation other than tensile – Bending and bending fatigue – shear properties – loop strength and knot strength – Torsional properties, Model theory of visco elasticity, rubber elasticity. **6 Hrs.**

Unit 3. **Theories of mechanical properties –** variety of approaches – structural effect in various fibres – Theories of time dependence. Thermo mechanical **5 Hrs.**

response of fibres.

Unit 4. **Nature and mechanism of Heat setting of fibres –** physics of heat setting – Heat setting and structural parameters – Mechanism of heat setting – Thermodynamic Argument of heat setting – multiple sequence – structural model. **6 Hrs.**

Unit 5. **Characteristics of different yarn structures –** structural parameters – fibre configuration in yarn – Ideal migration, characterization of migration behaviour, theory of migration, migration in spun yarns. Yarn structure in relation to the aesthetic and tactile qualities of apparel fabrics. **9 Hrs.**

Unit 6. **Twist in yarn –** geometry of twisted yarns – yarn size and twist factor – contraction because of twist – twist and fibre packing in yarn – (ideal and real) – effect of twist on yarn diameter and volume – Twist and yarn bending measurement of yarn diameter. **6 Hrs**

References

1. Fibre Science – Edited by J.M. Preston, Published by The Textile Institute, Manchester.
2. Cotton Testing by Steadman,
3. Physical Testing of Textiles by B.P. Saville
4. Physics of Fibres – An Introductory Survey – Woods H.J. published by The Institute of Physics – London, 1955.
5. Physical Properties of Textile Fibres – Morton W.E. and Hearle J.W.S. published by The Textile Institute Manchester.
6. Fibre Microscopy – Stores J.L. – published by London National Trade Press.
7. Structure / Property relationship in Textile Fibres – Textile Progress Vol.20, No.4 – The Textile Institute, Manchester.

M. Tech. (Textile Technology) Semester - I
TTLEL1 (TTL533): TEXTILE REINFORCED COMPOSITE MATERIALS

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives

1. To explain requirements of fibre and matrix for composite fabrication & their types
2. To describe the fibre-matrix interactions in unidirectional lamina
3. To explain details of various methods of composite fabrication
4. To explain properties of composites and their applications

Course Outcomes

At the end of the course students will be able to

1. Describe the logic, need, requirements of composites based on end use
2. Explain the manufacturing of the composites and fibre used for fabrication
3. Evaluate the performance of composites including fibre matrix interactions
4. Discuss the 3D textile structural composites

Course Contents

Unit 1. **General introduction:** Meaning and types of composite materials, design of composite materials, the concept of load transfer. **8 Hrs.**

Fibers and matrices

Reinforcements: carbon fibers, glass fibers, organic fibers, silicon carbide, Strength of reinforcements: thermal stability, compressive strength, fiber fracture and flexibility, A statistical treatment of fiber strength.

Matrices: polymer matrices, metal matrices, ceramic matrices.

Fiber architecture:

Volume fraction and weight fraction, fiber packing arrangements, clustering of fibers and particles.

Long fibers: laminates, woven, braided and knitted fabric arrays,

characterization of fiber orientations in a plane.
Short fibers: fiber orientation distributions in three dimensions, fiber length distributions.

Unit 2. **Fabrication:** Liquid resin impregnation routes, pressurized consolidation of resin prepregs, injection mouldings of thermoplastics, hot press mouldings of thermoplastics, powder blending and consolidation, physical vapour deposition diffusion bonding of foils, Layered ceramic composites, reactive processing, carbon/carbon composites, powder based routes. **4 Hrs.**

Unit 3. **The interface region:** Bonding mechanisms: absorption and wetting, inter diffusion and chemical reaction, electrostatic attraction, mechanical keying, residual stresses. **8Hrs.**
Bond strength:Measurements of bond strength: single fiber pull out strength, single fiber push out and push down strength.
Control of bond strength: coupling agents and environmental effects, toughness reducing coatings, interfacial chemical reaction and diffusion barrier coatings.

Unit 4. **Strength of composites:**Failure mode of long fibers like axial tensile failure, transverse tensile failure, shear failure, failure in compression. **8 Hrs.**
Failure of laminae under off-axis loads. Strength of laminates like tensile cracking, interlaminar stresses and edge effects.
Basic concepts of fracture mechanics, interfacial fracture and crack deflection.
Contributions to work of fracture like Matrix deformation, fiber fracture, interfacial debonding and frictional sliding.
Subcritical crack growth like fatigue and stress corrosion cracking.

Unit 5. **Thermal behavior of composites:** Thermal stresses and strains, thermal expansivities, thermal cycling of unidirectional composites, thermal cycling of laminates, basics of matrix and fiber in relation to creep, axial creep of long fiber composites, transverse creep and discontinuously reinforced composites. **8Hrs.**
Thermal conduction mechanism like heat transfer, conductivity of composites and interfacial thermal resistance.

Unit 6. **Applications:** minesweeper hull, sheet processing rolls, helicopter rotor blade, and golf driving club, racing bicycle, diesel engine piston, microelectronics housing, aircraft brakes and gas turbine combustor can. **4Hrs.**

Reference Books

1. Introduction to Composite Materials, Clyne and Hull
2. Fabre reinforced composites by P. K. Mallick
3. Composite materials: Engineering & science by F. L. Mathew & R. D. Rawlings.

4. Micro structural Characterization of fibre reinforced conposites by John Summerscales.
5. New millennium fibres by T. Hongu & G. O. Phillips.
6. Effects of mechanical & Physical properties on fabric hand by H. M. Behery.
7. 3-D Textile reinforcements in composite materials by Prof. A. Miravete
Mechanics of Textile & Laminated composites by A. E. Bogdanovich & C. M. Pastore.

M. Tech. (Textile Technology) Semester - I

TTLEL1 (TTL534): ENGINEERING OF APPAREL FABRICS AND GARMENTS

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course objectives:

1. To explain handle and making-up performance of fabrics and garments.
2. To explain testing of Fabrics and Garments and pilling of Fabrics and Garments.
3. To explain aappearance issues in garment processing and Physiological comfort of fabrics and garments.
4. To describe functional properties and laundry performance of fabrics and garments.

Course outcomes:

At the end of the course students will be able to

1. Describe handle and making-up performance of fabrics and garments.
2. Describe testing of Fabrics and Garments and pilling of Fabrics and Garments.
3. Describe aappearance issues in garment processing and Physiological comfort of fabrics and garments.
4. Explain functional properties and laundry performance of fabrics and garments.

Course Contents

Unit 1. **Handle and making-up performance of fabrics and garments:**Fabric Objective Measurement (FOM) of fabric handle and making-up performance, other methods, Effects of fibre properties, Effects of yarn properties, Effects of fabric properties ,Effects of dyeing and finishing (chemical and mechanical) treatments **4 Hrs.**

Unit 2. **Testing of Fabrics and Garments:** Wrinkling of fabrics and garments. The measurement of wrinkle and crease recovery, Surface smoothness after repeated laundering , Factors affecting fabric wrinkling and recovery, Factors affecting wrinkling during wear, Effects of fibre properties, Effects of yarn and fabric parameters, Effects of fibre, yarn and fabric processing parameters **8 Hrs.**

	Pilling of fabrics and garments: Effects of fibre composition and properties, Effects of yarn structure and properties, Effects of fabric structure and properties, Effects of fibre, yarn and fabric processing parameters Bagging of fabrics and garments:The measurement of bagging, Effects of fi bre properties, Effects of yarn properties, Effects of fabric properties, Effects of garment construction, Effect of finishing, Fabric bagging prediction and modelling Fabric and garment drape:Drape measurement, Engineering fabric drape, Empirical prediction of drape, Modelling fabric and garment drape, Drape models in CAD and Internet systems	
Unit 3.	**Appearance issues in garment processing:**Seam appearance, Appearance issues in fusing, Appearance issues in garment dyeing, Appearance issues in pressing, Storage and packaging Durability of fabrics and garments Abrasion resistance, Fabric and garment strength, Effects of dyeing and finishing on fabric strength, Modelling and predicting fabric strength	**6Hrs.**
Unit 4.	**Physiological comfort of fabrics and garments** : Different aspects of clothing physiological comfort, Tactile comfort, Assessment of tactile comfort, Thermophysiological comfort, Liquid water transport properties of fabrics and clothing, Garment fit and ease of body movement, Pressure comfort, Effects of colour and surface texture ,Effect of garment design, Effects of garment sizing and fit, Fashion and prejudice	**6 Hrs.**
Unit 5.	**Functional Properties:**Flammability of fabrics and garments Burning mechanisms, Index for burning behaviour of textiles, Effects of fibre composition, structure and properties, Effects of yarn structure and properties, Effects of fabric structure and properties, Effects of fibre, yarn and fabric processing parameters, Effect of garment design, Test methods and standards for textiles and apparel Waterproofing and breathability of fabrics and garments Measurement of waterproofing and breathability, Engineering fabric and garment breathability, Fabric finishes, Construction of shower proof garments, Comparative fabric and garment properties Ultraviolet protection of fabrics and garments Measurement of UV protection, Effects of fibre properties, Effects of yarn properties, Effects of fabric structure and properties, Effects of dyeing, finishing and other chemical treatments	**8Hrs.**
Unit 6.	**Laundry performance of fabrics and garments:** Laundering, Care labels, Effects of fibre composition, structure and properties, Effects of	**4Hrs.**

sewing thread linear density, Effects of fabric structure and properties, Effects of colouration and finishing, Effect of garment design, Test methods and standards related to laundering and care labelling
Applications of artificial intelligence in fabric and garment engineering
Expert systems, artificial neural networks (ANNs)

Reference Books

1. Engineering apparel fabrics and garments, J. Fan and L. Hunter, Woodhead Publishing Limited, 2009
2. Engineering textiles: Integrating the design and manufacture of textile product, Y. E. El Mogahzy, Woodhead Publishing Limited, 2009
3. The Apparel Industry, Richard M Jones
4. Ergonomics in the garment industry, Dr Gordana Colovic, Woodhead Publishing India Pvt. Ltd., 2014

M. Tech. (Textile Technology) Semester - I
TTLEL1 (TTL535): NANO FIBRE TECHNOLOGY

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives:

1. To explain nano fiber production.
2. To describe controlling the morphologies of electrospun nanofibres.
3. To explain processing of composite functional nanofibers, carbon nanotube and nanofibre reinforced polymer fibres
4. To explain Nanofilled polypropylene fibres, applications and developments in nanofibres.

Course Outcomes:

At the end of the course students will be able to

1. Describe nano fiber production.
2. Explain controlling the morphologies of electrospun nanofibres.
3. Describe processing of composite functional nanofibers, carbon nanotube and nanofibre reinforced polymer fibres
4. Describe Nanofilled polypropylene fibres, applications and developments in nanofibres.

Course Contents

Unit 1. **Nano fiber production:** Introduction, principles of electrostatic atomization, Electrospraying and electrospinning by the capillary method, Electrospraying and electrospinning by the charge injection method, Solution electrospinning, Melt electrospinning. **8 Hrs.**

Types and processing of structured functional nanofibers:
Core-shell, aligned, porous and gradient nanofibers, Core-shell nanofibers, Aligned nanofibers, Porous nanofibers Gradient nanofibers, Applications of structured functional nanofibers

Continuous yarns from electro spun nano fibers:
Using electro spun nanofibers: background and terminology, controlling fiber orientation, producing non-contiguous or short yarns, producing continuous yarns

Producing polyamide nanofibers by electrospinning:
Introduction, The electrospinning process, Properties of electro spun

	nanofibers, measuring the effects of different spinning conditions and the use of high molecular weight polymers on the properties of electrospun nanofibers, Improving the properties of ele*ct*rospun nanofibers	
Unit 2.	**Controlling the morphologies of electrospun nanofibres:** Introduction, The electrospinning process and fibre morphology, Polymer concentration and fibre diameter, Fibre bead formation and fibre surface morphology, Controlling fibre alignment and web morphologies, Bicomponent cross-sectional nanofibres, Future trends.	**8 Hrs.**
Unit 3.	**Processing of composite functional nanofi bers:** Formation of polymer and polymer composite nanofibers, Formation of polymer and nano particle composite nanofibers, Formation of polymer and inorganic salt composite nanofibers, Examples and applications of composite functional nanofibers	**4Hrs.**
Unit 4.	**Carbon nanotube and nanofibre reinforced polymer fibres:** Introduction, Synthesis and properties of carbon nanotubes, Developing nanotube/nanofibre–polymer composites, Adding nanotubes and nanofibres to polymer fibres, Analysing the rheological properties of nanotube/nanofibre–polymer composites, Analysing the microstructure of nanotube/nanofibre polymer composites, Mechanical, electrical and other properties of nanocomposite fibres, Future trends	**6 Hrs.**
Unit 5.	**Nanofilled polypropylene fibres:** Introduction, Polymer layered silicate nanocomposites, the structure and properties of layered silicate, polypropylene nanocomposites, Nanosilica filled polypropylene nanocomposites, Calcium carbonate and other additives	**4Hrs.**
Unit 6.	**Applications:** Filtration applications, drug delivery applications, tissue engineering, in lithium-ion batteries, sensor applications, clothing for protection against chemical and biological hazards, food processing, sound absorption, electromagnetic wave attenuation and bioreactor , water purification, microelectronics Developments in nanofibers: Background, Nanotechnology, materials and nanofiber, Creation of new industries, Researches and global developments of nanofiber	**6Hrs.**

Reference Books

1. Nanofibers and nanotechnology in textiles, Edited by P. J. Brown and K. Stevens, Wood head Publishing Limited Cambridge, England, 2007
2. Functional nanofibers and their applications, Edited by Qufu Wei, Wood head Publishing Limited, 2012

M. Tech. (Textile Technology) Semester-I
TTLEL1 (TTL536): HIGH PERFORMANCE FIBRES

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives

1 To describe the Requirements of high performance (HP) fibres
2 To explain the Manufacturing of aramids, carbon, glass and chemical resistant fibres
3 To illustrate the properties of aramids, carbon, glass and chemical resistant fibres
4 To explain the applications of aramids, carbon, glass and chemical resistant fibres

Course Outcomes
At the end of the course students will be able to

1 Describe the significance and scope of HP fibres in technical textiles
2 Explain the technical details of Glass, Aramids, Carbon and other HP fibres
3 Compile the various properties and merits of above stated fibres in technical textiles
4 Evaluate the criteria for applications in technical textiles and their cost.

Course Contents

Unit 1. Significance of high performance fibres. Critical comparison of Reguar and High performance fibres, Review of various fibre manufacturing processes. **4 Hrs.**

Unit 2. Manufacturing of aramid fibres, Analysis of structure and characteristics of important aramd fibres, Comparison of characteristics of important commercially available aramid fibres, Studies on the applications of aramid fibres. **8 Hrs.**

Unit 3. Manufacturing of high performance polyethylene and fully aromatic polyester fibres, Analyses of characteristics of high performance polyethylene fibres and fully aromatic polyester fibres Studies on the applications of these fibres **6Hrs.**

Unit 4.	Inorganic high performance fibres: Glass fibre manufacture, properties and Applications Ceramic Fibres: Analysis of characteristics and applications of silicon carbide based fibres, Alumina based fibres. Single crystal oxide fibres.	**6 Hrs.**
Unit 5.	Critical analyses of fibre characteristics and applications of Chlorinated fibres: PVDC Fluorinated Fibres: PTFE, PVF, PVDF and FEP Poly (entheretherketones): PEEK Poly (phenylene sulphide): PPS Poly (ether imide) : PEI, PBI, and PBO	**8Hrs.**
Unit 6.	Technological developments in the manufacturing of bicomponent fibres, importance and applications of bicomponent fibres.	**4Hrs.**

Reference Books

1. High Performance Fibres, Edited by J. W. S. Hearle, Published by wood head publishing Ltd., England in association with Textile Institute Manchester
2. Carbon fibers by J. P. Donnet and R. C. Bansal, Marcel Dekker, New York
3. Hand book of Fibres Science and Technology, High Technology Fibres, Edited by Manachem Lewin and Jack Preston.
4. New fibers. T. Hongu and G. 0. Phillips Ellis Horwood Ltd, Chichester,
5. Kevlar aramid fiber. by H.H. Yang. John Wiley and Sons, Chichester, New York,
6. Mukhopadhyay S. K., "Advances in Fibre Science" The Textile Institute. 1992, ISBN: 1870812379
7. Gupta V.B. Textile Fibres: Developments and Innovations. Vol. 2, Progress in Textiles: Science and Technology. Edited by V.K. Kothari, IAFL Publications, 2000.

M. Tech. (Textile Technology) Semester-I
TTLEL2 (TTL537): ADVANCED COMPUTER PROGRAMMING AND APPLICATIONS

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives

1 To describe the Object-oriented Programming using C++
2 To explain the Relational Databases & E Commerce
3 To illustrate the applications of ERP and Its Related Technologies with real life examples
4 To explain the applications of SAP & its advantages

Course Outcomes

At the end of the course students will be able to

1 Describe the significance and scope of Programming using C++
2 Explain the technical details of Relational Databases & E Commerce
3 Compile the various properties, merits and applications of ERP
4 Evaluate the suitability of SAP for various applications

Course Contents

Unit 1: **Object-oriented Programming using C++:** Introduction to object oriented programming, basic program construction, variable types, loops & decisions, structures, functions, objects & classes, arrays, polymorphism, operator overloading, function overloading, inheritance **8 Hrs.**

Unit 2. **Relational Databases:** Relational Model, Database Users, Roles of Database Administrator, keys, Domain Constraints, Referential Integrity, Structured Query Language (SQL),Database recovery methods **8 Hrs.**

Unit 3. **E-Commerce :**The scope of electronic commerce, definition of electronic commerce,E-commerce and the trade cycle, Electronic markets, Electronic data interchange, Internet Commerce, Business Strategy in E-commerce, **6 Hrs.**

The value chain, supply chain, Porter's value chain model. Inter organization value chains, Business to business E-commerce, Inter organizational transaction, the credit transaction trade cycle. Advantages & disadvantages of Electronic markets. Application of E-commerce in textile industries.

Unit 4. **ERP and Its Related Technologies:** Introduction to ERP, Basic ERP concepts, Justifying ERP Investments, RISK of ERP, Benefits of ERP. ERP and Related Technologies, Business Process Reengineering (BPR), Product Life Cycle Management, Supply Chain Management (SCM), Customer Relationship Management (CRM). Use of ERP in Textile Industry. **6rs.**

Unit 5. **SAP: Architecture** of SAP R/3, SAP Integrated- Analysis, Implementation, and Design, Three-Tier Architecture, Need of Multi-tier Architecture, Integrating Environments. **4 Hrs.**

Unit 6. **Business Intelligence System:** Technical Architecture overview, Back room Architecture, Presentation Server Architecture, Front room Architecture, Metadata, Standard Reports, Dashboards and Scorecards **6 Hrs**

Reference Books

1. Object Oriented Programming with C++ - E. Balagurusamy.
2. Database System Concept by Henry F. Korth, Abraham Silberschatz, Sudarshan (McGraw Hill Inc.)
3. E-Commerce – David Whiteley, TmH.
4. ERP Demystified - Alexis Leon, TMH
5. Enterprise Resource Planning – Alexis Leon, TMH.
6. SAP R/3 SAP Architecture, Administration, Basis, ABAP Programming with MM and SD Modules – Dreamtech Press
7. The Data Warehouse Lifecycle Toolkit By Ralph Kimball,Ross, 2nd edition, Wiley Publication

M. Tech. (Textile Technology) Semester-I
TTLEL2 (TTL538): POLYMER AND FIBRE CHEMISTRY

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives:

1. To explain basic determinants of Fibre Forming Polymers.
2. To explain Condensation Polymerization, Addition polymerization and Co-polymerization.
3. To describe techniques of polymerization.
4. To explain Molecular Weight and Polymer Degradation.

Course Outcomes:
At the end of the course students will be able to

1. Describe basic determinants of Fibre Forming Polymers.
2. Describe Condensation Polymerization, Addition polymerization and Co-polymerization.
3. Explain techniques of polymerization.
4. Describe Molecular Weight and Polymer Degradation.

Course Contents

Unit 1. **Basic Determinants of Fibre Forming Polymers :** Importance of polymer science. Various applications of polymers. Classification of polymers. Definition of monomer, oligomer, high polymer, mesomer, cohesive energy density, solubility parameter, glass transition temperature, functionality and degree of polymerization. Concept of basic determinants of fibre forming polymer. Effect of molecular weight, Symmetry, rigidity and chemical reactivity of polymeric chain on the properties of polymer. Concept of rubber, plastic and fibre. Essential requirements of suitability of a polymer for apparel wear and industrial applications. **7 Hrs.**

Unit 2. **Condensation Polymerization:** Mechanism, types, featness, essential requirements and importance of condensation polymerization. Carother's equation. Significance of Carother's equation. Concept of gelation & cyclic polymer formation. Effect of functionality on gelation. Factors **7 Hrs.**

affecting cyclization. Kinetics of condensation polymerisation. Stoichiometry of reactants and degree of polymerization.

Unit 3. **Addition polymerization :**Mechanism, types, features and essential requirements of addition polymerization. Types of initation, chemistry of initiators, retarders and inhibitors. Effect of catalyst, temperature, pressure, solvents, modifiers, emulsifying and suspending agents on addition polymerisation. Kinetics of addition polymerisation. Industrial applications of addition polymerisation. **7 Hrs.**

Unit 4. **Co-polymerization :**Concept of graft and block co-polymerization and their importance. Various techniques of grafting. Various factors such as temperature, time, dose-rate, concentration of monomers, diffusion, scavengers, initiators & physical state on copolymerization. Concept of ideal, alternating and azeotropic co-polymerisation. Reactivity ratios of monomers and its significance. Concept of Q-e scheme. Kinetics of co-polymerisation.6 **6 Hrs.**

Unit 5. **Techniques of polymerization:**Study of various techniques of polymerisation such as bulk, solution, suspension, emulsion, solid state, plasma polymerization. **6 Hrs.**

Unit 6. **Molecular Weight and Polymer Degradation:** Concept of Mn, Mw and poly-dispersibility & their significance. Effects molecular weight distribution of polymer on spinnability & drawability. Light scattering and ultra-centrifuge techniques to determine Mw. Endgroup analysis, osmotic pressure, cryscopic methods & viscosity methods to determine Mn & Mv. Characteristics of polymer using DSC, TGA, DTA, DMA and GPC.Concept of chain end and random polymer degradation. Study of polymer degradation by thermal, mechanical, chemical and other agencies. **12 Hrs.**

Reference Books

1. Polymer sciences and technology by Joel R. Fried.
2. Text book of polymer science by Fred W. Billmeyer, Jr.
3. Polymers and their properties by J.W.S. Hearle.
4. Organic chemistry of high polymers by Lenz.
5. Applied Polymer science by Flory.
6. Fundamentals of polymers by Anilkumar and Rakesh K. Gupta.
7. Principles of Polymerisation by George Odian.
8. Polymer science by Steven.
9. Introduction to polymer chemistry by G.S. Mishra.
10. Polymer science and technology of plastics & rubbers by Dr. Premamoy Ghosh.
11. Polymer Science by V.R. Gowarikar, N.V. Viswanathan & Jaydev Shreedhar.

M. Tech. (Textile Technology) Semester - I
TTLEL2 (TTL539): SPECIALITY YARNS

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives:

1. To explain Core and cover yarns.
2. To describe special yarns on Unconventional Spinning Technologies.
3. To explain Melange Yarn, Sewing Threads, Embroidery Yarns, Laces & Braids .
4. To describe manufacture of some special purpose yarns.

Course Outcomes:
At the end of the course students will be able to

1. Describe Core and cover yarns.
2. Explain special yarns on Unconventional Spinning Technologies.
3. Describe Melange Yarn, Sewing Threads, Embroidery Yarns, Laces & Braids .
4. Explain manufacture of some special purpose yarns.

Course Contents

Unit 1.	**Core and cover yarns: -** Principles of formation of yarn, constructional details of machine, process description, production of different types of core and cover yarns, yarn properties & end uses.	**6Hrs.**
Unit 2.	**Special Yarns on Unconventional Spinning Technologies: -** Manufacture Properties & end uses of, Siro, Bobtex, Self-twist, Twistless, etc. Concepts of composite yarns	**6Hrs.**
Unit 3.	**Melange Yarn: -** Concepts of producing mélange yarn. Process and sequence used for production of Melange yarn.	**4Hrs.**
Unit 4.	**Sewing Threads: -** Introduction to thread construction, Characteristics of sewing threads, production methods, Types of thread packages, Ropes, Cordage, & Twines: - Requirements of initial fibres & yarns, Manufacturing process, structures & properties of yarns	**8Hrs.**

Unit 5.	**Embroidery Yarns, Laces & Braids: -** Introduction, Process sequence, Manufacturing details & Machines required. Properties & application of embroidery yarns, Laces & Braids.	**8Hrs.**
Unit 6.	**Manufacture of some special purpose yarns like:–** Slub, double twist, Knop yarn, Chenille yarn, Diamond yarn, Eccentric yarn, Boucle yarn, Thick 'n' Thin *Yarns*.	**4Hrs.**

Reference Books

1 Sewing Threads' Textile progress vol.30 no.3/4, by J.O. Ukponmwan, The Textile Inst. Publisher.

2 Modern Yarns for Modern Fabrics Seminar' Conference proceddings. By TTI, The Textile Inst. Publisher. 25

3 Woollen – Yarn manufacture' Textile progress, vol.15, no.1/2 by D.A. ROSS, The Textile Inst. Publisher.

4 The production of textured yarn by methods other than the false – twist technique, The Textile progress vol.16, No.3, By D.K. Wilson and T Kollu, The textile Inst. Publisher.

5 Fancy yarns: Their manufacture and application R H Gong and R M Wright, UMIST, UK, The Textile Inst. Publisher.

6 The Textile Institute Publication - Manual of Textile Technology – Short Staple Spinning Series Vol.V – New Spinning System by W. Klein.

M. Tech. (Textile Technology) Semester - I
TTLEL2 (TTL540): TECHNICAL TEXTILES

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives:

1. To explain introduction of technical textiles.
2. To describe Coating & Lamination Textiles and application of technical textiles.
3. To explain Textiles in Defence.
4. To describe Miscellaneous Applications.

Course Outcomes:
At the end of the course students will be able to

1. Describe introduction of technical textiles
2. Explain Coating & Lamination Textiles and application of technical textiles.
3. Describe Textiles in Defence.
4. Explain Miscellaneous Applications.

Course Contents

Unit 1. **Introduction -** Definition and scope of Technical Textiles – Development stages in Technical Textiles – present status and future trends in Technical Textiles – Areas of Application of Technical Textiles and Classification**.** **4 Hrs.**

Unit 2. **Coating & Lamination Textiles -** Introduction –materials for coating – Substrate for coating – Coating methods - Fusible interlinings – physical properties of coated fabrics - Laminating – Applications of coated fabrics and Laminated Textiles. **8 Hrs.**

Unit 3. **Applications:**Heat and Flame Protection Applications – Flammability, thermal characteristics and combustion mechanisms of fibres, prevention of combustion – Flame retardant fibres suitable for protective clothing – Testing of Flame retardant and Flame proof fabrics. **6Hrs.**
Filtration Application – Introduction –Fabric construction & Finishing

Treatments, Solid-liquid separation, liquid – liquid filteration, liquid-gas separation, Mechanism of filteration,.

Medical Textiles – Introduction – Non implantable materials, Extra corporeal devices – Implantable materials **-** Health care / hygiene products.

Textile Reinforced Composite Materials – Introduction to composite materials – Textile reinforcement – Applications of composites in brief.

Textiles in Transportation – Introduction, Textiles in passenger cars – Textiles in other road vehicles – Rail applications – Textiles in Air crafts – Marine application.

Unit 4. **Textiles in Defence –** Introduction, Historical Background – Criteria for modern military textiles materials – various application of Textiles in various areas of defence such as environmental protection, thermal insulation, water proof water vapour permeable materials – ballistic protection – heat protection – biological and chemical warfare protection, High altitude fabrics, etc. **6 Hrs.**

Unit 5. **Miscellaneous Applications –** Electrical insulation – Battery separators – synthetic turf and sports application – sound insulation –power transmission, parachute textiles, ropes, cordage and twines. **8Hrs.**

Unit 6. Case studies related to Product development in Technical Textiles **4Hrs.**

Reference Books

1. Handbook of Technical Textiles by A.R. Horrocks and S. C. Anand
2. Coated Textiles Principles and Applications by Dr. A. K. Sen
3. Medical Textiles by Subhash Anand
4. Wellington Sear's Hand book of Industrial Textile by Rd. Sabit Adnur.
5. Shape memory polymers and Textiles by Jinlian HU
6. Clothing biosensory engineering by Y. Li and A.S.W. Wong
7. Biochemical Engineering of Textile and Cloting by Y. Li and X-Q. Dai

M. Tech. (Textile Technology) Semester-I
TTD541: MINI PROJECT –I

Teaching Scheme			Evaluation Scheme	
Practical	**7 Hrs/Week**		**CIE**	**50**
Credits	**7**		**SEE**	**50**
			Total	**100 Marks**

Course Objectives:

1. To identify the problem /idea and review and summarize the literature for the topic of the identified problem & to provide a platform to students to enhance their practical knowledge and skills
2. To describe the process flow for undertaking the research/survey trials with appropriate standards and process variables
3. To design, development, construction, and fabrication of innovative product/system for the final submission
4. To explain various tools of testing and statistical analysis for the data in order to draw relevant conclusions

Course Outcomes:
At the end of the course students will be able to

1. Describe the problem /idea and review and summarize the literature for the topic of the identified problem
2. Illustrate the suitable design of experiments including experimental plan.
3. Explain the concepts of design, development, construction, and fabrication of innovative product/system for the project title
4. Use various tools of testing and statistical analysis for the data in order to draw relevant conclusions.

Rationale: The mini project will involve the design, development, construction, and fabrication of innovative product/system approved by the department. This is a laboratory oriented course which will provide a platform to students to enhance their practical knowledge and skills. Each student must keep a project notebook The notebooks will be checked periodically throughout the semester by the guide and also during the internal viva, as part of the project grade.

Guidelines:

1. Students should select a problem which addresses some textile industry problem, or other product developments in textiles. One mini project per semester per student.

2. The selected topic for mini project should be based on development/fabrication of innovative product which he/she learnt during course work.
3. Students should understand testing of various instruments relating to topic of mini project.
4. Execution of mini project should be carried out by students only under guidance of allotted faculty. One faculty per student.
5. Students should develop a necessary product with product specifications with reference to end use.
6. Students should see that final product submitted by them is in working condition.
7. 15-20 pages report to be submitted by students in prescribed guide lines. Presentation is for 10 minutes.
8. Group of students cannot be permitted to work on a single mini project. Individual student has to carry out mini project.
9. A demonstration and internal oral examination on the mini project also should be done at the end of the semester.
10. Department may arrange demonstration with poster presentation of all mini projects developed by the students at the end of semester.
11. It is desirable that the product developed by the students have some novel features.
12. A test of significance should be applied to the test results to ascertain the conformity of significant differerence.

M. Tech. (Textile Technology) Semester-II
TTL542: YARN MANUFACTURING TECHNOLOGY –II

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**25**
Total	**100**

Course Objectives:

1. To explain design developments in various components of ring frame and process parameters involved in it.
2. To describe yarn conditioning, technical developments in rotor spinning machine and process parameters involved in it.
3. To describe Technical developments in air jet spinning and friction spinning along with process parameters involved in it..
4. To describe critical evaluation of different texturising system.

Course Outcomes:

At the end of the course students will be able to

1. Critically analyze design developments in various components of ring frame and process parameters involved in it.
2. Critically analyze yarn conditioning, technical developments in rotor spinning machine and process parameters involved in it.
3. Critically analyze Technical developments in air jet spinning and friction spinning along with process parameters involved in it..
4. Explain critical evaluation of different texturising system.

Course Contents

Unit 1. Basic stages in spinning & their influence on final product. Design Developments in various components of ring frame, such as drafting, spindles, ring, travellers & drives etc. Spinning geometry of ring frames. Twist flow in ring frame. Twist / tension interaction and end breaks. Mechanisms of end breaks. Generation and control of hairiness in ring spinning – development of compact spinning. Research Papers – i) Spinning geometry and its significance – W. Klein ITB 2/90. ii) Letest trends in cots and aprons – **8 Hrs.**

Mr. P.
K. Basu JTA 1999. iii) Ring traveller interaction & spinning performance – R.
R. Salhotra – NCUTE on Ring frame. iv) Design aspects of high speed rings,
spindles & travellers – Sudhir Sharma NCUTE programme.

Unit 2. Rotor spinning – Technical developments in rotor spinning machine – Modification in the design of spinning unit – developments in rotor drives –yarn monitoring. Automation in rotor spinning machines. Structure andproperties of yarn produced. **6 Hrs.**
Research Papers – i) Auto coro 360 with fancynation new concepts for fancy yarns – Waltrand jansen – ATJ 2004.
ii)Developments in rotor spinning – Dr. R. Chattopadhyay – Advances in yarn manufacturing technology – IIT publication.
iii) New spinning technologies – Dr. S. M. Ishtiaque – Advances in yarn manufacturing technology – IIT publication

Unit 3. Air jet spinning – Technical developments in air jet spinning – Structure and properties of air jet spun yarns, Evolution of vortex spinning, critical review of both systems. **6Hrs.**
Research Papers – i) A new spinning technology air vortex spinning – Dr. J. Hayavadana etal Man made textiles in India 2005.
ii) Structure & properties of air jet yarns – Jasesh J. etal – TRJ 1990.

Unit 4. Friction Spinning – Technical developments in friction spinning structure & properties of friction spun yarn. Evolution of different spinning technologies based on friction spinning system. **4 Hrs.**
Research Papers – i) Yarn tension in friction spinning – H. Stalder & H. Soliman – ITB 3/86.
ii)Mechanism of OE friction spinning – Dr. J. Lunenschloss – ITB 3/85.

Unit 5. Texturising – Critical evaluation of different texturising system – Significance of developments in false twist and air texturising technologies. **4 Hrs.**
Factors influencing the properties of false twist & air textured yarns

Unit 6. Yarn Conditioning – Concepts and theory of yarn conditioning at lower temperatures. Study of effect of yarn conditioning on yarn properties and processing behavior. Design principles of various yarn conditioning **6 Hrs.**

machines used in the industry.
Detailed review of latest practices in the industry with reference products norms etc.

Reference Books

1) The Textile Institute Publication - Manual of Textile Technology – Short
1. Staple Spinning Series
2. Vol.I – The Technology of short staple spinning by W. Klein.
3. Vol.-IV – A Practical Guide to Ring spinning by W. Klein.
4. Vol.V – New Spinning Systems – W. Klein.
5. Vol.VI - Man-made fibre spinning – W.Klein
2) Series publications of NCUTE Training Programs.
3) Textile Progress Series by Textile Institute,Manchester
4) Fundamentals of Spun Yarn Technology by Carl A. Lawrence
5) Yarn Production-Theoretical Aspects by P.Grosberg & C.Iype.
6) Yarn Texturising Technology by Hearle.

M. Tech. (Textile Technology) Semester-II
TTL543: FABRIC MANUFACTURING TECHNOLOGY –II

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives:

1. To explain limitation of shuttle loom and Theory of weft insertion by rapiers.
2. To describe Theory of weft insertion in air and water jet and developments in machines.
3. To describe developments in warp let off and take-up motions.
4. To explain Nonwovens and Technical Textiles.

Course Outcomes:
At the end of the course students will be able to

1. Describe limitation of shuttle loom and Theory of weft insertion by rapiers.
2. Explain Theory of weft insertion in air and water jet and developments in machines.
3. Explain developments in warp let off and take-up motions.
4. Describe Nonwovens and Technical Textiles.

Course Contents

Unit 1: Limitation of shuttle loom with respect to loom speed, picking, shuttle checking, sley motion, energy consumption.Theory of weft insertion by projectiles, developments in torsion rod picking motion, geometrical aspects of torsion rod, energy for picking, projectile flight & checking, developments in projectile weaving machines. **6 Hrs.**

Unit 2. Theory of weft insertion by rapiers, developments in rapier heads, positive, rapiers, developments in rapier drives, developments in rapier weaving. **6 Hrs.**

Unit 3. Theory of weft insertion in air and water jet picking, developments in machine design, nozzles. Design developments in high speed shedding devices, cam, dobby and jacquard motions, developments in cam beat-up. **6 Hrs.**

Unit 4.	Developments in warp let off and take-up motions, motorized electronic take-up & let off.Control systems – weft feeders, warp & weft monitor systems, selvedge, colour control, lubrication clearing, drive, intelligent monitoring system. Yarn quality and preparation requirements for high speed weaving.	**6 Hrs.**
Unit 5.	**Non wovens-** Raw material characteristics & effect on fabric properties, characteristics of needle punched, adhesive bended, thermal bonded & spun bended non-wovens, process variables and their effect on structure & proportion of non-wovens. Developments in non-woven machines**.**	**6 Hrs.**
Unit 6.	**Technical Textiles –** Market overview & growth projection, products, Filtration- dry & wet filtration, mechanism of separation, requirements for good filtration, fibre & fabric selection, automotive textiles – scope, products, applications, requirements & design for pneumatic tyres, airbag & belts methods of productin & properties. Engineering approach to fabric formation, shed geometry pick spacing, bumping conditions, fabric cover.	**6 Hrs**

Reference Books

1 Weaving Technology & Operation by Allan Ormerod.
2 Shuttleless Weaving Machines by – Svaty.
3 Principles of Weaving by Robinson & Marks.
4 Weaving Handbook - Sulzer publication
5 Handbook of Technical Textiles, A R Horrocks & S C Anand

M. Tech. (Textile Technology) Sem-II

TTL544: DESIGN OF EXPERIMENTS & STATISTICAL APPLICATIONS IN TEXTILES

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives

1 To explain the ANOVA with suitable examples
2 To describe basic designs of DoE
3 To explain the 2^n factorial Experiments in textiles
4 To explain properties, advantages and merits of Linear programming & Network Analysis

Course Outcomes

At the end of the course students will be able to

1 Describe the logic, requirements of Analysis of Variance in textiles
2 Explain the Basic Designs of Design of Experiments(DoE)
3 Explain the 2^n factorial Experiments
4 Discuss the Linear programming & Network Analysis

Course Contents

Unit 1: **Analysis of Variance:**Revision of basic concepts of testing of hypothesis and estimation. Introduction of ANOVA, Types of ANOVA. One-way analysis of variance, mathematical model, ANOVA table &examples.Two-way analysis of variance one observation per cell & with m observations per cell, Mathematical models, ANOVA table & examples. **6 Hrs.**

Unit 2. **Design of Experiments:Basic Designs:** CRD & examples as one-way ANOVA, RBD & examples astwo-way ANOVA. LSD & examples of LSD. **6 Hrs.**

Unit 3. **Factorial Experiments:**Introduction of factorial experiments , 2^n factorial experiments, Analysis of 2^n factorial experiments. Examples of 2^n factorial experiments.Introduction of fractional factorial experiments and Taguchi technique for reduction and optimization in design ofexperiments (No examples) **6 Hrs.**

Unit 4. **Linear programming Problem:**Introduction, formulation of LPP, graphical and simplex methods forfinding solutions of LPP. Examples. **6 Hrs.**

Unit 5. **Transportation and Assignment Problems:** Introduction, Methods for finding initial solution and U-V method of finding optimum solution oftransportation problem and Examples.Hungerian method of solving assignment problem and Examples. **6 Hrs.**

Unit 6. **Network Analysis:** Programme Evaluation and Review Techniques(PERT): Introduction,Slack time critical path, Probability of completion of projects.Examples.Ctitical path method (CPM): Introduction, Time estimates, Floats,Critical path. Examples. **6 Hrs**

Reference Books

1 Modern Elementary Statistics by J. Fruend.

2 Mathematical Statistics by J. Fruend.
3 Probability & Statistics for engineers by Johnson
4 Applied Statistics & probability for engineers by Montgomery.
5 Experimental Designs by Cochran & Cox.

M. Tech. (Textile Technology) Semester-II

TTLEL3 (TTL545): GEO-TEXTILES & GEO-SYNTHETICS

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives:

1. To describe Overview of geo textiles.
2. To explain raw materials used fibre properties for geo textiles.
3. To explain functions and testing of geo textiles.
4. To explain design principles of geosynthetics, National and international standards governing geosynthetics.

Course Outcomes:

At the end of the course students will be able to

1. Explain Overview of geo textiles.
2. Describe raw materials used fibre properties for geo textiles.
3. Describe functions and testing of geo textiles.
4. Describe design principles of geosynthetics, National and international standards governing geosynthetics.

Course Contents

Unit 1. **Overview of geo textiles,** types of geo textile, development of Geo textiles, functions of Geo textiles. Growth of Geo textiles, potential of geo textiles in India **4 Hrs.**

Unit 2. **Raw materials used fibre properties for geo textiles**, production of Geo textiles. Such as wovens, non-wovens, knitted, grids, mats, ties, cellular Geo textiles, webs, stripes, bio degradable geo textiles, and their properties for different functions and test methods. **8 Hrs.**

Types of soils, their characteristics, testing of soil.

Unit 3. **Functions of Geo textiles:**Filtration and erosion control application. Principles, Erosion control for inland waterways, coastal erosion protection, scour protection, rain fall erosion control.Drainage application: structural drainage, fin drains, land drainage etc. Separation application: Unpaved Road, Paved road, Railways. Soil Reinforcement **6Hrs.**

	application. Steep faced embankment, slope stabilization, retaining walls, Geo Textiles pile capping.	
Unit 4.	**Testing:**Durability and creep: Soil induced degradation, chemical pollution, Temperature resistance, sunlight degradation, stress relaxation	**6 Hrs.**
Unit 5.	**Geosynthetics:** The design principles of geosynthetics: Introduction, past practice in geosynthetic design, Present practice in geosynthetic design, possible future practice in geosynthetic design. The material properties of geosynthetics: Introduction, Physical properties, Mechanical properties, Hydraulic properties, Endurance properties, Degradation, The durability of geosynthetics: Introduction, Mechanisms of degradation, Synergistic effects, accelerated testing methods. Quality assurance for geosynthetics: Introduction, Definitions, Responsibilities, Design aspects, Manufacturing quality control, Installation and construction, Benefits, Costs	**8Hrs.**
Unit 6.	**National and international standards governing geosynthetics:** Why standardization, Types of standard, Standards development organizations, Geosynthetic standards Multifunctional uses of geosynthetics in civil engineering: Introduction, Composite geosynthetics, Smart geosynthetics, Active geosynthetics	**4Hrs.**

Reference Books

1. Geo Textile by NWM John.
2. Geo synthetics world by J. N. Mandal.
3. Designing with Geo synthetics by R. M. Koerner.
4. Periodicals on Non Woven & Geo Textiles.
5. Geotextiles by Dr P.K.Banerjee
6. Geotextiles by BTRA (Private circulation)
7. Geosynthetics in civil engineering, Edited by R. W. Sarsby, Published by Wood head Publishing Limited in association with The Textile Institute, 2007
8. Geo synthetics world by J. N. Mandal.

M. Tech. (Textile Technology) Semester-II

TTLEL3 (TTL546): ADVANCED TEXTILE MATERIAL ENGINEERING

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives

1 To describe the concept, scope and logic of product development in Textiles
2 To explain the stages of product development such as market research, product life cycle and bench marking
3 To illustrate the scope and merits of simulation of textile products including simulation tools available like FABCAD, MECHFAB
4 To explain the different case studies related to the product development of technical textile products

Course Outcomes

At the end of the course students will be able to

1 Describe the significance of product development in textiles and its overall design logic
2 Explain the market research, product life cycle and bench marking with suitable examples in textiles
3 Apply the knowledge of simulation for the product development
4 Study & Analyze the techno economics of each of the case studies

.

Course Contents

Unit 1. General overview of innovation and textile product development : 6 Hrs.

Innovation and new product development in textiles, Introduction: incremental change versus disruptive innovation, Forces for innovation, organizing for disruptive innovation, the textile industry and innovation, Trends in textile innovation: wearable electronics, biomedical, biomimetic and nano-textiles, Case studies in innovation in textile manufacture for Technical Textiles.

Product Engineering: Objectives and Scope of product development in textiles and clothing. Performance and serviceability concepts in textiles. Effect of changes in fibre, yarn type and fabric construction and finishing on performance and serviceability of textile products.

	Consideration of a good product design. Product development procedure -Selection of product, Product analysis, Product design procedure- Preliminary design, Maintainability, Reliability and Redundancy, Final design. Product life cycle. Market Research, Material Research, Equipment and process research	
Unit 2.	**Simulation of specified properties or structures leading to design –** Special yarns, Woven fabrics, Non – woven fabrics, Simulation of material, Texture by using computer graphics, Concept of overall designing procedure. Practical aspects of innovation in the textile industry Introduction and practical aspects of innovation, Meeting the needs of customers better than the competition, Innovation as a driver of new strategic issues in the apparel industry, Future trends in innovation Textile product development and definition Introduction, Nylon to Tactel, Sustainability, Future trends New product developments in knitted textiles Introduction, Seamless knitwear, Printing on knitwear, Computer aided knitwear design (CAD) and virtual knitwear Fabrics and new product development Introduction, Market demand, Functionality responses, Environmental sustainability responses, sensing textiles responses, New product development in automotive upholstery Introduction, The automotive textile market, key drivers and supply chain, New product development process for automotive upholstery, Novel materials and processes in automotive upholstery, Future developments in automotive upholstery	**8 Hrs.**
Unit 3.	**Nanotechnology innovation for future development in the textile industry:** Introduction, Nanotechnology in the textile industry, Adoption of nanotechnology for textile applications	**6Hrs.**
Unit 4.	**New product development in interior textiles :** Introduction, New product development of interior textiles – basics and general procedures, Case studies, Learning experiences for successful new product developments of interior textiles, Future trends in interior textiles	**6 Hrs.**
Unit 5.	**New product development for e-textiles:** Introduction, Integration of electronics and fabrics, E-textiles product development challenges	**6Hrs.**
Unit 6.	**Customer co-creation:** moving beyond market research to reduce the risk in new product development ,Introduction, Challenges of identifying customer needs in the product development process	**4Hrs.**

Reference Books

1. New product development in textiles: Innovation and production, Edited by L. Horne, Published by Woodhead Publishing Limited in association with The Textile Institute,2012
2. Hand book of Textile Design Principles, Process and Practice by Jacquie Wilson, Textile Institute Publication.
3. The Design Logic of Textile Products, Textile progress vol. 27, No. 3, T Matuo and M. N. Suresh. The Textile Institute Publication.
4. Engineering Design by George Dieter.
5. Proceedings of the Seminar – Non woven Technology, Market and Product Potential, IIT, New Delhi, December 2006

M.Text. (Textile Technology) Semester-II
TTLEL3 (TTL547): CLOTHING SCIENCE

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course objectives:

1. To explain clothing classification system, Planning and organization of clothing production.
2. To describe clothing production management and Quality requirements for clothing materials.
3. To explain role of fabric properties in the clothing-manufacturing process.
4. To describe Fabric sourcing and selection.

Course Outcomes:

At the end of the course students will be able to

1. Describe clothing classification system, Planning and organization of clothing production.
2. Explain clothing production management and Quality requirements for clothing materials.
3. Describe role of fabric properties in the clothing-manufacturing process.
4. Explain Fabric sourcing and selection.

Course Contents

Unit 1. **Clothing classification systems:** General clothing classification, Harmonised clothing classification systems, Classification of functional clothing **4 Hrs.**

Introduction to clothing biosensory engineering

Consumer trends, Definition of sensory comfort, Human–clothing–environment system, Clothing biosensory engineering

Psychology and sensory comfort

Perception of comfort, Psychological research techniques, Comfort sensory descriptors, Psychophysics, Scales of measurement, Scales to measure direct responses, Wear trial techniques

	Clothing sizing systems Clothing size and designation systems: a chronological review, European and international sizing systems, ISO clothing sizing systems, European designation of clothing sizes, The JUS clothing sizing system	
Unit 2.	**Planning and organization of clothing production:** Production planning and organization within a company, Clothing-design analysis and activity planning, Key documentation Planning of clothing design, pattern making and cutting Constructing garment patterns, Pattern-pieces and their preparation, Pattern cutting-markers ,Designating cutting-markers, Defining fabric and other parameters, Technological requirements when arranging pattern-pieces within a cutting-marker, Cutting-marker efficiency, Fabric losses outside the cutting-marker, Determining fabric consumption Planning clothing manufacturing Analysis of clothing manufacture requirements and selection of appropriate equipment, Joining technologies, Work analysis, Identifying work methods, Selecting processing equipment, Types of sewing machine, Determining standard time, Planning manufacturing operations, Planning clothing assembly	**8 Hrs.**
Unit 3.	**Clothing production management :** Determining production capacity needs, Production planning, Production scheduling, Production monitoring and control, Costs in production planning and management, controlling production planning and management	**6Hrs.**
Unit 4.	**Quality requirements for clothing materials :** Quality requirements for textile materials for clothing, Physical characteristics: types, methods of measurement and tolerances, Performance characteristics: types, methods of measurement and minimum quality standards, Visible faults, Care labelling of clothing and textile products, Ecological labelling of clothing and textile products Product development in the apparel industry Product-development models and product-development process, Variations in apparel product development: demand-led product development, Apparel product-development technologies, Apparel product standards, specifications, quality assurance and product technical package, Apparel product life-cycle management (PLM) and supply-chain relationships, Measures for apparel product development, Future trends in apparel product development, Case studies: PD tools and technologies	**8 Hrs.**
Unit 5.	**Role of fabric properties in the clothing-manufacturing process:** Fabric properties and performance, Garment make-up process and fabric	**6Hrs.**

properties, Low-stress mechanical properties and make-up process, Control system, Fabric tailorability, buckling and formability, Sewability

Unit 6. **Fabric sourcing and selection :**Fabric sourcing, Fabric inspection Garment-finishing techniques ,Garment finishing for functionality, Knitwear finishing, Denim garment finishing, Pressing (factors and equipment) **4Hrs.**

Reference Books

1. Design of clothing manufacturing: A systematic approach to planning, processes scheduling and control, Jelka Geršak, Published by Woodhead Publishing in association with The Textile Institute, 2013
2. Garment Manufacturing Technology Edited by Rajkishore Nayak and Rajiv Padhye, Published by Woodhead Publishing in association with The Textile Institute, 2015
3. Apparel Machinery and Equipments, R.Rathinamoorthy and R. Surjit, Woodhead Publishing India Pvt. Ltd, 2015
4. Clothing biosensory engineering, Edited by Y. Li and A.S.W. Wong, Published by Woodhead Publishing Limited in association with The Textile Institute, 2016

M. Tech. (Textile Technology) Semester-II

TTLEL3 (TTL548): PROJECT PREPARATION, APPRAISAL & IMPLEMENTATION

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives

1 To explain the logic of project concept and its development cycle
2 To describe in detail the technical analysis for raw material and utilities
3 To illustrate the correlation of money with time with examples
4 To explain requirements for appraisal and project implementation

Course Outcomes

At the end of the course students will be able to

1 Describe the logic of Project development cycle & identification of Investment
2 Explain the Basics of Technical Analysis for Material inputs & utilities
3 Explain the Time value of money with numerical examples
4 Discuss the study on Appraisal criteria & Project implementation steps

Course Contents

Unit 1. **Overview.** **4 Hrs.**

Project development cycle, Objectives of investment, decision-making, Risk & return Identification of investment opportunities – Governmental regulatory framework – Generation & screening of project ideas – Project identifications for an existing company.

Unit 2. Market & demand analysis – Information required for market & demand analysis – demand forecasting methods – market planning. **8 Hrs.**

Cost of Capital – Basic concepts – Cost of debt – cost of preference capital – cost of Equity Capital – Weighted average cost of capital – Marginal cost of capital-Cost of capital for a new company

Unit 3.	Technical Analysis – Material inputs & utilities – Manufacturing process./ technology – Plant capacity – location & site – structures & civil works – Machineries & equipments – Project charts & layouts – Work schedule – Need for tendering alternatives.	**6Hrs.**
Unit 4.	Financial Analysis – Cost of Project – Means of finance – Estimation of Sales & Production – Cost of production – Working capital requirement & financing – Profitability projections – Break even point – Project cost flow statements – Projected balance sheet – Multi – year projection.	**6 Hrs.**
Unit 5.	Time value of money – Future value of single amount, Future value of an annuity –Present value of single amount – Present value of an annuity. Analysis of Risk – Types & measurement of project risk – Analytical derivation or simple estimation – Sensitivity Analysis – Scenario analysis –Selection of a project-Risk analysis in practice	**8Hrs.**
Unit 6.	Appraisal criteria – Urgency, Pay back period – Accounting, Debt service coverage ratio, Rate of Return, Net present value – Internal rate of return – Annual capital charge – Investment appraisal in practice. Project implementation – Forms of project organization – Project planning – project control – Human aspects of project management – Prerequisites for successful project implementation	**6Hrs.**

.

REFERENCE BOOKS :-

1. Textile Project Management by A. Ormerod, The Textile Institute Publication.
2. Goal Directed Project Management by E.S. Andersen, K.V. Grude & Tor Hang, Coopers & Cybranl Publication.
3. Project, Planning Analysis, Selection Implementation & Review by Prasanna Chandra, Tata McGraw Hill Publishing Co. Ltd.,
4. Industrial Organisation & Engg. Economics T.R. Banga & S.C. Sharma, Khanna Publishers, Delhi.

M. Tech. (Textile Technology) Semester - II
TTLEL4 (TTL549): SMART TEXTILES

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course objectives:

1. To describe general introduction of smart textiles and modelling of intelligent materials.
2. To explain temperature sensitive shape memory polymers.
3. To explain solar textiles and introduction to conductive materials.
4. To explain applications of smart / intelligent textiles.

Course Outcomes:

At the end of the course students will be able to

1. Explain general introduction of smart textiles and modelling of intelligent materials.
2. Describe temperature sensitive shape memory polymers.
3. Describe solar textiles and introduction to conductive materials.
4. Describe applications of smart / intelligent textiles.

Course Contents

Unit 1. **General introduction:** Definition, classification, intelligent systems and general applications. **4 Hrs.**

Unit 2. **Modelling of intelligent materials:** Background, underpinnings of interdisciplinary, scientific practices and research strategies for intelligent garments **8 Hrs.**

Phase change materials: Heat balance and thermo-physiological comfort, Phase change technology, PCM in textiles, Future prospects of PCM in textiles and clothing

Intelligent textiles with PCMs: Basic information of phase change materials, Phase change properties of linear alkyl hydrocarbons, Textiles containing PCM, Measurement of thermo regulating properties of fabrics with micro PCMs Shape memory polymer: Introduction to shape memory polymer, Shape memory alloys, Shape memory ceramics, Magnetic shape memory materials, Shape memory polymers and gels, Future prospects of shape memory materials

Unit 3.	**Temperature sensitive shape memory polymers:** A concept of smart materials, Shape memory polymer and smart materials, Some examples of shape memory polymer for textile applications, Potential use of shape memory polymer in smart textile, General field of application, Challenges and opportunities Study of shape memory polymer films for breathable textiles: Breathability and clothing comfort, Breathable fabrics, Water vapor permeability (WVP) through shape memory polyurethane Chromic and conductive materials: Photo chromic materials, Thermochromic materials, Colour changing, Electro chromic materials	**8Hrs.**
Unit 4.	**Solar textiles**: production and distribution of electricity coming from solar radiation: Solar cells, Textiles as substrates, Technological specifications, Challenges to be met, Suitable textile constructions.	**4 Hrs.**
Unit 5.	**Introduction to conductive materials**: Electric conductivity, Metal conductors, Ionic conductors, inherently conducting polymers, Application technologies for conducting fibre materials Multipurpose textile based sensors: Introduction, Conductive polymer textile sensors, Conductive polymer composites (CPCs) textile sensors Textile micro system technology: Textile micro system technology, Textiles are inherent microstructures, Textile-based compliant mechanisms in micro-engineering and mechatronics	**6Hrs.**
Unit 6.	**Applications:**Intelligent textiles for medical and monitoring applications,Context aware textiles for wearable health assistants,Intelligent garments in prehospital emergency care,Intelligent textiles for children,Wearable biofeedback systems,Applications for woven electrical fabrics	**6Hrs.**

Reference Books

1. Smart fibres, fabrics and clothing edited by Xiaoming Tao, Wood head publishing Ltd., Englang.
2. Intelligent Textile and clothing edited by H. R. Mattila, Wood head Publishing, England.
3. Clothing bisensory Engineering edited by Y. L. and A. S. W Wang, Wood head publishing ltd. England.

M. Tech. (Textile Technology) Semester - II
TTLEL4 (TTL550): NARROW FABRICS

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course objectives:

1. To explain Introduction and narrow fabric weaving.
2. To describe other methods of Narrow fabrics production.
3. To explain dyeing and finishing of Narrow fabrics.
4. To describe testing and applications of narrow fabric.

Course Outcomes:

At the end of the course students will be able to

1. Describe Introduction and narrow fabric weaving.
2. Explain other methods of Narrow fabrics production.
3. Describe dyeing and finishing of Narrow fabrics.
4. Explain testing and applications of narrow fabric.

Course Contents

Unit 1. **Introduction:** Definition and scope of Narrow fabric, General aspects of Narrow fabric, Different Methodsof Narrow fabric production, various materials used for manufacturing of Narrow fabrics **8 Hrs.**

Unit 2. **Woven Narrow fabrics:** General aspects of narrow fabric weaving, Methods of weft insertion, Preparatory process for Elastic, Non elastic warp and weft for Narrow fabric weaving, Weaving of Elastic, Non elastic and core sheath yarn as a warp on loom, Requirement of warp let off motion for elastic, non-elastic yarns, various shedding mechanism and its usage, Take up motion for elastic and non-elastic yarns, various types of selvedge and its mechanism, stop motions on loom, Multi colour weft insertion mechanism, Driving arrangement of loom, Designing of narrow fabrics using CAD, Velvet and Pile narrow fabric and its application **8 Hrs.**

Unit 3. **Other methods of Narrow fabrics production:** Knitted narrow fabrics, Braided narrow fabrics, Non-woven narrow fabric and their applications**.** **6Hrs.**

Unit 4.	**Dyeing and finishing of Narrow fabrics:** Various dyes used in dyeing, batch process of dyeing, continuous dyeing of fabrics, Calendaring of Narrow fabrics, Coating and lamination of Narrow fabrics, Thermal printing, Digital printing of Narrow fabrics, Winding and Packing of Narrow fabrics	**6Hrs.**
Unit 5.	**Testing of Narrow fabrics:** Tensile strength testing, Elasticity of fabrics, Fatigue of fabric, Wicking testing, Flame retardancy test, Ageing test, UV resistance test, Narrow fabric inspection system	**4Hrs.**
Unit 6.	**Application of Narrow fabric:** Aerospace, Military, Fire and safety, Industrial, Automotives, Footwears, Fasteners, Luggage, Medical Textiles, Outdoor, Garments specially undergarments, smart textiles	**4Hrs.**

Reference Books

1. Jacob Muller's Mubook-1 (Narrow fabrics Part -1)
2. Jacob Muller's Mubook-2 (Narrow fabrics Part -2)
3. Hand Books of Textile Industry- Narrow woven Fabrics, Vol – 2, E. A. Posselt

M. Tech. (Textile Technology) Semester-II
TTLEL4 (TTL551): NON WOVEN TECHNOLOGY

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives:

1. To explain historical background of nonwovens and web forming techniques of nonwoven manufacturing.
2. To describe meltblown nonwovens and composite nonwovens.
3. To describe finishing and testing of nonwoven fabrics.
4. To explain process variables, advantages, disadvantages and techno economics of all above non woven technologies.

Course Outcomes:

At the end of the course students will be able to

1. Describe historical background of nonwovens and web forming techniques of nonwoven manufacturing.
2. Explain melt blown nonwovens and composite nonwovens.
3. Explain finishing and testing of nonwoven fabrics.
4. Describe process variables, advantages, disadvantages and techno economics of all above non woven technologies.

Course Contents

Unit 1. **Historical background of nonwovens,** non woven definition, stages in Non woven manufacturing. Classification of nonwoven – On the basis of use, on the basis of manufacturing process, on the basis of web formation, on the basis of bonding. **6 Hrs.**

Unit 2. Web Forming Techniques: Carding, Garneting, air laid, wet process, polymer extrusion. Dry laid webs – fibre selection, fibre preparation, web formation, layering, Wet laid nonwoven – Raw materials, production process, special features of the wet laid process and its product. Spun **8 Hrs.**

laced webs,Mechanically bonded webs – needle punched nonwovens, Application of needle punching, stitch bonded nonwovens, applications.

Hydro entangled nonwovens – Bonding process, water system, filtration system, web drying, properties of spun laced webs, applications.
Chemically bonded nonwoven – Latex binder, other types of nonwoven binders, formulation, order of formulation, bonding technology – saturation, foam bonding, spray bonding, print bonding, powder bonding, application of chemical bonded nonwovens.
Thermally bonded nonwovens – binder, binding fibres, binding powder, binding webs, methods of thermal bonding – Hot calendaring, belt calendaring, oven bonding, ultrasonic bonding, radiant heat bonding.

Unit 3.	**Melt blown nonwovens**	**4Hrs.**
Unit 4.	**Composite Nonwovens**	**4 Hrs.**
Unit 5.	**Nonwoven fabric finishing:** Introduction, Wet finishing, Application of chemical finishes, Lamination, Mechanical finishing, Surface finishing, Developing technologies, Fabric inspection	**8Hrs.**
Unit 6.	**Testing & study of process variables,** advantages, disadvantages and techno economics of all above non woven technologies.	**8Hrs.**

Reference Books

1. Nonwoven Process Performance & Testing – Turbak
2. Nonwoven Fabric Construction Synthetic Fibres – Jan-Mar 2007.
3. Proceedings of the Seminar - Nonwoven Technology Market & Product Potential, IIT, New Delhi December 2006.
4. Handbook of nonwovens, Edited by S. J. Russell, Wood head Publishing, CRC Press, Washington DC, 2007
5. W.Albrecht, H. Fuchs and W.Kettelmann, Nonwoven Fabrics: Raw Materials, Manufacture, Applications, Characteristics, Testing Process, Wiley-VCH,Verlag GmbH & Co.KGaA, Weinheim, 2003.
6. M.S. Casper, Nonwoven Textiles, Noyes Data Corp.(Park Ridge, N.J), 1975.
7. M. McDonald, Nonwoven Fabric Technology, Park Ridge, NJ: Noyes Data, 1971

M. Tech. (Textile Technology) Semester-II
TTLEL4 (TTL552): COMPUTER AIDED FABRIC MANUFACTURING

Teaching Scheme	
Lectures	**3 Hrs. /Week**
Total Credits	**3**

Evaluation Scheme	
SE-I	**25**
SE-II	**25**
SEE	**50**
Total	**100**

Course Objectives:

1. To explain Electronic dobby and jacquard.
2. To describe CAD for dobby, jacquard, label weaving and carpet.
3. To explain e-shedding and Management Information System in Fabric Forming.
4. To describe Recent Developments in Computer Aided Fabric Manufacturing.

Course Outcomes:

At the end of the course students will be able to

1. Describe Electronic dobby and jacquard.
2. Explain CAD for dobby, jacquard, label weaving and carpet.
3. Describe e-shedding and Management Information System in Fabric Forming.
4. Explain Recent Developments in Computer Aided Fabric Manufacturing.

Course Contents

Unit 1. **Electronic Dobby:** concept of electronic Dobby, Working principle, constructional variants, , mounting possibilities, pitch of heald frames, capacity, data transfer, adjustments during weave change, design of the electronic dobby, drive arrangement, systems for pattern data transfer, various models available in the markets. **8 Hrs.**

Unit 2. **Electronic Jacquard:** Concept of electronic Jacquard, details of construction and working of electronic Jacquard, comparison between various Jacquard (Bonas, Staubli, Grosse) working principles, selection system, adjustment for various weaves, Jacquard capacity, mounting, suitability for various end uses, data transfer and management, Networking with looms **8 Hrs.**

Unit 3. **CAD for dobby, jacquard, label weaving and carpet:** Development of Jacquard designs, process of drafting and sketch design, development of **6Hrs.**

figures, composition of design, geometric ornamentation, arrangement of figures, weave simulation.

Unit 4. **E Shedding:** Introduction to e shedding, various available machines with this system, need of e shedding, details of construction and working of e device, advantages of this system over quality fabrics. **6 Hrs.**

Unit 5. **Management Information System in Fabric Forming:** Introduction to MIS, Advantages of MIS in Weaving machines, Various MIS available with machines, detailed operational modes of MIS & optimization of process & machine data. **4Hrs.**

Unit 6. **Recent Developments in Computer Aided Fabric Manufacturing** **4Hrs.**

Reference Books

1. Modern Preparation & Weaving by A. Ormerod
2. Shuttless weaving machine – O. Talavasele, V. Svaty
3. Handbook of weaving – Sabit Adanur.
4. Advanced Textile Design by Watson
5. Software manual of Textronics
6. Software manual of Wonder weaves
7. Weaving Machines, Materials & Methods by Prof. M.K. Talukdar, Prof.D.B. Ajgaonkar
8. Modern Methods of Weaving by Duxburry

M. Tech. (Textile Technology) Semester-II
TTD 553: MINI PROJECT –II

Teaching Scheme			Evaluation Scheme	
Practical	**7 Hrs/Week**		**CIE**	**50**
Credits	**7**		**SEE**	**50**
			Total	**100 Marks**

Course Objectives:

1. To identify the problem /idea and review and summarize the literature for the topic of the identified problem & to provide a platform to students to enhance their practical knowledge and skills
2. To describe the process flow for undertaking the research/survey trials with appropriate standards and process variables
3. To design, development, construction, and fabrication of innovative product/system for the final submission
4. To explain various tools of testing and statistical analysis for the data in order to draw relevant conclusions

Course Outcomes:
At the end of the course students will be able to

1. Describe the problem /idea and review and summarize the literature for the topic of the identified problem
2. Illustrate the suitable design of experiments including experimental plan.
3. Explain the concepts of design, development, construction, and fabrication of innovative product/system for the project title
4. Use various tools of testing and statistical analysis for the data in order to draw relevant conclusions.

Rationale: The mini project will involve the design, development, construction, and fabrication of innovative product/system approved by the department. This is a laboratory oriented course which will provide a platform to students to enhance their practical knowledge and skills. Each student must keep a project notebook The notebooks will be checked periodically throughout the semester by the guide and also during the internal viva, as part of the project grade.

Guidelines:

1. Students should select a problem which addresses some textile industry problem, or other product developments in textiles. One mini project per semester per student.
2. The selected topic for mini project should be based on development/fabrication of innovative product which he/she learnt during course work.
3. Students should understand testing of various instruments relating to topic of mini project.
4. Execution of mini project should be carried out by students only under guidance of allotted faculty. One faculty per student.
5. Students should develop a necessary product with product specifications with reference to end use.
6. Students should see that final product submitted by them is in working condition.
7. 15-20 pages report to be submitted by students in prescribed guide lines. Presentation is for 10 minutes.
8. Group of students cannot be permitted to work on a single mini project. Individual student has to carry out mini project.
9. A demonstration and internal oral examination on the mini project also should be done at the end of the semester.

DKTE Society's

TEXTILE & ENGINEERING INSTITUTE

Rajwada, Ichalkaranji - 416115

(An Autonomous Institute)

DEPARTMENT: TEXTILES

CURRICULUM

M. Tech. (Textile Technology)

Second Year

With Effect From

2017-18

DKTE

Promoting Excellence in Teaching
Learning & Research

M. Tech. (Textile Technology) Semester-III
TTD601: DISSERTATION PHASE 1

Teaching Scheme			Evaluation Scheme	
Practical	**20 Hrs/Week**		**CIE**	**50**
Credits	**20**		**SEE**	**100**
			Total	**150 Marks**

Course Objectives:

1. To identify the problem /idea and review and summarize the literature for the topic of the identified problem
2. To describe the process flow for undertaking the research/survey trials with appropriate standards and process variables
3. To design, development, construction, and fabrication of innovative product/system for the final submission
4. To explain various tools of testing and statistical analysis for the data in order to draw relevant conclusions

Course Outcomes:
At the end of the course students will be able to

1. Describe the problem /idea and review and summarize the literature for the topic of the identified problem
2. Illustrate the suitable design of experiments including experimental plan.
3. Explain the concepts of design, development, construction, and fabrication of innovative product/system for the project title
4. Use various tools of testing and statistical analysis for the data in order to draw relevant conclusions.

Rationale: The Dissertation work is divided into 2 phases. Phase 1 will involve the finalization of topic of project, Literature survey, Plan of action and at least half of the project trials (50%) should be completed.
The project will be chosen with reference to design, development, construction, and fabrication of innovative product/system approved by the department/Guide. This is a laboratory oriented

course which will provide a platform to students to enhance their practical knowledge and skills by development of novel and intelligent product. Each student must keep a project notebook

Guidelines for Dissertation Phase I:

1. Students should select a project which addresses some textile industry problem, or other product developments in textiles. Duplicate work is not allowed in any case.
2. The selected topic for project should be based on development/fabrication of innovative product which he/she learnt during course work. The selected project title has to verify by any means so as to avoid repeated type of work which is not allowed.
3. Students will be working under 2 guides. One guide is Main guide and second is co-guide. Both should have guide ship, recognized by University.
4. Students should carry out the in depth literature survey covering total spectrum of data from different sources.
5. Students should propose suitable plan of work in the form of flow chart considering the available resources at Institute.
6. In case of shortage of resources, they can access to the outside textile world for the procurement of raw material or trails on desired machines or testing etc.
7. Students should take prior permission to utilize the available resources in the institute.

M. Tech. (Textile Technology) Semester-IV
TTD602: DISSERTATION PHASE II

Teaching Scheme			Evaluation Scheme	
Practical	**28 Hrs/Week**		**CIE**	**100**
Credits	**28**		**SEE**	**200**
			Total	**300 Marks**

Course Objectives:

1. To identify the problem /idea and review and summarize the literature for the topic of the identified problem
2. To describe the process flow for undertaking the research/survey trials with appropriate standards and process variables
3. To design, development, construction, and fabrication of innovative product/system for the final submission
4. To explain various tools of testing and statistical analysis for the data in order to draw relevant conclusions

Course Outcomes:
At the end of the course students will be able to

1. Describe the problem /idea and review and summarize the literature for the topic of the identified problem
2. Illustrate the suitable design of experiments including experimental plan.
3. Explain the concepts of design, development, construction, and fabrication of innovative product/system for the project title
4. Use various tools of testing and statistical analysis for the data in order to draw relevant conclusions.

Rationale: The Dissertation work of Phase II is mainly the completion of the remaining 50% of the project work. This includes the compilation of results, results and discussions, conclusions.

Guidelines for Dissertation Phase II:

1. Students should complete and compile the trials, testing.
2. Students should propose a complete thesis writing with given guidelines
3. Students will be ready for the internal Viva with synopsis, objectives, plan of work and results and discussion.
4. The results and discussion will be as per in line with the plan of work. No deviation is allowed.

5. The students have to present their work in front of the internal dissertation evaluation committee.
6. The suggestions from internal experts should be incorporated in the soft copy of the final thesis.
7. Sufficient time of 2 weeks will be given for the corrections.
8. The corrected soft copy can be verified from the allotted faculty. If it is OK as per the guidelines, then thesis will be printed, bound.
9. The bound copies will be submitted to the institute for further action on the externals.