DKTE Society's

TEXTILE & ENGINEERING INSTITUTE

Rajwada, Ichalkaranji - 416115

(An Autonomous Institute)

DEPARTMENT: TEXTILES

CURRICULUM

M. Tech. (Technical Textiles)

First Year

With Effect From

2017-18

DKTE

Promoting Excellence in Teaching
Learning & Research

M. Tech. (Technical Textiles) Semester – I – Structure

Sr. No.	Course Code	Name of the Course	Group	Teaching Scheme				Credit
				Theory Hrs / week	Practical Hrs / week		Total	
1	TXL530	Fabric Structure and Engineering	D	3			3	3
2	TXL531	Industrial Applications of Textiles	D	3			3	3
3	TXL532	Theory of Textile Structures	D	3			3	3
4	TXLEL1	Elective-I	D	3			3	3
5	TXLEL2	Elective - II	D	3			3	3
6	TXD542	Mini Project -I	F		7*		7	7
Total				15	7		22	22

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

List of Electives -I

TXL533 Agro and Geotech

TXL534 Recycling of Technical Textiles

TXL535 Smart Materials and Textiles

TXL536 High Performance Fibres

List of Electives -II

TXL537 Advanced Computer Programming and Applications

TXL538 Medical Textiles

TXL539 Shape Memory Polymers & Phase Changing Materials

TXL540 .Automotive Textiles

TXL541 Environmental Engineering in Textiles

M. Tech. (Technical Textiles) Semester – II – Structure

Sr. No.	Course Code	Name of the Course	Group	Teaching Scheme				Credit
				Theory Hrs / week	Practical Hrs / week		Total	
7	TXL543	Textiles Composites	D	3			3	3
8	TXL544	Surface Treatment of Textiles for Technical Applications	D	3			3	3
9	TXL545	Design of Experiments & Statistical Applications in Textiles	D	3			3	3
10	TXLEL3	Elective - III	D	3			3	3
11	TXLEL4	Elective - IV	D	3			3	3
12	TXD555	Mini Project -II	F		7*		7	7
Total				15	7		22	22

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

List of Electives -III

TXL546 Advanced Textile Material Engineering

TXL547 Science and Technology of Nano Materials in Textiles

TXL548 Stand up and Start up in Technical Textiles

TXL549 Project Preparation, Appraisal & Implementation

List of Electives -IV

TXL550 Nonwoven Technology

TXL551 Textile For Protection

TXL552 Speciality Fabrics Manufacturing

TXL553 Testing and Analysis of industrial Textiles

TXL554 Computer Aided Fabric Manufacturing

M. Tech. (Technical Textiles) Semester – III – Structure

Sr. No.	Course	Name of the Course	Group	Teaching Scheme				Credit
				Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	
1	TXD601	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. (Technical Textiles) Semester – IV – Structure

Sr. No.	Course	Name of the Course	Group	Teaching Scheme				Credit
				Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	
1	TXD602	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. (Technical Textiles) Semester – I

Differences in the University and Autonomy syllabus-structure

Shivaji University Subject Name	Autonomy Subject Name	Remarks/ Major changes in Syllabus
First Year I semester		
Manufacture of Fabrics for Technical Textiles	Fabric structure and Engineering	Some part of the basic fabric production methods are replaced with engineering aspects of fabric structure. The theories proposed by the various authors are also included. Braided and 3D fabrics are also included in this proposed syllabus for autonomous.
Industrial Applications of Textiles	Industrial Applications of Textiles	The most demanding part of industrial textiles is coating and lamination. This is included. Phase change materials, shape memory polymers and nano fibres are also proposed for study since these are the new developments for the technical textiles.
Nanotechnology in Textiles	Theory of Textile Structures	Theory of Textile Structures has detailed study of fibre and yarn structure and its impact on yarn and fabric properties. This is very important subject for the product development and fabric engineering. Hence is it included in first semester and replaced Nanotechnology subject.
ELECTIVE-I : 1.Textiles for Protection 2. Textiles for sports application	ELECTIVE-I : 1.Agro and Geotech 2. Recycling of Technical textiles 3. Smart Materials and Textiles 4.High Performance Fibres	In university structure, number of electives was limited to only two. But, in autonomy structure, four subjects will be available for students to choose. The more relevant subjects such as agro & geotech, Recycling of technical textiles, smart textiles etc.are also introduced in the electives of autonomy structure
Advanced Computer Applications In Textiles	Elective –II 1. Advanced Computer Programming and Applications 2. Medical Textiles 3. Shape Memory Polymers & Phase Changeing Materials 4. Automotive Textiles 5. Computer Aided Fabric Manufacturing	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 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 II semester		
Plasma Technology for Textiles	Textile Composites	Textile composite market is rapidly growing and hence knowledge of fibre reinforced composite is a must even for further education and research. Hence Plasma subject is replaced.
Medical Textiles	Surface Treatment of Textiles for Technical Applications	The fabric surface can be modified as per the end use. Surface treatments market is growing. The functional finishes based on nano technology, plasma & coating, Lamination is also proposed in this syllabus.
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.
Fibre Reinforced Composites	ELECTIVE-III : 1.Advanced Textile Material Engineering 2. Science and Technology of Nano Materials in Textiles 3. Stand up and Start up in Technical Textiles 4. Project Preparation, Appraisal & Implementation	Knowledge on the Project preparation, appraisal & implementation are the key factors for the successful of any new venture. The project fundamental studies on the costing are also added. This subject is proposed in Elective-III. The other three subjects are also included in the elective list. In the place of Fibre Reinforced Composites subject Elective –III group is introduced. Therefore, students will have more subjects to choose.
Elective-II 1. Textiles for Automobile Engineering 1. Intelligent Textiles & Clothing	Elective –IV 1. Nonwoven Technology 2. Textile For Protection 3. Speciality Fabrics Manufacturing 4. Testing and Analysis of industrial Textiles 5. .Environment Aspects in Technical Textiles	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.
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. (Technical Textiles) Semester - I
TXL530: FABRIC STRUCTURE AND 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 Geometrical modeling of woven fabric structure
2. To explain the Design and engineering of woven fabrics based on braided technology
3. To illustrate the Modelling of knitting
4. To explain the market size and techno economics of Non Woven Fabric

Course Outcomes

At the end of the course students will be able to

1. Describe the Geometrical modeling of woven fabric structure with numerical examples and also based on braided technology
2. Explain the technical details of Design and engineering of woven fabrics based on the input variables
3. Compile the technology applied in manufacturing of technical textiles using knitting & non woven technology
4. Evaluate the performance of technical textiles of woven, knitted and non woven technology

Course Contents

Unit 1. WOVEN FABRIC 8 Hrs.

Geometrical modeling of woven fabric structure

Introduction: woven fabric structure, A simple geometric model of woven fabric structure, Using the model to predict the fabric thickness, cover, mass and specific volume, Modeling maximum fabric cover, Calculating fabric properties: numerical examples

Unit 2. **Using a geometric model to predict woven fabric properties** 8 Hrs.

Introduction, predicting the weavability limit, Weave factor & Yarn diameter, Maximum construction theories, Pierce's tightness(cloth cover), Russell's Tightness, Newton's Tightness, Calculating fabric properties: numerical examples, Application: calculating tightness values

Unit 3. **Modeling three-dimensional (3-D) woven fabric structures** 4Hrs.

Introduction: 3-D fabrics, 2D and 3-D fabric weaving, Classifying 3-D woven fabrics, Modeling equations for weaving 2-D and 3-D fabrics, use of 2-D and 3-D textiles in composites.

Unit 4. **KNITTED FABRIC** 6 Hrs.

Modelling of knitting

Introduction, Knitted fabric geometry, Mechanics of knitted fabric
Advances in knitting: Intelligent yarn delivery systems in weft knitting
Flat bed weft knitting machine, Circular knitting machine, warp knitting machine.

Advances in warp knitted fabric production

Introduction, Commercial warp knit machines, Tricot and Raschel containing spandex, Newly developed constructions with spandex, Surface interest fabrics. Production of Spacer fabrics in knitting.

Unit 5. **NON WOVEN FABRIC** 6 Hrs.

Biodegradable materials for nonwovens

Reasons for using biodegradable nonwovens, Cotton, hemp and other natural fibres, Cotton and flax-based nonwovens, Nonwovens from animal fibres, Technologies for biodegradable nonwovens, Applications of biodegradable nonwovens

Computer programs for measuring nonwoven performance Characterization, testing and modelling of nonwoven fabrics

Introduction: characterization of nonwoven fabrics, Characterization of fabric bond structure, Fabric weight, thickness, density and other structural parameters, General standards for testing nonwovens, Measurement of basic parameters, Measuring fibre orientation distribution, Measuring porosity, pore size and pore size distribution, Measuring tensile properties, Measuring gas and liquid permeability, Measuring water vapour transmission, Measuring wetting and liquid absorption, Measuring thermal conductivity and insulation, Modelling pore size and pore size distribution, Modelling tensile strength, Modelling absorbency and liquid retention, Modelling capillary wicking. The

influence of fibre orientation distribution on the properties of thermal bonded nonwoven fabrics

Unit 6. BRAIDED TECHNOLOGY FOR TEXTILES 4Hrs.

Introduction : Market, scope, advantages, techno economic study, Types, machines

The mechanics of the braiding process: Braiding point parameters, Forces on the braid building yarn segment, Relationship between take-off velocity and braiding angle, Control of the yarn tension in the braid former

Computer assisted design (CAD) software for the design of braided structures: Introduction, Colour design of braided structures, 3D geometrical models, Calculations for braiding.

Manufacturing Technology and Technical specifications of Braided Biaxial fabric, Braided Triaxial Fabric.

Reference Books

1. Woven textile structure: Theory and applications, B. K. Behera and P. K. Hari
2. Advances in knitting technology, Edited by K. F. Au
3. Woven Fabric Structure : Design and Product Planning, J. Hayavadana
4. Soft computing in textile engineering, Edited by A. Majumdar
5 Applications of nonwovens in technical textiles, Edited by R. A. Chapman
6 Nonwoven Process Performance & Testing – Turbak
7 Proceedings of the Seminar - Nonwoven Technology Market & Product Potential, IIT, New Delhi December 2006.
8 Handbook of nonwovens, Edited by S. J. Russell, Wood head Publishing, CRC Press, Washington DC, 2007
9 The Comparison of Woven Fabrics by Reference to Their Tightness, **Journal of the Textile Institute** 86(2):232-240 · January 1995.
10 Braiding Technology for Textiles , Y. Kyosev , Woodhead Publishing Series in Textiles: Number 158, 2015
11 Newton, A. (1991). Tightness comparison of woven fabrics, Indian Textile Journal, 101, 38-40.
12 Newton, A. (1995). The comparison of woven fabrics by reference to their tightness, J.Text. Inst., 86,232-240.
13 Peirce, F. T. (1937). Journal of the Textile Institute, 28, T45-112.

M. Tech. (Technical Textiles) Semester - I
TXL 531: INDUSTRIAL APPLICATIONS OF 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 the market size ,scope and advantages of Industrial Textiles
2 To explain the details of manufacturing of technical textile products including the coated and laminated textiles
3 To illustrate the various applications of Technical Textiles and their specifications
4 To explain the test methods of Industrial Textiles

Course Outcomes

At the end of the course students will be able to

1 Describe the significance of product development in Industrial Textiles
2 Explain the technical details of Technical textile products including the coated and laminated textiles with classification
3 Compile the fibres used, technology applied in manufacturing of industrial textiles based on end use like filtration, Medical use, composites, defence and other industrial applications
4 Evaluate the performance of industrial textiles with different test methods of Indian and International standards

Course Contents

Unit 1. **Classification of Technical Textiles based on End use.** 8 Hrs.

Construction: Importance of buildtech with respect to technical textiles, Requirements of buildtech, study of structure and properties of high performance textile structures in relation to requirements of buildtech. Applications like Fabrics for Architecture and Construction, Applications of Coated Fabrics in Building Structures, Awnings and Canopies, Textiles as Roofing Materials, Storage Vessels, Fibre Reinforced Concrete and Cements, Textiles for Acoustic and heat Insulation

Filtration: Introduction, importance of filtration, Principles and mechanism of Filtration, requirements of filtration, Filtration Equipments, Textile in Dry Filtration, Textile in Liquid Filtration, Designing for Filtration, Testing and evaluation of performance. Application and developments in filtration fabrics.

Military and defense: Introduction, Applications of various textile structure in protective Clothing and Individual Equipment, Textiles Used in Defense Systems and Weapons, Testing and evaluation of various textile structures used in defense and military applications.

Transportation: Introduction, Manufacturing process, structure and properties of Tyre cord fabrics, Airbags, Seat Belts, Automotive Interior Trim, Automotive Exterior Trim ,Truck and Car Covers, Hoses and Filters in Cars. Textile for Aircrafts, Textiles as structural Elements in Transport Vehicles, Inflatable Products Used in Transportation. Testing and evaluation techniques of above products.

Unit 2. **Miscellaneous industrial applications of textiles**: Textiles in Agriculture, Electronics. Textiles for Banners and Flags. Textile Reinforced Products ,Transport Bags and Sheets, Fabrics to Control Oil Spills, Canvas Covers and Tarpaulins, Ropes and Nets, Home and Office Furnishings, Testing and evaluation techniques of all these products. 4 Hrs.

Unit 3. **Coated Textile** – Textile and Coating materials: Textile materials and fibers, their properties, woven, knitted, non-woven materials. Polymeric materials for coating and their properties like rubber (natural and synthetic), polyvinyl chloride, polyurethane, acrylic polymers. 8Hrs.

Applications of coated materials.

Unit 4. **Phase changing materials**: Concept of Phase Change Materials, Mode of action of Phase Change materials, Application of Phase Change Materials. 6 Hrs.

Unit 5. **Shape memory polymers**: Concepts associated with shape memory materials, principle of temperature dependant shape memory polymers, Application and prospects for shape memory polymers. Shape memory fibres, role of smart materials in textiles, shape memory material in smart fabrics and garments. 6Hrs.

Unit 6. **Nano fibers** : Various Methods of manufacturing of nano-fibres, properties and application of nano fibres Introduction, Basics of wetting, Wicking and absorption, Experimental liquid take-up 4Hrs.

Reference Books

1. Wellington Sears Handbook of Industrial Textiles by Sabit Adanur.
2. Handbook of Technical Textiles by A.R. Horrocks.
3. Military Textiles by E. Wilusz.
4. Textiles in Automotive Engineering by W. Fung & M. Hardcastle.
5. Textiles for Protection by R.A. Scott.
6. Fibre-Reinforced Composites by P.K. Mallick.

M. Tech. (Technical Textiles) Sem-I
TXL532: 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 response of fibres. **5 Hrs.**

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. (Technical Textiles) Semester - I
TXLEL1 (TXL533): AGRO & GEO TECH

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 market size ,scope and advantages of Agro textiles & Geo textiles
2 To explain the details of manufacturing of agro textiles products & geo textiles
3 To illustrate the various applications of Agro & geo textiles and their specifications
4 To explain the test methods of Agro & geo textiles

Course Outcomes

At the end of the course students will be able to

1 Describe the significance of product development in Agro and Geo textiles
2 Explain the technical details of Agro and Geo textile products
3 Compile the fibres used, technology applied in manufacturing of Agro and Geo textiles based on end use
4 Evaluate the performance of Agro and Geo textiles with different test methods of Indian and International standards

Course Contents

Unit 1. **PART I:** 4 Hrs.
AGROTECH
History of Agro Textile, Market prospectus of agro textiles, Need of agro textiles

Unit 2. Fibers used for Agro Textiles, Properties Required for Agro-Textiles, Manufacturing Processes of Agro-Textiles, Advantages & Disadvanges of Agro-Textiles 4Hrs.

Unit 3. **Applications of Agro-Textiles**: Agro-textiles for production of crops, Agro-textiles for Horticulture & Floriculture, Agro-textile for Animal Husbandry, Fishing and aquaculture nets etc, Techno-economics of Agro textiles, Norms and Testing 6Hrs.
Research study and publications

Unit 4.	**PART II :** **Geo textiles** 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 5.	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. Types of soils, their characteristics, testing of soil.	8 Hrs.
Unit 6.	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 application. Steep faced embankment, slope stabilization, retaining walls, Geo Textiles pile capping. Testing Durability and creep: Soil induced degradation, chemical pollution, Temperature resistance, sunlight degradation, stress relaxation	10Hrs.

Reference Books

1. Fibrous and composite materials for civil engineering applications, Edited by R. Fangueiro
2. Handbook of Technical Textiles by A.R. Horrocks and S. C. Anand
3. Handbook of Agro textiles: www.technotex.gov.in
4. Coated Textiles Principles and Applications by Dr. A. K. Sen
5. Wellington Sear's Hand book of Industrial Textile by Rd. Sabit Adnur.
6. www.technicaltextiles.net
7 www.textileworld.com/textile-world/.../agrotextiles-a-growing-field/
8 textilelearner.blogspot.com/2012/02/agro-textiles-general-property.htm
9 http://www.textilemedia.com/technical-textiles/new-textile-materials/agrotextiles/
10 http://www.textileworld.com/Issues/2005/September/Nonwovens-Technical_Textiles/Agrotextiles-A_Growing_Field
11 http://www.fibre2fashion.com/industry-article/textile-industry-articles/agro-textiles-a-rising-wave
12 http://www.indiantextilejournal.com/articles
13 Geo synthetics world by J. N. Mandal.
14 Geotextiles by Dr P.K.Banerjee
15 Geotextiles by BTRA (Private circulation), www,btraindia.com

M. Tech. (Technical Textiles) Semester - I
TXLEL1 (TXL534): RECYCLING OF 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 describe the General textile recycling issues and technology
2 To explain the Designing textile products that are easy to recycle
3 To illustrate the various Systems for planning for carpet recycling & waste water
4 To explain the Applications of recycled textiles

Course Outcomes

At the end of the course students will be able to

1 Describe the significance of textile recycling issues and technology
2 Explain the technical details of Designing textile products that are easy to recycle
3 Compile the various Systems for planning for carpet recycling & waste water
4 Evaluate the performance & Applications of recycled textiles

Course Contents

Unit 1. **General textile recycling issues and technology** 6Hrs.
Textile recycling: a system perspective, Introduction, Systems theory, Understanding the textile and apparel recycling process, Textile recycling companies, The sorting process, The pyramid model, Textile recycling constituents

Unit 2. **Designing textile products that are easy to recycle** 4 Hrs.
History, Product responsibility, Current situation in Germany, Basic methods, Examples

Unit 3. **Carpet stewardship in the United States** - a commitment to sustainability 8Hrs.
Introduction, Carpet industry environmental stewardship, Carpet recycling – early efforts, The Carpet America Recovery Effort, Creating a

new industry – material flows, The role of non-carpet products in carpet recycling

Unit 4. **Systems planning for carpet recycling** 8 Hrs.

Introduction, The need for strategic systems planning, Previous system issues, The estimation of carpet recycling volumes, Initial collection schemes, The alternative structures for consolidating and sorting of carpets, Case studies

Carpet recycling technologies

Introduction, Fiber identification and sorting, Size reduction, Mechanical separation of carpet components, Solvent extraction of nylon from carpet, Depolymerization of nylon, Melt processing, Use of waste fibers as reinforcement in polymer composites, Waste to energy conversion

Unit 5. **Recycling waste water from textile production** 6Hrs.

Introduction, System analysis, Optimization of processes for water recycling, direct re-use of waste water, Waste water treatments and water recycling with membrane technology, Re-use of reclaimed/recycled water, Future trends

Recycling and re-use of textile chemicals

Introduction, Fabric preparation processes, Dyeing and printing processes, recycling of finishing compounds, Waste minimization at source

Recycled textile products: Development of products made of reclaimed fibres

Reclaimed fibres as raw materials, Characteristics of reclaimed fibres, Products and markets

Manufacturing nonwovens and other products using recycled fibers containing spandex

Introduction, Spandex, Review of recycling, Evaluation and characterization of the remnant material, Fiber separation trial at recycling plant, Laboratory-scale processing of the recycled material, Chemical treatment of the raw material, Mechanical processing of the chemically treated samples, Types of nonwovens, Markets for needle-punched fabrics, Experiments in production of nonwoven samples, Oil absorption with fibrous waste

Unit 6. **Applications of recycled textiles** 4Hrs.

Recycling of textiles used in the operating theatre, Standards, Products,

Materials, Properties required, Market, Environmental aspects, Waste management

Composite products from post-consumer carpet

Introduction, Separating carpet, Composites from sorted carpet, Wood fiber reinforced composites, Products from reinforced post-consumer carpet

Utilization of recycled carpet waste fibers for reinforcement of concrete and soil

Introduction, Fiber reinforced concrete, Recycled fiber reinforced concrete, Fiber reinforced soil, Recycled fiber reinforced soil

Reference Books

1 Recycling in textiles, Edited by Youjiang Wang, Published by Woodhead Publishing Limited in association with The Textile Institute, 2006
2 Nonwoven Textiles by L.C. Wadsworth.
3 www.indiantextilejournal.com, Published August, 2011,
4 Handbook of Industrial Textiles, Sabit Adanur
5 Nonwovens from Recycled fibres, Asian Textile Journal

M. Tech. (Technical Textiles) Semester - I
TXLEL1 (TXL535): SMART MATERIALS AND 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. (Technical Textile) Semester-I
TXLEL1 (TXL536): 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

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 **6 Hrs.**

Ceramic Fibres: Analysis of characteristics and applications of silicon carbide based fibres, Alumina based fibres. Single crystal oxide fibres.

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. (Technical Textile) Semester-I
TXLEL2 (TXL537): 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, The value chain, supply chain, Porter's value chain model. Inter organization value chains, Business to business E-commerce, Inter **6 Hrs.**

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. (Technical Textiles) Semester - I
TXLEL2 (TXL538): MEDICAL 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 the Biomaterials utilized in medical textiles & Healthcare and hygiene products
2 To explain the Infection control and barrier materials and its testing
3 To illustrate the Bandaging and pressure garments with Mannequin
4 To explain the Implantable devices

Course Outcomes

At the end of the course students will be able to

1 Describe the significance of Biomaterials & Healthcare and hygiene products in medical
2 Explain the technical details of Infection control and barrier materials
3 Compile the various Bandaging and pressure garments with Mannequin
4 Evaluate the performance & Applications of Implantable devices

Course Contents

Unit 1. General introduction: 4 Hrs.

Definition and classification of medical textiles.

Unit 2. Biomaterials utilized in medical textiles: 4 Hrs.

Natural carbohydrate polymers, Modified carbohydrate polymers, Natural and modified proteins, Commercial applications and products using carbohydrate polymers. Reformed collagen fibres, Novel Chitosan-alginate fibres for advanced wound dressings, Modification of alginic acid fibres with hydrolysed chitosans, Effect of degradation on the mechanical properties of biodegradable textiles

Unit 3. Healthcare and hygiene products 8Hrs.

Market prospects, Current issues, Healthcare and hygiene products, Superabsorbent fibres, Antimicrobial fibres, Disposable products, Operating room garments.

Application of nonwovens in healthcare and hygiene sector

Hygiene, Design issues, Absorbent hygiene products, Material used in nonwoven products available in the market . Role of advance textile materials in healthcare

Fibres for medical and healthcare applications, advanced medical textiles

Unit 4. Infection control and barrier materials 8 Hrs.

Infection control and barrier materials, The use of dye-like interactions for developing novel infection-resistant materials, The impact of ageing on the properties of single use garments, The use of Amcor Pure technology in medical textiles for qualitative evaluation of the barrier effect of textiles, Reducing microbial contamination in hospital blankets.

Unit 5. Bandaging and pressure garments 8Hrs.

Compression therapy for venous leg ulcers treatment, A comparison of elastic and non-elastic compression bandages for venous leg ulcer treatment, The theory of the Laplace Law, Laplace Law to predict pressures exerted by pressure garments, Evaluation of pressure profile of bandages using mannequin legs, Effect of fibre type and structure in designing orthopedics wadding for the treatment of venous leg ulcers.

Unit 6. Wound care materials 6Hrs.

Wound care materials: The use of textiles in burns – from injury to recovery, Support surfaces - Initial management - Bandages - Splinting - Skin substitutes, Skin grafts and donor sites - Dressings' - Pressure garments - Silicone gels, Wound care dressings from chitin, Metronidazole loaded microspheres and membranes of dibutyrylchitin: preparation and drug release investigation

Implantable devices:

Vascular Prosthesis, Advantages of gelatin, Impregnated graft, Ligament prostheses, Mesh grafts. Repair of articular cartilage defects using 3-

dimensional tissue engineering textile architectures, A spider silk supportive matrix used for cartilage regeneration, Third generation scaffolds for tissue engineering

Reference Books

1 Medical Textiles & Biomaterial for Healthcare by S.C. Anand, M.M. Traftab, S. Rajendra – Woodhead Publication
2 Advance Textile for Wound Care – by S. Rajendra - Woodhead Publication
3 Medical Textiles 2007 : Proceedings of the fourth international conference on Health card & medical textile – by J.F. Kennedy, S.C. Anand & F. Miraftab.
4 Medical Textile : Proceeding of the Second International Conference & Exhibition by S.C. Anand : CRC Publication.
5 Medical Textiles & Biomaterial for Healthcare by S.C. Anand, M.M. Traftab, S. Rajendra – Woodhead Publication

M. Tech. (Technical Textiles) Semester - I

TXLEL2 (TXL539): SHAPE MEMORY POLYMERS AND PHASE CHANGING 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 describe the significance of shape memory polymers and phase changing materials
2 To explain the Structure & Properties of Shape Memory polymer
3 To explain the Water Vapor Permeability of Shape Memory Polyurethane
4 To compile the various shape memory fabrics

Course Outcomes

At the end of the course students will be able to

1 Describe the significance of shape memory polymers and phase changing materials
2 Explain the technical details of Structure & Properties of Shape Memory Polyurethane Ionomer
3 Describe the Water Vapor Permeability of Shape Memory Polyurethane
4 Evaluation of Shape Memory Fabrics

Course Contents

Unit 1. Introduction **4 Hrs.**

Concept associated with shape memory materials, Principle of temperature-dependent shape memory polymers, Application of shape memory polymers, Prospects for shape memory polymers, Shape memory fibres, Role of smart materials in textiles, Shape memory materials used in smart fabrics, Shape memory garments – active structure for fashion apparel.

Unit 2. Preparation of Shape Memory Polymers **4 Hrs.**

Structures of Shape Memory Polymers, Synthesis of Shape Memory Polymers, Preparation of Shape Memory Polymers for medical uses.

Unit 3. Structure & Properties of Shape Memory Polyurethane Ionomer **8 Hrs.**

Morphology of crystalline soft segment in shape memory polyurethane ionomer, Thermal properties of shape memory polyurethane ionomer, Isothermal crystallization kinetics of the soft segment in shape memory polyurethane ionomer, Analysis of crystallization activation energy of the soft segment in shape memory polyurethane ionomer, Effect of Ionic groups on equilibrium melting temperature, Dynamic mechanical property of shape memory polyurethane ionomer, Infrared Absorption analysis, Shape memory effect of shape memory polyurethane ionomer.

Unit 4. Water Vapor Permeability of Shape Memory Polyurethane 8 Hrs.

Factors affecting Water Vapor Permeability of SMPU, Factors affecting equilibrium sorption and dynamic sorption of SMPU, Dependence of WVP through SMPU membranes on temperature, Dependence of free volume of SMPU on temperature.

Unit 5. Characterization of Shape Memory Properties in Polymers 8 Hrs.

Parameters for characterization, Measurements of parameters, Effect of thermo mechanical cyclic conditions, Effect of sample preparation.

Unit 6. Evaluation of Shape Memory Fabrics 6 Hrs.

Shape memory & wrinkle-free fabrics, Evaluation method for Shape memory fabrics, Subjective method for characterizing Shape memory fabrics, Objective method for characterizing Shape memory fabrics, Effect of temperature on shape memory effect, conclusion.

Reference Books

1 Shape Memory Polymer and Textiles by Jinlian HU
2 Shape Memory Materials Edited by Otsuka K & Wayman C.M., Cambridge University Press
3 Encyclopedia of Polymer Science & Technology, 3rd edn, Edited by Kroschwitz J.I., John Wiley & Sons, New York
4 Smart Structures & Materials, San Diego, Artech House Publisher, CA
5 Fibres & Clothing, Wood Head Publishing Ltd., Cambridge.
6 Polyurethane Handbook, Hanser Publication, New York

M. Tech. (Technical Textiles) Semester - I

TXLEL2 (TXL540): AUTOMOTIVE 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 the Fabric structures and production methods for Automobile textiles
2 To explain the Quality assurance and testing for Automotive textiles
3 To illustrate the Product engineering in Automobile engineering with case studies
4 To explain the Automotive textiles with reference to the environment

Course Outcomes

At the end of the course students will be able to

1 Describe the Fabric structures and production methods for Automobile textiles
2 Explain the technical details of Quality assurance and testing for Automotive textiles
3 Compile the technology applied in Product engineering in Automobile
4 Evaluate the performance of automotive textiles

Course Contents

Unit 1. **Introductory survey** : General survey, Material survey – fibres, Material survey – plastics, Material survey – natural and synthetic rubbers, Requirements from suppliers, Interior design — 4 Hrs.

Unit 2. **Fabric structures and production methods for Automobile textiles**: Introduction, fibres and yarn types , Fabric structures – wovens Fabric structures – warp knitted Fabric structures – weft knitted Fabric structures – flat-bed knitting Fabric structures – non-wovens , Yarn and fabric processing: Introduction, dyeing and finishing, Printing, Coating and lamination, — 4 Hrs.

Unit 3. **Quality assurance and testing for Automotive textiles**: Quality assurance, Test method details. — 6Hrs.

Unit 4.	**Product engineering** – interior trim Introduction, Seats, Headliners, Door casings, Parcel shelves, other interior trim, complete modular interiors Other textile applications Introduction , Seat belts 228, Airbags, Carpets, Cabin air filters, Battery separators, Bonnet (hood) liners Wheel arch liners, Hood material for convertibles, Tyres, Hoses and belts – general considerations	8 Hrs.
Unit 5.	**Automotive textiles and the environment** Introduction, The greenhouse effect and global warming, Environmental legislation, the effects of pollutants, Manufacturing concerns, Sustainable development	8Hrs.
Unit 6.	**Textiles in other forms of transportation** Introduction, Composite materials, Flame retardancy, Fabric coating, Textiles in other road vehicles, Railway applications, Marine applications, Textiles in aircraft.	6Hrs.

Reference Books

1 Textiles in automotive engineering by W. Fung
2 Wellington Sears Handbook of Industrial Textiles by Sabit Adanur.
3 Hand book of Technical Textiles by A. R. Horrocks.
4 Textiles in automotive engineering by W. Fung.
5 Composite materials: Engineering & Science by F. L. Matthews & R. D. Rawlings.
6 Fire retardant materials by A. R. Horrocks & D. Price.
7 Textile advances in the automotive Industry by R. Shishoo.
8 Knitting Technology by Spencer.
9 Composite forming technologies by A. C. Long.
10 Automotive textiles by Textile progress Vol. 29 by S. K. Mukhopadhyay.

M. Tech. (Technical Textiles) Semester - I

TXLEL2 (TXL541): ENVIRONMENTAL ENGINEERING 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 describe the Eco System & Environment Management
2 To explain the Environmental Management Systems
3 To illustrate the Air, water, noise Pollution in Textile Industry with case studies
4 To explain the Effluent Treatments

Course Outcomes

At the end of the course students will be able to

1 Describe the various Eco Systems & Environment Management
2 Explain the technical details of Environmental Management Systems like EMS 14000.
3 Compile the technology applied in reducing Air, water, nosie Pollution in Textile Industry
4 Evaluate the performance of Effluent Treatments

Course Contents

Unit 1. Introduction to Eco System & Environment Management **4 Hrs.**

Environmental problems and human health, Risk assessment and risk management, ecology and textiles, Toxicological considerations of textile processing. Definitions of environment, ecology, pollution, Types of pollution and effects on environment, general waste categorization, effective pollution prevention program

Unit 2. Environmental Management Systems **4 Hrs.**

Importance of ISO - 14000 standards, environmental policy, EMS planning, Implementation, Checking of corrective action, Concept of Okötex, GOTS

Unit 3. Noise Pollution in Textile Industry **6 Hrs.**

Noise Pollution and its control in Textile Industry – Introduction, Noise in Textile Industry – Effect of noise on human beings – measurement of noise – methods of reducing noise

Unit 4. Air Pollution in Textile Industry **8**

Classification and properties of air pollutants, Sources of emission, Green house gases, Behaviour and fate of air pollutants, Effects of air pollution on human health, vegetation, animals, machinery and building. **Hrs.**

Sources of air pollution in wet processing, their levels, toxicity and effects on atmosphere. Air pollution laws and norms, Plume behavior, Analysis of air pollutants, Measures to control air pollution

Unit 5. Water Pollution in Textile Industry **8**

Sources of water, their nature and use pattern, General types of water pollutants and their effects, Factors polluting water in textile wet processing in each unit operations. The volume of waste generated and nature of the wastewater, Effects of wet processing effluent parameters on the environment **Hrs.**

Unit 6. Effluent Treatments **8**

Basic processes of wastewater treatment, Basic factors to be considered for waste water or effluent treatment. Methods of Treatment of Textile effluent, preliminary, primary, secondary and tertiary treatments. Advancement in the effluent treatment like reverse osmosis, plasma technology, removal of dissolved solids, removal of heavy metals. Sludge disposal, Reuse of water and cost of effluent treatment, Norms of treated effluent. A typical design for effluent treatment plant to meet the norms laid down by Pollution Control Board Measures to be taken into consideration to improve the quality of the effluent generated either by chemical substitution, eco-friendly processing, process modification, etc **Hrs.**

Reference Books

1 Environmental pollution control engineering – C.S. Rao.
2 Best management practices for pollution prevention in the textile industry – Textiles committee, 1997
3 Environmental issues – technology options for textile industry – Book of papers published by R.B. Chavan et.al of IIT, New Delhi.
4 Fundamentals of air pollution – Richard W. Boubel, D. Fox etal.
5 Treatment of textile processing effluents – N. Manivaskan.
6 Textiles energy and waste seminar – proceedings from textile institute, 1997.
7 Environmental Issues – Technology option for Textile Industry Edited by R. B. Chavan, Indian Journal of Fibre & Textile Research Special Issue - March, 2001
8 The Management Systems – Quality, Environment, Health & Safety ISO 9001 : 2000, ISO 14001, OHSAS 18001 BY Pranab Kr. Nag, International Certification Services
9 Handbook of Environments, health & safety by Herman Koren & Michael Biseri

M. Tech. (Technical Textile) Sem-I

TXD542: 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 difference.

M. Tech. (Technical Textiles) Semester -II

TXL543: TEXTILE COMPOSITES

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. 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.	**8Hrs.**
Unit 4.	**Strength of composites:**Failure mode of long fibers like axial tensile failure, transverse tensile failure, shear failure, failure in compression. 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.	**8 Hrs.**
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. Thermal conduction mechanism like heat transfer, conductivity of composites and interfacial thermal resistance.	**8Hrs.**
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

5. Introduction to Composite Materials, Clyne and Hull
6. Fabre reinforced composites by P. K. Mallick
7. Composite materials: Engineering & science by F. L. Mathew & R. D. Rawlings.
8. Micro structural Characterization of fibre reinforced conposites by John Summerscales.
9. New millennium fibres by T. Hongu & G. O. Phillips.
10. Effects of mechanical & Physical properties on fabric hand by H. M. Behery.
11. 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. (Technical Textiles) Semester -II

TXL544: SURFACE TREATMENT OF TEXTILES FOR TECHNICAL 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 explain requirements & significance of surface treatments for technical applications
2 To describe the concepts and application methods of nano technology, Plasma and coating lamination to the technical textiles
3 To explain the evaluation methods of performance of Products from nano technology, Plasma and coating lamination
4 To explain properties of nano technology, Plasma and coating laminated fabrics and their applications

Course Outcomes

At the end of the course students will be able to

1 Describe the logic, need, requirements of nano technology, Plasma and coating lamination to the technical textiles
2 Explain the concepts and application methods nano technology, Plasma and coating lamination to the technical textiles
3 Evaluate the performance of Products from above stated treatments
4 Discuss the properties of stated treatments

Course Contents

Unit 1. PART I: NANOTECHNOLOGY FOR TEXTILES 4 Hrs.

Introduction to Nanotechnology: Concept of nanoscale and Historical background of nanotechnology, Fundamental concepts of nanotechnology - Bottom-up approaches, Top-down approaches, Functional approaches.

Synthesis and Properties of Nanoparticles: Synthesis of Fullerenes and various forms of carbon. Synthesis of nano metal particles by various chemical, physical and biological methods. Properties of nano particles

like organic and inorganic materials in various chemical forms.

Characterization of Nanoparticles: X-Ray Diffraction, Transmission Electron Microscopy and Spectroscopy; Scanning electron microscopy (SEM); Transmission electron microscopy (TEM); Energy-dispersive x-ray spectroscopy (EDS), Small-Angle X-Ray Scattering (SAXS), The Cone Calorimeter (CC), The Mass Loss Calorimeter (MLC).

Unit 2. **Nan engineered Textiles :** Conductive textiles, Antimicrobial textiles, Self cleaning textiles, Moisture absorbing textiles, Improved hydrophilicity, colourability and wear resistance, UV- blocking textiles, Controlled release of active agents. **8 Hrs.**

Unit 3. **PART II: PLASMA TECHNOLOGY FOR TEXTILES** **6Hrs.**

The Physics and Chemistry of Plasmas for Processing of Textiles

Introduction, gases used, plasmas generated, plasma chemistry, plasma surface collisions.

Low Pressure Cold Plasma Processing Technology

Low pressure vacuum plasma technology, plasma activation in the technical textiles and nonwoven industries, plasma deposition on nonwoven materials, the economics of vacuum plasma treatment for fabrics and nonwovens.

Atmospheric Pressure Cold Plasma Processing Technology

Basic manufacturing needs from plasma technology, Atmospheric pressure plasma types for textile processing, Atmosphere pressure plasma equipment for textile processing, Atmospheric pressure plasma surface properties for textile products.

Corona and Dielectric Barrier Discharge Plasma Treatment for Technical Applications

Special adoption of DBD technology for textiles, plasma induced surface activation of fibres, Deposition of nano layers by gas polymerization combination of DBD treatment and liquor deposition.

Unit 4. Textile Application of Plasma Technology **6 Hrs.**

Plasma treatment of Textiles for water and soil repellency, Interfacial engineering of functional textiles for biomedical applications, plasma modification of wool, plasma modification of natural cellulosic fibres, plasma treatments of fibres and textiles.

Characteristics of Plasma Treated Textiles

Surface reaction in plasma treatment, techniques for characteristics of plasma treated textiles.

Unit 5. PART III : COATING & LAMINATION **8Hrs.**

Introduction

Advantages & Disadvantages of conventional finishing, Concept of Coating & Lamination, Merits & Demerits of Coating & Lamination, Production, Structure & Properties of Rubbers like- Natural Rubber, Styrene- Butadiene rubber, Isoprene-Isobutylene Rubber, Butyl Rubber, EPM & EPDM, Polychloroprene Rubber, Nitrile Butadiene Rubber & Silicone Rubber, Polymeric materials like Polyvinyl Chloride, Polyurethene, Acrylic Polymers, Foams For Laminates, Radition-Cured Coating, Test methods of coated materials

Unit 6. Coating Methods **4Hrs.**

Knife Coating- Different types of Knifes, Knife coating with premetering & postmetering, Roll Coating- Mayer rod coating,Direct-roll coating, Kiss roll coating, Gravure coating, Reverse roll coating, Dip Coating, Transfer Coating, Rotary screen Printing, Calendering- Zimmer coating, Hot-Melt Coating, Scatter Coating,Foam Coating, Lamination by Adhesives, Flame Lamination, Hot melt Lamination Merits & Demerits of each coating methods. Test methods of Laminated materials

Examples of Coated and Laminated technical textiles

Reference Books:-

1. Principles of Nanotechnology by Phani Kumar
2. Nanofibres & Nanotechnology in Textiles by P.J. Brown & K. Stevens.
3. New Millennium Fibres by G.O. Phillips & M.Takigami.
4. Analytical Electrochemistry in Textiles by P. Westbroek, G. Priniotakis & P. Kiekens.
5. Smart Textiles for Medicine & Healthcare by L. Van Langenhove.
6. The Nanoscope, Encyclopedia of Nano Science & nanotechnology Vol.-I to VI, Dr. Parag Diwan & Ashish Bharadwaj.
7. Nanotechnology in Fibres matures: A New Perspective, Textile Progress, The Textile Institute by Rajesh D. Anandiwala.
8. Plasma Technology for Textiles by Roshan Shishoo, CRC Publication.
9. Plasma Surface Modification and Plasma Polymerization – Norihiro Inagaki: CRC Press.
10. Plasma Kinetic Theory –Donald Gary – CRC Publication.
11. Proceedings 2 : The 5th Asian Textile Conference Kyoto Research Park, Kyoto Japan by Federation of Asian Professional Textile Association
12. Coated Textiles Principles and Applications by Dr. A. K. Sen

M. Tech. (Technical Textile) Semester-II
TXL545: 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 **6 Hrs.**

technique for reduction and optimization in design ofexperiments (No examples)

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.(Technical Textile) Semester-II
TXLEL3 (TXL546): 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. **8 Hrs.**
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

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. Tech.(Technical Textile) Semester-II

TXLEL3 (TXL547): SCIENCE AND TECHNOLOGY OF NANO MATERIALS 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 requirements of nanotechnology in textiles and its advantages
2 To describe the Synthesis and Properties of Nanoparticles
3 To explain the Characterization of Nanoparticles
4 To explain Electrospinning of Nanofibers & Nanocomposites

Course Outcomes

At the end of the course students will be able to

1 Describe the logic, need, requirements of Nanotechnology in textiles. Describe its technology
2 Explain the Synthesis and Properties of Nanoparticles
3 Evaluate the Characterization of Nanoparticles
4 Discuss the Electrospinning of Nanofibers & Nanocomposites

Course Contents

Unit 1. Introduction to Nanotechnology

Concept of nanoscale and Historical background of nanotechnology, Fundamental concepts of nanotechnology - Bottom-up approaches, Top-down approaches, Functional approaches. 4

Unit 2. Synthesis and Properties of Nanoparticles

Synthesis of Fullerenes and various forms of carbon. Synthesis of nano metal particles by various chemical, physical and biological methods. Properties of nano particles like organic and inorganic materials in various chemical forms. 8

Unit 3. Characterization of Nanoparticles

X-Ray Diffraction, Transmission Electron Microscopy and Spectroscopy; Scanning electron microscopy (SEM); Transmission electron microscopy 8

	(TEM); Energy-dispersive x-ray spectroscopy (EDS), Small-Angle X-Ray Scattering (SAXS), The Cone Calorimeter (CC), The Mass Loss Calorimeter (MLC).	
Unit 4.	**Electrospinning of Nanofibers**	
	Principles of electrostatic atomization, Electrospraying and electrospinning by the capillary method, Electrospraying and Electrospinning by the charge injection method, Controlling fiber orientation, Producing noncontinuous or short yarns, Producing continuous yarns. Various applications of nanofibres viz, tissue engineering, filter media.	8
Unit 5.	**Nanocomposites**	
	Carbon nanotube / nanofibre polymer composites, development of functional polymer nanocomposites, Nano filled polypropylene nanocomposites and Dyeable PP.	6
Unit 6.	**Nanoengineered Textiles**	
	Nanolayer deposition/coating of polymer films through viz. grafting, plasma and self-assembled for various applications like Conductive textiles, Antimicrobial textiles, Self-cleaning textiles, Moisture absorbing textiles, Improved hydrophilicity, colourability and wear resistance, UV-blocking textiles, Controlled release of active agents.	8

Reference Books

1 Principles of Nanotechnology by Phani Kumar
2 Nanofibres & Nanotechnology in Textiles by P.J. Brown & K. Stevens.
3 New Millennium Fibres by G.O. Phillips & M.Takigami.
4 Analytical Electrochemistry in Textiels by P. Westbroek, G. Priniotakis & P. Kiekens.
5 Smart Textiles for Medicine & Healthcare by L. Van Langenhove.
6 The Nanoscope, Encyclopedia of Nano Science & nanotechnology Vol.-I to VI, Dr. Parag Diwan & Ashish Bharadwaj.
7 Nanotechnology in Fibres matures : A New Perspective, Textile Progress, The Textile Institute by Rajesh D. Anandiwala.

M. Tech.(Technical Textile) Semester-II
TXLEL3 (TXL548): STAND UP AND START UP IN 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 requirements of Entrepreneurship quality in India
2 To describe the "business model" with examples
3 To explain the Architecting the product with different methods
4 To explain Financing resources and managing growth

Course Outcomes

At the end of the course students will be able to

1 Describe the logic, need, requirements of Entrepreneurship quality in India
2 Explain the "business model"
3 Evaluate the Architecting the product with different methods
4 Discuss the Financing resources and managing growth

Course Contents

Unit 1. Introduction to Entrepreneurship **6 Hrs.**
What is an entrepreneurship?
How you know if you are one: Characteristics & philosophies

Unit 2. Start-ups Demystified **8 Hrs.**
Why people want to build their companies
The pros and cons of running a start up
What it takes to start a company
Why most people fail
The founder shuffle
Bootstrapping and jumping off the cliff

Unit 3. Creating something from nothing **6 Hrs.**
Opportunity recognition and selection
Understanding the problem you're solving
Defining a "business model"

	Prototyping and customer development	
	Competitive advantage and positioning	
	Achieving product market fit	
	Marketing, demand generation and customer acquisition	
	Defining and tracking key performance indicators	
	Pivoting and iteration	
Unit 4.	Understanding the Technology	**6 Hrs.**
	Proof of concept	
	Choosing a stack	
	Architecting the product	
	User interface and experience	
	Front end, back end and everything in between	
	Scaling the platform	
Unit 5.	Financing resources and managing growth	**8 Hrs.**
	Pitching and raising money	
	Building a team	
	Roles and responsibilities	
	Hiring and firing	
	Accounting and finance	
	Partnership and vendors	
	Stock and stock options	
	Planning for exit	
Unit 6.	Miscellaneous topics	**4Hrs.**
	Passion, inspiration and confidence	
	Culture & vision	
	Prioritizing and focus	
	Money, life balance & happiness	

Reference Books

1 Think & grow rich by Napoleon Hill
2 The lean starup by Eric Ries
3 Good to great by jim Collins
4 The seven habits of highly effective people by Stephen Covey
5 The tipping point by Malcolm Gladwell
6 The E-Myth by Michael Gerber

M. Tech. (Technical Textile) Semester-II
TXLEL3 (TXL549): 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 Capital expenditure, Phase of capital budgeting, Project development cycle
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.**

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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. (Technical Textile) Semester-II
TXLEL4 (TXL550): 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. (Technical Textiles) Semester - II
TXLEL4 (TXL551): TEXTILES FOR PROTECTION

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 market size, scope of protective textiles
2 To describe the Factors affecting the design and use of protective clothing
3 To explain the type of hazards and Protection against hazard
4 To explain the protection requirements and applications in detail.

Course Outcomes

At the end of the course students will be able to

1 Describe the Overview of protective clothing and its international standards
2 Explain the Factors affecting the design and use of protective clothing
3 Explain the type of hazards and Protection against hazard
4 Discuss the protection requirements and applications

Course Contents

Unit 1. **Overview of protective clothing**: Overview and various standards for protective clothing, Market prospects, Classification, Materials and technologies, Future of personal protection, Requirements, International standards, Certification, Future trends **6 Hrs.**

Unit 2. **Factors affecting the design and use of protective clothing**: Introduction, Factors influencing the design development process, Clothing systems and functionality, Reconciling fashion and function, Future trends, Recommended steps in the selection of textiles for protective clothing, Relevant standards, specifications or guidelines, Protection performance of materials, Biological protection performance, Flame and thermal protection performance, Mechanical protection **8 Hrs.**

performance, Selection of materials based on other major factors

Unit 3.	**Protection against hazard**: Introduction, Types of hazards, Mechanical hazards, Pressure hazards, Environmental and fire hazards, Chemical and biological hazards, Electrical and radiation hazards	**4Hrs.**
Unit 4.	**Intelligent textiles and surface treatments for textiles:** Smart textiles, Applications of smart textiles for protective purposes, Sensor function, Data processing, Actuators, Energy, Communication, Thermal protection, Electric actuation, Types of surface treatments, Early treatments for protective textiles, Progression to modern treatments, Choice of treatments in relation to fibre and fabric types, Treatment process fundamentals, Treatment application systems, Brief overview of finishes for protection.	**6 Hrs.**
Unit 5.	**Interactions between protection and thermal comfort** :Introduction, Definition of comfort, Test methods for heat and moisture transfer, Measurement of thermal comfort with practice-related tests, Interactions between heat and mass transfer, Moisture storage and influences on protection, Thermal manikins, Measuring the insulation of protective clothing systems, Measuring the evaporative resistance of protective clothing systems, Ensemble data, Moving manikins, Manikin tests vs fabric tests, Using manikins under transient conditions.	**6Hrs.**
Unit 6.	**General protection requirements and applications**: Civilian protection and protection of industrial workers from chemicals, Textiles for UV protection, Textiles for protection against cold, Thermal (heat and fire) protection, Microorganism protection, Textiles for respiratory protection. Electrostatic protection, Ballistic protection, Military protection, Fire fighters protective clothing, Protection against knives and other weapons, Flight suits for military aviators, Protection for workers in the oil and gas industry, Motorcyclists	**6Hrs.**

Reference Books

1 Handbook of Fibre Science & Technology Vol-III Part –B.
2 New Fibres Second Edition by T. Hongu & Phillips.
3 Advanced Fibres Spinning Technology by T. Nakajima.
4 High Performance Fibres by J.W.S. Hearle.
5 Advances in Fibre Science by Dr. S.K. Mukhopadhyay.
6 Kevlar Aramid Fibres by H.Yang.
7 Textiles for Protection by R.A. Scott.

M. Tech.(Technical Textile) Semester-II
TXLEL4 (TXL552): SPECIALITY 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 the market size, scope of 3D fabrics & narrow fabrics and their classification
2 To describe the Factors affecting the design and use of 3D fabrics & narrow fabrics
3 To explain the manufacturing of 3D fabrics & narrow fabrics
4 To explain the applications with examples of 3D fabrics & narrow fabrics

Course Outcomes

At the end of the course students will be able to

1 Describe the Overview of 3D fabric & narrow fabrics and their international standards
2 Explain the production methods of 3D fabrics & narrow fabrics
3 Explain the merits and demerits of 3D fabrics & narrow fabrics and their techno economics
4 Discuss the applications of 3D fabrics & narrow fabrics

Course Contents

Unit 1. **3-D Fabric Manufacturing** **6 Hrs.**
Classification of Textile Structures required for 3 D fabrics, Dimensions used in fabrics like 2D, 2.5D & 3D formation, Disadvantages of 2D fabrics, Introduction to 3-D fabrics. Requirement of 3-D fabrics

Unit 2. **Classification of 3D fabrics**- based on type of structure, based on type of process and based on type of weaving, Advantages of 3D structures-Application & performance wise, Essential & Desired characteristics of 3D structures **6 Hrs.**

Unit 3. **Application of 3D fabrics** in structural composites & protective textiles. Modelling of fabrics by solid works CAD program **6 Hrs**

Unit 4. **Narrow Fabrics** **6 Hrs.**
Introduction: Definition and scope of Narrow fabric, General aspects of Narrow

fabric, Different Methods of Narrow fabric production, various materials used for manufacturing of Narrow fabrics,

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 ,

Other methods of Narrow fabrics production Knitted narrow fabrics, Braided narrow fabrics, Non-woven narrow fabric and their applications

Unit 5. **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.**

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

Unit 6. **Application of Narrow fabric**: Aerospace, Military, Fire and safety, Industrial, Automotives, Footwears, Fasteners, Luggage, Medical Textiles, Outdoor, Garments specially undergarments, smart textiles **6 Hrs**

Reference Books

1 Textile Structure Composites course material by IIT Delhi under QIP Feb 15 to 18, 2016.
2 3D Fabrics for Technical Textile Applications a book published by Kadir Bilisik, Nesrin Sahbaz Karaduman and Nedim Erman Bilisik
3 Proceedings of the Third World Conference on 3D Fabrics and Their Applications X. Chen, J. Hearle, and W Xu
4 Proceedings of the 5th World Conference on 3D Fabrics and their Applications December 16-17, 2013 Venue: Indian Institute of Technology (IIT) Delhi, India.
5 Proceedings of the Sixth World Conference on 3D Fabrics and their Applications North Carolina State University (NCSU), Raleigh, NC, USA
6 Woven Textile Structure: Theory and applications a book by B K Behera, P K Hari
7 Jacob Muller's Mubook-1 (Narrow fabrics Part -1)
8 Jacob Muller's Mubook-2 (Narrow fabrics Part -2)
9 Hand Books of Textile Industry- Narrow woven Fabrics, Vol – 2, E. A. Posselt
10 Narrow Fabric Weaving, Sauer Lander Verlag
11 Narrow Fabric Weaving, Thompson A

M. Tech.(Technical Textile) Semester-II

TXLEL4 (TXL553): TESTING AND ANALYSIS OF INDUSTRIAL 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 Statistical Terminologies, sampling, errors, accuracy of testing
2 To describe the Factors affecting the Textile Properties
3 To explain the types of Coated Material Testing
4 To explain the applications of latest testing instruments

Course Outcomes

At the end of the course students will be able to

1 Describe the Statistical Terminologies, sampling, errors, accuracy for industrial textiles
2 Explain the Textile Properties
3 Explain the Coated Material Testing
4 Discuss the Speciality testing Instruments and its utilization

Course Contents

Unit 1. Introduction **6 Hrs.**

Statistical Terminologies, sampling, errors, accuracy, acceptance sampling, trend charts.

Concepts of care labels, Eco-Labels, Tags, and various Certifications

Unit 2. Textile Properties **6 Hrs.**

Mechanical and Physical properties of fibres and its evaluation

Mechanical and Physical properties of different types of Yarns, plied yarns, cords, cables, textured – bulked yarns, core- wrapped yarn and their evaluation.

Important Physical and Mechanical properties of speciality fabrics – 3D woven, narrow, braided, spacer etc.

Unit 3. Coated Material Testing **6 Hrs.**

General Characteristics, Tensile behaviour, tear, flexing and abrasion resistance, weathering behaviour, microbiological degradation and

yellowing

Coating properties: Add-on, degree of fusion of curing in coating, adhesion of coat, low temperature bending and low temperature impact testing.

Unit 4. Performance of textile material **4 Hrs.**

Water repellency, Soil release, resistance to water penetration, air and water vapour permeability, water permittivity, resistance to hazardous liquid chemicals and gases, resistance to pathogens, electrical resistivity.

Unit 5. Product Performance evaluation **6 Hrs.**

Various Flame retardancy test methods, antimicrobial property, filtration efficiency, liquid and air filtration, HAPA filtration, clean room filtration and norms, water absorbency and water holding capacity, resistance to UV and temperature, ballistic performance.

Unit 6. Speciality testing Instruments **8 Hrs.**

Principles and working of instruments like – ballistic, weathering, UPF, spectrophotometer – transmittance and reflectance, colorimeter, FTIR, X – Ray, SEM, Atomic Spectroscopy and AFM.

Reference Books

1 Coated Textile, A K Sen, CRC Press
2 Hand Book of Industrial Textiles, S. Adanur
3 Hand Book of Technical Textile, Harrocks and Anand
4 Coated and laminated Textile, Walter fung
5 Basic Concepts of Analytical Chemistry, Second Addition by S M Khopkar
6 Physical Testing of Textile, B P Savili

M. Tech. (Technical Textile) Semester-II
TXLEL4 (TXL554): 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. (Technical Textile) Semester-II
TXD555: 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. (Technical Textiles)

Second Year

With Effect From

2017-18

DKTE

Promoting Excellence in Teaching
Learning & Research

M. Tech. (Technical Textile) Semester-III
TXD601: 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:

a) 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.
b) 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.
c) 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.
d) Students should carry out the in depth literature survey covering total spectrum of data from different sources.
e) Students should propose suitable plan of work in the form of flow chart considering the available resources at Institute.
f) 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.
g) Students should take prior permission to utilize the available resources in the institute.

M. Tech. (Technical Textile) Semester-IV
TXD602: DISSERTATION PHASE II

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

Course Objectives:

5. To identify the problem /idea and review and summarize the literature for the topic of the identified problem
6. To describe the process flow for undertaking the research/survey trials with appropriate standards and process variables
7. To design, development, construction, and fabrication of innovative product/system for the final submission
8. 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

5. Describe the problem /idea and review and summarize the literature for the topic of the identified problem
6. Illustrate the suitable design of experiments including experimental plan.
7. Explain the concepts of design, development, construction, and fabrication of innovative product/system for the project title
8. 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:

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

e) The students have to present their work in front of the internal dissertation evaluation committee.
f) The suggestions from internal experts should be incorporated in the soft copy of the final thesis.
g) Sufficient time of 2 weeks will be given for the corrections.
h) 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.
i) The bound copies will be submitted to the institute for further action on the externals.