DKTE Society's

TEXTILE & ENGINEERING INSTITUTE

Rajwada, Ichalkaranji - 416115

(An Autonomous Institute)

Curriculum (Structure and Syllabus) for

M.Tech Program
In
Textile Engineering

(First Year)

w.e.f. August 2019

M. Tech. (Textile Engineering) Semester – I – Structure

Sr. No.	Course Code	Name of the Course	Group	Teaching Scheme				Credit
				Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	
1	TEL 501	High performance Fibres	D	3			3	3
2	TEL 502	Advanced Computer Programming and Applications	D	3			3	3
3	TEL 503	Theory of Textile Structures	D	3			3	3
4	TEL EL1	Elective-I	D	3			3	3
5	TEL EL2	Elective - II	D	3			3	3
6	TED 511	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

TEL551 Advanced Yarn Manufacturing

TEL552 Advanced Chemical Processing

TEL553 Apparel Engineering

List of Electives -II

TEL554 Advanced Fabric Manufacturing

TEL555 Surface Treatment of Textiles

TEL556 Fibre Reinforced Composite

M. Tech. (Textile Engineering) Semester – II – Structure

Sr. No.	Course Code	Name of the Course	Group	Teaching Scheme				Credit
				Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	
1	TEL 504	Project Preparation, Appraisal & Implementation	D	3			3	3
2	TEL 505	Nonwoven Technology	D	3			3	3
3	TEL 506	Design of Experiments & Statistical Applications in Textiles	D	3			3	3
4	TEL EL3	Elective - III	D	3			3	3
5	TEL EL4	Elective - IV	D	3			3	3
6	TED 512	Mini Project -II	F			7*	7	7
Total				15	5	2	22	22
* Mini project involves field trials, experimental work, hence it is considered as full credit								

List of Electives -III

TEL557 Finishing and Quality Evaluation of Apparels

TEL558 Industrial Engineering

TEL559 Textile Product Engineering

List of Electives -IV

TEL560 Theory of Clothing Comfort

TEL561 Modelling & Simulation in Textiles

TEL562 Mechanics of Textile Machines

M. Tech. (Textile Engineering) 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	TED601	Dissertation Phase 1	F	---	----	20*	20	20
Total						20	20	20

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

M. Tech. (Textile Engineering) 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	TED602	Dissertation Phase 2	F	----	-----	28*	28	28
Total						28	28	28

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

First Year M. Tech-Textile Engineering Semester – I
TEL501: 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.	Explain the importance of high performance fibres and critical comparison of high performance fibres with regular fibers
2.	Explain the manufacturing processes of commonly available high performance fibres
3.	Explain the structure and properties of high performance fibres
4.	Explain the technology of manufacturing bicomponent fibres

Course Outcomes At the end of the course students will be able to	
1.	Express the importance of high performance fibres and contrast high performance fibres with regular fibers
2.	Illustrate the manufacturing processes of commonly available high performance fibres
3.	Compare the structure and properties of various high performance fibres
4.	Demonstrate the technology of manufacturing bicomponent fibres

	Course Contents	**Hrs.**
Unit 1.	Significance of high performance fibres. Critical comparison of Regular and High performance fibres, Review of various fibre manufacturing processes.	4
Unit 2.	Manufacturing of aramid fibres, Analysis of structure and characteristics of important aramid fibres, Studies on the applications of aramid fibres	8
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	6
Unit 4.	Inorganic high performance fibres: Glass fibre manufacture, properties and Applications. Ceramic Fibres: Analysis of characteristics and applications of silicon carbide based fibres, Alumina based fibres. Single crystal oxide fibres.	6

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	8
Unit 6.	Technological developments in the manufacturing of bicomponent fibres, importance and applications of bicomponent fibres.	4

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.

First Year M. Tech-Textile Engineering Semester – I

TEL502: ADVANCED COMPUTER PROGRAMMING AND APPLICATION

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, functions, merits and applications of ERP
4.	Evaluate the suitability of SAP for various applications

	Course Contents	**Hrs.**
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	7
Unit 2.	**Relational Databases:** Relational Model, Database Users, Roles of Database Administrator, keys, Domain Constraints, Referential Integrity, Structured Query Language (SQL),Database recovery methods and	8

	techniques	
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 organizational transaction, the credit transaction trade cycle. Advantages & disadvantages of Electronic markets. Application of E-commerce in textile industries.	8
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	8
Unit 5.	**SAP: Architecture** of SAP R/3, SAP Integrated- Analysis, Implementation, and Design, Three-Tier Architecture, Need of Multi-tier Architecture, Integrating Environments.	5
Unit 6.	**Business Intelligence System:** Technical Architecture overview, Back room Architecture, Presentation Server Architecture, Front room Architecture, Metadata, Standard Reports, Dashboards and Scorecards	5

Reference Books	
1	Object Oriented Programming with C++ - E. Balagurusamy.
2	Let us C++ - Y.P.Kanitkar
3	Database System Concept by Henry F. Korth, Abraham Silberschatz, Sudarshan (McGraw Hill Inc.)
4	E-Commerce – David Whiteley, TMH.
5	Enterprise Resource Planning – Alexis Leon, TMH.

First Year M. Tech-Textile Engineering Semester – I

TEL503: 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 morphology of fibre.
2.	To study the Tensile and other properties of fibres
3.	To illustrate the Theories of time dependence.
4.	To explain the structure of yarn

Course Outcomes At the end of the course students will be able to	
1.	Describe the morphology of fibre.
2.	Study the Tensile and other properties of fibres
3.	Illustrate the theories of time dependence.
4.	Explain the yarn structure.

	Course Contents	**Hrs.**
Unit 1.	**Fibre Structure-**Requirements of fibre formation, morphological model, one phase two phase and three phase models, morphology of cotton, viscose, Wool. Silk, polyester, nylon 6 & nylon 66, acrylic, polypropylene fibres.	**6Hrs.**
Unit 2.	**Tensile & directional properties and elastic recovery of fibres** – Importance of tensile properties, factors affecting the tensile properties of fibres, elastic recovery-effect of test conditions on elastic recovery ,stress and strain dependent elastic recovery, mechanical conditioning of fibre, swelling recovery. 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.	**6Hrs.**
Unit 3.	**Time Effects –** The study of time dependence, creep,factors affecting the creep, stress relaxation, time and tensile testing, dynamic tests, methods of dynamic testing, Boltzmann superposition principle,WLF equation,viscoelasticity-Eyring model of visco-elasicity, thermodynamic effects.	**7 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.	**5 Hrs**
Unit 5.	**Ideal Yarn-** Ideal geometry of twisted yarns, yarn contraction on twisting – limit of twist, packing of fibres in yarn, concentrating and disturbing features of actual yarn, specific volume and packing fraction, effect of twist on yarn diameter and volume-Schwarz constant.	**6Hrs.**
Unit 6.	**Migration of fibres in a yarn –** Ideal migration, geometrical approach, tracer fibre technique, characterization of migration, theory of migration, migration in spun yarns, tension variation as mechanism of migration, order of migration	**7Hrs**

Reference Books	
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.
8	Fibre Science – Edited by J.M. Preston, Published by The Textile Institute, Manchester.

First Year M. Tech-Textile Engineering Semester – I
TEL 551: ADVANCED YARN 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 opening and cleaning principles of blow room machinery and process parameters involved in it and to describe fibre blending and process.
2.	To describe design aspects of different zones of card theory and process parameters involved in it, design aspects of comber and theories of drafting.
3.	To explain design developments in various components of ring frame, theories of balloon spinning geometry, tension and process parameters involved in it.
4.	To describe Technical developments in rotor spinning, air jet spinning and friction spinning along with parameters involved in the process.

Course Outcomes At the end of the course students will be able to	
1.	Critically analyze various aspects of opening and cleaning in blow room machinery, fibre blending and also parameters involved in the process.
2.	Critically analyze design aspects of different zones of card various components of a comber, theories of drafting and process parameters involved in each process stage.
3.	Critically analyze design developments in various components of ring frame, theories of ring spinning and parameters involved in the process.
4.	Critically analyze Technical developments in rotor spinning, air jet spinning and friction spinning along with parameters involved in the process.

	Course Contents	**Hrs.**
Unit 1.	**Opening and cleaning.** Evolution of opening and cleaning process. A critical study of factors affecting opening, cleaning and blending in blow-room. Critical design aspects and principles of modern blow-room machinery. Fibre Blending – Importance, Methods of blending and its analysis.	7 Hrs.
Unit 2.	**Carding** Basic theories of carding. Critical design aspects in different zones of	7 Hrs.

	modern card, Conditions of fibre transfer and Transfer efficiency. Design developments of carding components. Configuration and disorder of fibres in a card sliver.	
Unit 3.	**Combing:** Researches on combing preparation. Critical design aspects in various components of a comber. Fibre fractionation at comber, Evolution of combing process and technology. **Drafting** Theories of drafting. Causes for irregularity in drafted strand. Role of fibre friction in drafting – Drafting force – Definition, Measurement and study of factors affecting drafting force. Design significance of modern draw frames. Auto leveling: - Concept and necessity. **Speed frame** Evolution of speed frame machines and process. Design significance of modern Speed frames.	8Hrs.
Unit 4.	Basic stages in spinning & their influence on final product. Design Developments in various components of ring frame. Role and importance of spinning geometry. Mechanism of end breaks. Generation and control of hairiness in ring spinning – development of compact spinning.	6 Hrs
Unit 5.	**Rotor spinning** – Technical developments in rotor spinning machine – Modification in the design of spinning unit – developments in rotor drives –yarn monitoring. Automation in rotor spinning machines. Structure and properties of yarn produced.	4 Hrs
Unit 6.	**Air jet spinning** – Technical developments in air jet spinning, Structure and properties of air jet spun yarns, Evolution of vortex spinning, critical review of both systems. Friction Spinning – structure & properties of friction spun yarn. Evolution of different spinning technologies based on friction spinning system.	4 Hrs

Reference Books	
1	Manual of Cotton spinning series vol 1,2,3,4.
2	Short staple spinning Series by W Klien. Vol 1, 2, 3,4,5,6.
3	Rotor Spinning by K R Salhotra.
4	Yarn Production-Theoretical Aspects by P.Grosberg & C.Iype.
5	Series publications of NCUTE Training Programs
6	Textile Progress Series by Textile Institute,Manchester
7	New spinning technologies – Dr. S. M. Ishtiaque – Advances in yarn manufacturing technology – IIT publication
8	Research Papers on basics and advances in Technology.

First Year M. Tech-Textile Engineering Semester – I
TEL 552: ADVANCED CHEMICAL PROCESSING

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

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

Course Objectives	
1.	Discuss need of modification and commercial trends in pretreatments with respect to environmental issue.
2.	Discuss developments in dyes and colouration techniques and digital printing
3.	Discuss colouration and finishing of denim fabric, processing of speciality material like linen, spandex and terry material
4.	Discuss advancement in machines with respect to energy and water conservation.

Course Outcomes At the end of the course students will be able to	
1.	Explain need of modification and commercial trends in pretreatments with respect to environmental issue.
2.	Enumerate developments in dyes and colouration techniques and digital printing
3.	Explain colouration and finishing of denim fabric, processing of specialty material like linen, spandex and terry material
4.	Explain advancement in machines with respect to energy and water conservation.

	Course Contents	**Hrs.**
Unit 1.	**Pre-Treatment** Developments in singeing, desizing and its eco-aspects, size recovery; Enzyme and solvent scouring; Bleaching and its eco-aspects, Per acetic acid bleaching, Redox bleaching, Ecofriendly stabilizers; Combined operations; Hot and ammonia and add-on mercerization; Pre-treatment and enzyme assisted processing of jute, linen, silk and lyocell.	6
Unit 2.	**Dyeing** Dyeing and its eco-aspects, new dyes and their advantages. Eco-friendly dyeing with sulphur and vat dyes. New developments in reactive dyes like HF dyes, low and no salt reactive dyes, multifunctional dyes, neutral fixing and acid fixing reactive dyes. Photo chromic dyes, thermo chromic dyes, fluorescent dyes. Concept, mechanism, methods and techno economical features of Super	6

	critical CO_2 dyeing, Ultrasound assisted dyeing.	
Unit 3.	**Printing** Digital Printing: Concept, methods of inkjet printing, colour separation, selection of dyes and developments in inks, techno-economical features Transfer Printing: Concept, selection of dyes and paper, mechanism of dye transfer, process sequences and techno-economical features.	6
Unit 4.	**Processing of Denim** Chemistry and processes of warp dyeing with indigo, Indigo dyeing techniques – warp sheet and rope dyeing machine. Dyeing with mixture of indigo and other dyes. Processing of denim fabrics.	7
Unit 5.	**Processing Specialty fibres and Fabrics** Terry towel: Process sequence and machines used for terry towel manufacturing, essential properties type and application of terry fabrics. Different stages of towel processing and finishing. Processing of Lyocell: General properties and uses of lyocell Pretreatment, dyeing and finishing of lyocell. Concept of fibrillation, its causes and remedies. Processing of Fabric containing Spandex: Properties and uses of spandex fibres and blends. Wet processing of its blends with Cotton and polyester	7
Unit 6.	**Finishing and energy conservation:** Resin, SPF, Antimicrobial and Flame retardant finishes. Various low liquor and minimum application techniques in textile finishing, their advantages and limitations; means to water conservation. Energy Conservation: Thermal energy, Steam generation, distribution and utilization; means for thermal energy conservation. Norms, HUE factor and consumption calculations. Electrical energy, quality requirement, power factor, illumination norms, consumption calculations and various means to conserve electrical energy.	8

Reference Books	
1	Chemical Finishing of Textiles by W. D. Schindler and P. J. Hauser
2	Environmental Issues – Technology option for Textile Industry Edited by R. B. Chavan, Indian Journal of Fibre & Textile Research Special Issue - March, 2001
3	Energy conservation in Textile wet processing, M L Gulrajani, Omega Publication, New Delhi
4	Denim a Fabric for All by dr. Parmar, NITRA
5	Manufacturing of Terry Towel by Subhash J. patil, Universal Book Corporation, Mumbai
6	Trouble shooting in Wet Processing: Acetate, Reyon / Lyocell and Spendex Blends, AATCC

First Year M. Tech-Textile Engineering Semester – I

TEL553: Apparel 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 understand factors influencing selection of materials and their influence on product performance
2.	To understand the concept of apparel product engineering based on aesthetic and functional requirements
3.	To learn and appreciate the correlation between fabric and sewing parameters and product performance.
4.	To acquire knowledge on influence of dewing materials on sewn product.

Course Outcomes At the end of the course students will be able to	
1.	Understand factors influencing selection of materials and their influence on product performance
2.	Understand the concept of apparel product engineering based on aesthetic and functional requirements
3.	Learn and appreciate the correlation between fabric and sewing parameters and product performance.
4.	Acquire knowledge on influence of dewing materials on sewn product.

	Course Contents	Hrs.
Unit 1.	**Apparel Engineering** Introduction, types of apparel categories, engineering functions in apparel manufacturing, apparel design and manufacture process to end use requirements - Evaluation of Making-up Quality and Analysis of Making-up Problems Subjective and objective methods for evaluating the making-up quality of garments (including quality in terms of fusing, sewing, and finishing etc). Solutions to sewing problems. Kawabata and FAST systems for assessing fabric making-up performance.	8
Unit 2.	**Raw Materials:** Fabric specifications, Raw material categories, physical properties of fabrics, style characteristics, Hand characteristics, Visual Characteristics, Utility characteristics, Durability characteristics, product production working characteristics, sewing thread characteristics, closures.	6
Unit 3.	**Analysis of stitches and seams:** Types of seams and stitches, machinery used for formation of various stitch types according to classification, Suitability of different stitch types in relation to fabric behavior, quality measurement of seams and stitches, fabric sewability, effect of stitch type on-elasticity, strength, seam slippage. Effect of seam type on seam slippage and yarn severance.	8
Unit 4.	**Fabric characteristics and sewing parameters:** Understanding of co-relation between fabric characteristics and sewing process parameters. Comparison of various types of seam finishing for industrial use in relation with performance and cost effect. Relation between end use of fabric and seam performance in regards to sewn materials. Understanding of seam properties and their application in relation to different fabrics and apparels	6
Unit 5.	**Sewing needle and sewing thread:** Compatibility of Sewing Needle and Sewing Thread in relation with other sewing parameters. Understanding the structure and specifications of sewing machine needles and their importance in sewing processes. Needle size and its relation to fabric and sewing quality requirements. Correlation	6

	between sewing thread and fabric and its impact to stitch performance. Controlling stitch performance and quality and minimizing of defect occurrence.	
Unit 6.	**Automation in Apparel industry:** Concept of automation in apparel industry, automation in apparel designing and fit analysis, automation in apparel finishing, automation in material handling and use of robotics in apparel industry.	5

Reference Books	
1	Solinger, J, 'Apparel Manufacturing Handbook', 2nd Ed., Van Nostrand Reinhold, New York, 1995
2	Carr, H. and Latham, B., 'The Technology of Clothing Manufacture', Wiley-Blackwell, 2009.
3	Barbara Stewart, Beverly Kemp-Gatterson, 'Apparel Concepts and Practical Applications', Fairchild New York, 2010
4	J Fan, "Engineering Apparel Fabrics and Garments", Wood Head Publishing Limited, 2012.
5	Burns.L.D., Bryant.N.G., 'Business of Fashion – Designing, Manufacturing and Marketing,' Fairchild NewYork, 2008.

First Year M. Tech-Textile Engineering Semester –I

TEL 554: ADVANCED FABRIC MANUFACTURING

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

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

Course Objectives	
1.	To study the effect of winding and warping process parameters on package quality
2.	To describe the importance of automation and its impact on machine productivity, efficiency and quality of beam in Sizing department.
3.	To explain design developments and process parameters during weaving on various components of Gripper Technology & fluid Technology shuttle- less technology.
4.	To describe technical developments & machine details of knitting and Nonwoven machine

Course Outcomes At the end of the course students will be able to	
1.	Analyze the winding and warping machine process
2.	Explain the impact of automation on machine productivity and quality of sized beam
3.	Describe the design developments of projectile, rapier and air jet looms.
4.	Explain the technical developments of knitting & Nonwoven machine including details of machine & process parameters

	Course Contents	**Hrs.**
Unit 1.	**Winding and Warping** Studies of research on over-end yarn unwinding from different ring bobbin specifications, Impact of yarn tension and drum design on package quality, Impact of yarn clearer on downstream and weaving process, Effect of splicer settings on yarn quality, Effect of various machine parameters on package quality. Analysis of the thread-tensioner working during the winding process, Effect of yarn hairiness reduction attachment on yarn properties, Effect of various modern machine design developments on machine productivity, Importance of automation and its impact on machine productivity, quality of package. Relation between yarn package parameters and yarn tension during unwinding on warping machine, Mathematical Modelling of Yarn Tension at warping machine Creel, General study of various process parameters on beam quality, Effect of various modern machine design developments on machine productivity, Importance of automation and its impact on machine productivity, efficiency and quality of beam, Effect of Warping Speed and	**7 Hrs.**

	Warp Yarn Tension on yarn properties and loom performance, Effect of Warp Yarn Material and Cone position on Warping Creel on yarn properties, Studies on beam pressure, warping speed and tape length on end breaks, Concept of warping cum dyeing.	
Unit 2.	**Sizing** Importance of automation and its impact on machine productivity, efficiency and quality of beam, Effect of various modern machine design developments on machine productivity and quality, Various aspects of weavability of yarns, Different studies on various process parameters affecting stretch, sized yarn properties, weavability, sizing productivity, beam quality and loom performance, Concept of Sizing cum dyeing, Studies on optimization of various process parameters.	**7 Hrs.**
Unit 3.	**Shuttle less Weaving (Gripper Technology)** Studies on warp cover factor, weft cover factor and warp tension on loom performance, effect of loom setting on fabric skewness. Comparative study of heald frame motion by rotary dobby and crank-cam shedding, effect of heald frame cross moment and initial warp tension on fabric properties, effect of shed geometry on loom performance and speed. Studies on reed and its construction on fabric properties, effect of sley motion on beat up force. Studies on Weft velocity and parameters affecting it on Projectile loom, Study of shed geometry on projectile loom, Design of projectile for weft tension, Dynamic analysis of Projectile Picking Mechanism. Studies on Weft velocity and parameters affecting it on Rapier loom, Study of shed geometry on rapier loom, Design of rapier for weft tension, Comparative studies on various rapier drives.	**8Hrs.**
Unit 4.	**Shuttle less Weaving (Fluid Technology)** Studies of air flow and weft velocity on airjet loom, effect of various airjet loom setting parameters on air consumption and weavability limits, Analysis and Development of a Main and Relay Nozzle, effect of air and various weft yarn characteristics like, elastane: core spun; core twist (single en double) and air covered yarn on weft velocity Airjet loom, Effect of various loom parameter on weft break, Modern developments in relay nozzle and profile reed geometry and its effect on weft break/velocity. Back rest roll setting and its effect on fabric properties, theoretical aspects of back-rest roller rotation on weaving machine, comparative studies on 2D and 3D fabric structures.	**6Hrs**
Unit 5.	**Knitting** Yarn tension effect on knitting machine and fabric quality, Effect of yarn count and stitch length on fabric properties, Evaluation and measurement of knittability, loop length effect on fabric with elastic yarn, various aspects of mechanics of loop formation on knitting machine, effect of yarn and machine setting on spirality, effect various machine parameters on fabric properties, Geometrical models of knitted structures, Modern design developments impact on process efficiency and fabric quality, Comparative studies on 2D and 3D fabric structures.	**4 Hrs**

Unit 6.	**Nonwoven** Effect of various raw material and machine parameters on needle punched, hydro-entangled nonwoven fabrics, effect material variables on thermal bonding process, Studies on pore size distribution of nonwoven fabric, studies on cross layered needle punched fabrics, studies of nonwoven fabric engineering for special applications, Comparative studies on 2D and 3D fabric structures.	**4 Hrs**

Reference Journals	
1	The unwinding of yarns from packages Part I: the theory of yarn-unwinding, V. K. Kothari & G. A. V. Leaf, Journal of Textile Institute 1979.
2	The unwinding of yarns from packages Part II: unwinding from cylindrical packages, V. K. Kothari & G. A. V. Leaf, Journal of Textile Institute 1979
3	Quality Parameters and Design Aspects of Warper's Beam, Prof.Ashwin Thakkar, Prof. (Dr.) Someshwar Bhattacharya. International Journal on Textile Engineering and Processes, 2018**.**
4	Analysis of design aspects of textile warping: Part I: review of literature, Prof.Ashwin Thakkar et al. International Journal of Engineering Science and Technology, 2017.
5	Impact of process parameters on sizing machine performance – a review, Ranjit Turukmane, Sujit Gulhane, Rupesh B. Patil, Melliand International · May 2019
6	Effect of yarn stretch in sizing on loom performance, Mr.Dhananjay Devare, Prof. R.N. Turukmane, Prof. S. S. Gulhane & Mr.L.C.Patil, International Journal on Textile Engineering and Processes, 2016.
7	Effect of stretch on frequency distribution of breaking elongation of sized warp and their weavability, Indian Journal of Textile Research, 1986.
8	Simulation and optimization of warp tension in the weaving process Gloy YS, Renkens W, Herty M and Gries T, Journal of Textile Science and Engineering 2015.
9	Effect of fabric structural parameters and weaving conditions to warp tension of aramid fabrics for protective garments, Seung Jin Kim1 and Hyun Ah Kim, Textile Research Journal, 2017.

First Year M. Tech-Textile Engineering Semester – I

TEL 555: SURFACE TREATMENT 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 discuss need and methodology of various surface modification techniques.
2.	To discuss physical and chemical aspects of coating, nano material and plasma treatment.
3.	To discuss changes brought in to textiles by surface modifications
4.	To discuss the principles, methods of evaluation of modified textile surface

Course Outcomes At the end of the course students will be able to	
1.	Explain need and methodology of various surface modification techniques.
2.	Understand physical and chemical aspects of coating, nano material and plasma treatment.
3.	Explain changes brought in to textiles by surface modifications
4.	Explain the principles, methods of evaluation of modified textile surface

	Course Contents	**Hrs.**
Unit 1.	**Coating Chemistry:** 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, Radiation-Cured Coating, Adhesion.	7
Unit 2.	**Coating Techniques:** Knife Coating- Different types of Knifes, Knife coating with pre-metering and post-metering, 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	6

	of each coating methods. Test methods for coated, laminated materials.	
Unit 3.	**Nano Technology**: Concept of nano-scale 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:** Principles of various techniques.	7
Unit 4.	**Nano Textiles:** Development of functional textile using nano material: Conductive textiles, Antimicrobial textiles, Self-cleaning textiles, Moisture absorbing textiles, Improved hydrophilicity, colourability and wear resistance, UV-blocking textiles, Controlled release of active agents.	6
Unit 5.	**Plasma Technology**: Introduction, gases used, plasmas generation, plasma chemistry and plasma surface collisions. Low pressure, Atmospheric pressure and DBD plasma generation, its equipment for textile processing	7
Unit 6.	**Textile Applications of Plasma Technology** Action of plasma on various textile substrates. 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. Characterization of Plasma Treated Textiles, principles of various techniques.	8

Reference Books	
1	Principles of Nanotechnology by Phani Kumar
2	Nanofibres & Nanotechnology in Textiles by P.J. Brown & K. Stevens
3	Plasma Technology for Textiles by Roshan Shishoo, CRC Publication
4	Plasma Surface Modification and Plasma Polymerization – Norihiro Inagaki: CRC Press
5	Coated Textiles Principles and Applications by Dr. A. K. Sen
6	The Nanoscope, Encyclopedia of Nano Science & nanotechnology Vol.-I to VI, Dr. Parag Diwan & Ashish Bharadwaj
7	Analytical Electrochemistry in Textiles by P. Westbroek, G. Priniotakis & P. Kiekens

First Year M. Tech-Textile Engineering Semester – I
TEL 556: FIBRE REINFORCED 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 applications of composites

	Course Contents	**Hrs.**
Unit 1.	**General introduction -** Meaning and types of composite materials, design of composite materials, the concept of load transfer. **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.	**10**

Unit 2.	**Fabrication:** Liquid resin impregnation routes, pressurized consolidation of resin pre-pregs, 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.	**04**
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.	**08**
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.	**06**
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.	**06**
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.	**02**

Reference Books	
1	Introduction to Composite Materials, Clyne and Hull
2	Fabre reinforced composites by P. K. Mallick
3	Composite materials: Engineering & science by F. L. Mathew & R. D. Rawlings.
4	Micro structural Characterization of fibre reinforced composites by John Summerscales
5	3-D Textile reinforcements in composite materials by Prof. A. Miravete
6	Mechanics of Textile & Laminated composites by A. E. Bogdanovich & C. M. Pastore.

M. Tech. (Technical Textile) SEM-I

TED 511: 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.

First Year M. Tech-Textile Engineering Semester – II
TEL 504: PROJET PREPERATION APPRAISAL AND 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 and project preparation.
4.	To explain requirements for appraisal and project implementation.

Course Outcomes At the end of the course students will be able to	
1.	Describe the logic of Project development cycle & identification of Investment.
2.	Explain the Basics of Technical Analysis for Material inputs & utilities.
3.	Explain the Time value of money and project preparation.
4.	Discuss the study on Appraisal criteria & Project implementation steps.

	Course Contents	**Hrs.**
Unit 1.	**Overview.** 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.	4 Hrs.
Unit 2.	**Market & demand analysis –** Information required for market & demand analysis – demand forecasting methods – market planning. 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.	8 Hrs.
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	6Hrs.

	tendering alternatives.	
Unit 4.	**Financial Analysis –** Cost of Project – Means of finance – Estimation of Sales & Production – Cost of production – Working capital requirement & financing – Profitability projections – Breakeven 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, Payback period – Accounting, Debt service coverage ratio, Rate of Return, Net present value – Internal rate of return – Annual capital charge – Investment appraisal in practice. Project implementation – Forms of project organization – Project planning – project control – Human aspects of project management – Prerequisites for successful project implementation.	6Hrs

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

First Year M. Tech-Textile Engineering Semester – II
TEL505: 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 the production flow chart of nonwovens and web forming techniques of nonwoven manufacturing.
2.	To describe the different bonding techniques to manufacture nonwoven fabrics.
3.	To describe the concept of composite nonwovens and finishing of nonwovens
4.	To explain the applications, testing and natural fibre nonwovens.

Course Outcomes At the end of the course students will be able to	
1.	Describe the market size, scope and web forming techniques of nonwoven manufacturing.
2.	Explain the different bonding techniques
3.	Explain finishing of nonwovens and composite nonwovens
4.	Illustrate the applications and explain the test methods and natural fibre nonwovens

	Course Contents	**Hrs.**
Unit 1.	**Introduction –** INDA, EDANA Non woven definitions, flow chart of non woven manufacturing, differerent methods of nonwoven classifications, Market size, scope, advantages, disadvantages, Key companies.	**03**
Unit 2.	**Dry-laid web formation -** Introduction, Selection of raw materials for carding, Carding: working and stripping principles, Cross-lapping, vertically lapped (perpendicular-laid) web formation. **Air laid web formation**: raw materials and fibre preparation, Air laying technology. **Wet-laid web formation -** Raw materials for wet-laid nonwoven, Cellulose fibre preparation, Man-made fibre preparation, Web-forming process technology, bonding systems for wet-laid nonwovens.	**05**
Unit 3.	**Polymer-laid web formation** **I. Spunbond fabric production** - Spunbond production systems,	**06**

	Bonding techniques, Operating variables in the spunbond process, Structure and properties of spunbond fabrics, Spunbond fabric applications. **II. Melt blown fabric production** - Characteristics and properties of melt blown fabrics, Melt blown fabric applications, Mechanics of the spunbond and melt blown processes, other extrusion processes	
Unit 4.	**Mechanical bonded** **Stitch bonded nonwovens** - Introduction, applications. **Needle punching -** Introduction, Needle design and selection, Penetration depth and other factors affecting, Needle punching technology, properties of needle punched fabric **Hydro entanglement –** Introduction, principles of hydro entanglement, Fibre selection for hydro entanglement, Hydro entanglement process technology, Process variables, properties of spun lace fabric. **Thermal bonding**- Introduction, Principle of thermal bonding, Raw materials, Methods of thermal bonding. **Chemical bonding** – Introduction, Chemical binder polymers, Mechanism of chemical bonding, Methods of binder application	**08**
Unit 5.	**Composite Nonwovens** - Definition, Importance of composite nonwovens ,Types of composite nonwovens, Composite nonwoven manufacturing processes , Application of composite nonwoven structures **Nonwoven fabric finishing**: Introduction, Wet finishing, Application of chemical finishes, Lamination, Mechanical finishing, Surface finishing.	**07**
Unit 6.	**Applications** of Nonwovens in apparel, agriculture, geotextiles, medical textiles, automotive textile & filtration. **Natural fiber nonwovens -** Introduction, Cotton fiber nonwovens, Flax fiber nonwovens, Jute fiber nonwovens, Pineapple fiber nonwovens, Wool fiber nonwovens. **Characterization, testing of nonwoven fabrics.**	**07**

Reference Books	
1	Handbook of nonwovens, Edited by S. J. Russell, Wood head Publishing, CRC Press, Washington DC, 2007
2	Nonwovens: Process, structure, properties and applications, T. Karthik, R. Rathinamoorthy& C. Praba Karan, Woodhead Publishing India Pvt. Ltd., 2016
3	Nonwoven Process Performance & Testing – Turbak
4	Proceedings of the Seminar - Nonwoven Technology Market & Product Potential, IIT, New Delhi December 2006
5	W.Albrecht, H. Fuchs and W.Kettelmann, Nonwoven Fabrics: Raw Materials, Manufacture, Applications, Characteristics, Testing Process, 2003.

First Year M. Tech-Textile Engineering Semester – II
TEL506: DESIGN OF EXPERIMENTS AND STATISTICAL APPLICATION IN TEXTILE

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

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

Course Objectives	
1.	Explain LPP, types and methods of finding solutions. To explain Explain Transportation problem. Method of finding optimum solution.
2.	Explain Assignment Problem. Method of finding optimum solution. Explain PERT and CPM networks. Calculation of Slack and float time estimates.
3.	Explain analysis of variance, types and method of solution.
4.	Explain DOE, basic designs and analysis. Explain Yate's method of Solution.

Course Outcomes At the end of the course students will be able to	
1.	Students are able to solve problems of LPP.
2.	Students are able to solve problems of transportation and assignment problem.
3.	Students are able to solve problems of one-way, two-way ANOVA.
4.	Students are able to solve problems of CRD, RBD, LSD and factorial experiments.

	Course Contents	**Hrs.**
Unit 1.	Linear Programming Problems: Definition and formulation of LPP. Max. & Min type of LPP. Solution of LPP by graphical and Simplex methods.	**7**
Unit 2.	Transportation and Assignment Problems: Definition of transportation problem. North West corner rule, Matrix Minima Method and Vogel Approximation Method for finding initial solution. UV Method for finding optimum solution. Definition of Assignment Problem and Hungarian method of finding optimum solution.	**8**
Unit 3.	Network Analysis: Network drawing. PERT and CPM networks. Calculation of slack and float times.	**5**
Unit 4.	Analysis of variance:	**4**

	Introduction, One-way and Two-way as types, analysis and conclusion by preparing ANOVA table.	
Unit 5.	Design of Experiments: Introduction, basic principles, basic designs CRD, RBD and LSD. Analysis of these designs.	**6**
Unit 6.	Factorial Experiments: Introduction, two factor two and three level designs. Analysis using Yate's method.	**6**

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
6	Modern Elementary Statistics by J. Fruend.

First Year M. Tech-Textile Engineering Semester – II
TEL 557: FINISHING AND QUALITY EVALUATION OF APPARELS

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

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

Course Objectives	
1.	Discuss finishing of fabric and garments: need, principles and chemistry involved.
2.	Discuss evaluation methods and analysis of results for colour fastness, functional finishes and care label
3.	Enumerate environmental issues with garments and discuss its evaluation
4.	Discuss principle, working and results interpretation of instrumental evaluation in eco-testing

Course Outcomes At the end of the course students will be able to	
1.	Explain finishing of fabric and garments: need, principles and chemistry involved.
2.	Explain evaluation methods and analysis of results for colour fastness, functional finishes and care label
3.	Enumerate environmental issue with garments and discuss its evaluation
4.	Explain principle, working and result interpretation of instrumental evaluation in eco-testing

	Course Contents	**Hrs.**
Unit 1.	**Finishing of fabric** Softeners: Mechanism, types and chemistry of softeners, compatibility. Hand builders: types and chemistry of hand builders. Resin finish: mechanism, formaldehyde issues, eco-friendly alternatives, concept of wet and moist curing. Concept, mechanism and application of UV protection finish, Antimicrobial finish, flame retardant finish, soil release finish.	7
Unit 2.	**Finishing of Garments** Essential physical and functional requirement of garments like handle, drape, hydro-philicity and -phobicity etc. Optics of denim, processing of denim garments and various wash down effects; cationization and pigment dyeing, bio-finishing of cellulosic garments.	6

Unit 3.	**Evaluation of Functional Finishes** Importance and principle of evaluation of functional finishes like durable press rating, flammability, soil release, anti-microbial and sun protection.	5
Unit 4.	**Colour fastness and Care Label** Introduction: importance of testing, sample preparation, acceptance sampling, errors and standardization. Need, principle, method and result interpretation for colour fastness to various agencies like washing, crock, light, perspiration, bleaching, dry cleaning, sublimation, saliva, chlorinated and sea water, ozone etc. Care label: voluntary and mandatory care label, Care label symbols. Instructions for washing, bleaching, drying, ironing, dry cleaning, and placement of care label.	8
Unit 5.	**Eco aspects** Concepts of Eco-Testing of Textiles; Principles of evaluation of Banned amines, Formaldehyde, PCP, heavy metals and restricted chemicals. Sources of hazards chemicals and acceptance norms. Certifications like Okö-tex, Organic cotton, GOTS and restricted chemicals.	6
Unit 6.	**Instruments** Classification of chromatographic methods, Principle and working and application of HPLC, GCMS; Concept, laws, instrument and working principle of UV – Visible spectroscopy Instruments, working principle and result interpretation of NMR, FTIR, XRD and AAS.	8

Reference Books	
1	Textile Physics by B P Savili
2	AATCC and ISO Standards Manual
3	Textile Finishing by Scholinger
4	Fabric Care by Naomi D'soza
5	Testing of Eco-Parameters by S Subramanian, Anita hazara; Textile Committee
6	Elementary Organic spectroscopy – Principles and Chemical Application by Y R Sharma

First Year M. Tech-Textile Engineering Semester – II
TEL558: Industrial Engineering

Teaching Scheme	
Lectures	**03Hrs. / Week**
Total Credits	**03**

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

Course Objectives	
1.	To understand the importance of Industrial Engineering.
2.	To discuss the factors affecting Production Planning and Control and inventory.
3.	To understand Ergonomics and costing, overheads.
4.	To Formulate of mathematical model and problem solving

Course Outcomes At the end of the course students will be able to	
1.	Understand the concepts of Industrial Engineering.
2.	Identify the factors affecting Production, Planning and Control of inventory
3.	Solve the problems based on Ergonomics and costing, overheads.
4.	Formulate mathematical model and problem solving

	Course Contents	**Hrs.**
Unit 1.	**Work Study and Productivity**- Production – Definition, Types of production, and characteristics of each type of production. Productivity, ways to increase productivity, measurement of productivity. **Method Study**-Definition, steps in method study, details of every step, charts used for recording, outline chart, flow process chart & its types, two handed process chart, multiple activity chart, principles of motion economy, **Micro motion Study** – Contribution of Gilbreth, Therblings, Procedure, SIMO Chart. c Work measurement Definition, Techniques, concept of total time, standard time, allowances, problems **Operation Research** – Definition, various techniques of OR.Basics of linear programming – Formulation of LP, Graphical solution,	8
Unit 2.	**Production, Planning & Control (PPC)-** objectives, functions. Forecasting- various techniques of sales forecasting, **Capacity Planning-** Strategic decisions, measurements, influences, translating capacity into workable units. **Process Planning-** inputs, factors, steps, route sheets, planning in different situations	8

	Scheduling- sequencing, scheduling, Gantt charts **Project Planning-** Network Analysis – PERT, CPM, and comparison. g Plant location, Plant layout, Material handling	
Unit 3.	**Material Planning**- Factors, Techniques, BOM, MRP, Inventory Control- objectives, selective inventory control,EOQ, EBQ, safety stock, Replenishment systems.	5
Unit 4.	**Ergonomics:** Introduction, areas of study under ergonomics, system approach to ergonomics model, man-machine system. Components of man-machine system and their functions – work capabilities of industrial worker, study of development of stress in human body and their consequences. Computer based ergonomics.	6
Unit 5.	**Overheads:** Classification, collection of overheads, Primary and Secondary apportionment of overheads, absorption of overheads- Machine hour and labour hour rate. Under and over absorption of overheads.	6
Unit 6.	**Costing:** Methods of costing and elements of cost. **Material Cost-** Different methods of pricing of issue of materials. **Labour Cost** -Different methods, wages and incentive plans. Principles of good remunerating system, labour turnover. **Depreciation Concept**,- importance and different methods of depreciation	6

Reference Books	
1	Introduction to work study-ILO, - III Revised Edition, 1981
2	Motion and Time study "- Ralph M Barnes; John Wiley, 8th Edition, 1985.
3	Work Study and Ergonomics "- S Dalela and Sourabh, Chand Publishers, 3rd edition.
4	Work Study - Ralph & Barnes.
5	"Engineered work Measurement" - Weldon, ELBS, Marvin E. Mundel- Motion and Time study, PHI, 1st edition, 1991.
6	B K Bhar, "Cost Accounting – Methods and Problems", Academic Publishers
7	Bhattacharya A. K., "Principles and Practice of Cost Accounting", Prentice Hall India.
8	Colin Drury, "Management and Cost Accounting", English Language Book Society, Chapman and Hall London.

First Year M. Tech-Textile Engineering Semester – II
TEL559: TEXTILE PRODUCT 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 CAD etc.
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	**Hrs.**
Unit 1.	**General overview of innovation and textile product development :** 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. **Product Engineering -** Objectives and Scope of product development in textiles and clothing. Performance and serviceability concepts in textiles. **Product design -** Consideration of a good product design. Product development procedure -Selection of product, Product analysis, Product design procedure, Product life cycle, Market Research, Material Research,	**10**

	Reverse Engineering.	
Unit 2.	**Simulation of specified properties or structures leading to design –** Special yarns, Non – woven fabrics, Simulation of material, Texture by using computer graphics, Concept of overall designing procedure. CAD. **Sustainability -** Introduction, Future trends. **New product developments in knitted textiles -** Introduction, Seamless knitwear, Printing on knitwear, Computer aided knitwear design (CAD) and virtual knitwear **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	**08**
Unit 3.	**Nanotechnology innovation for future development in the textile industry:** Introduction, Nanotechnology in the textile industry, Adoption of nanotechnology for textile applications	**04**
Unit 4.	**Nano fibre -** Introduction - Definition of nano fibres, concept, overview of nano fibres, types of nano fibres. **Developments & Applications.**	**04**
Unit 5.	**New product development for e-textiles:** Introduction, Integration of electronics and fabrics, E-textiles product development challenges	**04**
Unit 6.	**Case studies -** Parachute textiles, Air filters, Acoustic textiles, Industrial rope, Battery Separator, Geotextiles for Dam.	**06**

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	Automotive Textiles, Textile Progress, Vol.29, No.1/2 by S.K. Mukhopadhyay & J.F. Partridge, Textile Inst. 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	Nanofibers and nanotechnology in textiles, Edited by P. J. Brown and K. Stevens, Wood head Publishing Limited Cambridge, England, 2007
5	Electrostatic Charging of Textiles, Textile Progress Vol.28, No.1 BY I. Holme, Textile Institute Publication

First Year M. Tech-Textile Engineering Semester – II
TEL 560: THEORY OF CLOTHING COMFORT

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 define 'comfort'.
2.	To discuss the mechanism of thermal comfort.
3.	To explain fabric characteristics and tactile attributes
4.	To explain the ways to improve the clothing

Course Outcomes At the end of the course students will be able to	
1.	Describe 'comfort'.
2.	Explain the mechanism of thermal comfort.
3.	Explain fabric characteristics and tactile attributes
4.	Explain the ways to improve the clothing

	Course Contents	**Hrs.**
Unit 1.	**Human Physiology And Role Of Clothing:** Definition of Comfort. Human physiological aspect of comfort. Perception of Comfort. Various aspects of clothing comfort. Comfort variables. Comfort properties of fibres, yarns and fabric structures.	6
Unit 2.	**Thermal Comfort:** Thermal balance of human body. Mechanism of heat transfer through clothing. Parameters influencing heat transfer. Mathematical modeling of heat transfer through clothing. Moisture transmission: Liquid water transfer- wicking, water absorption and principles of moisture vapour transfer. Dynamic heat and mass transmission characteristics of clothing. Factors influencing heat and mass transfer through fabrics.	6
Unit 3.	**Tactile Comfort:** Tactile comfort sensations. Fabric characteristics and tactile attributes. Fabric parameters influencing tactile sensation.	6
Unit 4.	**Clothing Fit And Comfort:** Body dimensions and pattern. Tight-fit and loose-fit clothing. Clothing fit and pressure. Factors related to clothing fit. Clothing fit and body movement.	6

Unit 5.	**Aesthetic Comfort:** Psychological aspects of aesthetic comfort. Analysis of clothing aesthetics. Aesthetic concepts of clothing.	6
Unit 6.	**Improving Comfort In Clothing:** Different approaches for improving thermal comfort of clothing. Improving moisture transport and developments in moisture management. Improving textile surface properties for tactile sensation. Materials and design strategies for improved fit and movement.	6

Reference Books	
1	Guowen Song, "Improving Comfort in Clothing", Woodhead Publishing Limited, Cambridge, 2011
2	Apurba Das and Alagirusamy R, "Science in Clothing Comfort", Wood head Publishing India Limited, New Delhi, 2010
3	Li Y, "The Science of Clothing Comfort", Textile Progress, Vol.31, No.1/2, The Textile Institute, Manchester, 2001
4	Fan J and Hunter L, "Engineering Apparel Fabrics and Garments", Woodhead Publishing Limited, Cambridge, 2009

First Year M. Tech-Textile Engineering Semester – II
TEL 561: MODELLING & SIMULATION 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 familiarize the students with general understanding of various modelling and simulation techniques.
2.	To provide a deeper insight into the simulation basics in textile technology without having to know too much about the involved Mathematics.
3.	To expose the students to the power of modeling and simulation studies to obtain the targeted properties.
4.	To provide a few case studies to emphasize the utility of simulation and modeling.

Course Outcomes At the end of the course students will be able to	
1.	Learn the common techniques of Simulation and Modelling.
2.	Appreciate the importance of Simulation and Modelling.
3.	Make an attempt to employ the techniques in the development of high end technical textiles.
4.	Employ the techniques in their further studies.

	Course Contents	**Hrs.**
Unit 1.	Introduction to Modelling and simulation; Expert systems, Neural Networks, Fuzzy Logic and their application to textiles.	
Unit 2.	Structural hierarchy in textile materials and the techniques adopted for modelling textiles at different levels- molecular, fibre, yarn, woven and knitted fabric.	
Unit 3.	Introduction to Computational Fluid Dynamics; Simulation of currents with fibres, yarns and textiles; Validation methods and application to Textiles - extrusion processes, fluid flows through porous materials, heat and mass transfer.	
Unit 4.	Simulation of fibrous structures and yarns; Simulation of woven, Knitted, Nonwoven structures.	
Unit 5.	**Case Study 1:** Ballistic Protection; Materials employed; Ballistic Performance evaluation of woven fabrics based on experiments and Model simulations.	
Unit 6.	**Case Study 2:** Introduction to Air Inflated structures – Air ships,	

	Inflatable wings and Anti Gravitational Suits; Materials employed; Use of simulation and modeling techniques in their development.	

Reference Books	
1	X. Chen - Modelling and Predicting Textile Behaviour (Woodhead Publishing in Textiles) - CRC Press (2010)
2	Dieter Veit - Simulation in textile technology_ Theory and applications-Woodhead Publishing (2012)
3	R Shamey and X Zhao - Modelling, simulation and control of the dyeing process-Woodhead Publishing, , Elsevier Ltd (2014)
4	Majumdar, A. - Soft computing in textile engineering, Woodhead Publishing (2011a).
5	Majumdar, A.- Soft computing in fibrous materials engineering, CRC Press Inc.(2011b)

First Year M. Tech-Textile Engineering Semester – II
TEL 562: MECHANICS OF TEXTILE MACHINES

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 understand basic principles of mechanics, forces acting in mechanisms of textile machines.
2.	To describe constructional details and design aspects of machine parts and mechanisms involved in machines.
3.	To evaluate design performance parameters involved in mechanisms.
4.	To select criterion and selection process for mechanisms as per need.

Course Outcomes At the end of the course students will be able to	
1.	Explain principles of mechanics, forces acting in mechanisms of textile machines.
2.	Express design aspects of machine parts and mechanisms involved in machines.
3.	Evaluate design performance parameters involved in mechanisms.
4.	Select particular mechanisms as per need of textile machines.

	Course Contents	**Hrs.**
Unit 1.	**Fundamentals of mechanics** - Equations of forces, motion and energy; energy stored in rotating masses, simple harmonic motion its application to sley motion & heald shaft movement.	6
Unit 2.	**Design of machine elements –** forces acting on components, stress strain curve, factor of safety, design steps, combined stresses, design of drafting rollers & shaft.	6
Unit 3.	**Friction & Lubrication** – Machine degradation, factors & impact, meaning of lubrication, types of lubricants, selection criteria, lubricant monitoring.	6
Unit 4.	**Vibration monitoring** – types of machine vibrations, impact of vibration, natural frequency of vibration, important vibration characteristics, vibration monitoring programme, materials & methods to control vibrations.	6
Unit 5.	**Mechanics in yarn manufacturing processes** – elimination of trash & dust, carding theories, transfer of fibres, doubling & drafting, drafting force, design of cone drums, tension variation in roving, spinning	6

	geometry, balloon tension, cop winding, friction & open end spinning.	
Unit 6.	**Mechanics in fabric manufacturing processes** - Study of mechanisms in winding, Build of various packages. Screw traversing mechanism. Design of grooved drums for various packages. Design changes in Beam warping drive for high speed. Sectional warping drum design. Mechanism of squeezing, sow box design. Review of design changes of shedding mechanism. Picking mechanism theories for different shuttle less weaving techniques.	6

Reference Books	
1	Textile Mathematics, Vol-I, II and III By J.E. Booth, The Textile Institute Publication.
2	Control Methodology in Textile Engineering and Economics By John W.s. Hearle, Journal of the Textile Inst. Vol.83, No.3, 1992, The Textile Institute Publication
3	Textile Mechanics Vol.I, II By K. Slater, The Textile Institute Publication.
4	Mechanics of Spinning Machines By R.S. Rengasamy, NCUTE Publication
5	An Introduction to Textile Mechanisms By P. Grosberg, The General Publishing Company.
6	Theory of Machines by Sharma Agarwal
7	Mechanics of Textile Machinery By W.A.Hanton, The Textile Institute, Publication.
8	Principles of Weaving By R.Marks & Robbinson

M. Tech. (Textile Engineering) SEM-II

TED 512: 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.
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.

DKTE Society's

TEXTILE & ENGINEERING INSTITUTE

Rajwada, Ichalkaranji - 416115

(An Autonomous Institute)

Curriculum (Structure and Syllabus) for

M.Tech Program
In
Textile Engineering

(Second Year)

w.e.f. June 2020

M. Tech. (Technical Textile) Semester-III
TED601: 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
TED602: DISSERTATION PHASE II

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

Course Objectives:

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

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

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

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

Guidelines for Dissertation Phase II:

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.