DKTE Society's

TEXTILE & ENGINEERING INSTITUTE

Rajwada, Ichalkaranji - 416115

(An Autonomous Institute)

DEPARTMENT: TEXTILES

CURRICULUM

M. Tech. (Textile Chemistry)

First Year

With Effect From

2017-18

DKTE

Promoting Excellence in Teaching
Learning & Research

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

Sr. No.	Course Code	Name of the Course	Group	Teaching Scheme				Credit
				Theory Hrs / week	Practical Hrs / week		Total	
1	TCL530	Advanced Textile Chemical Processing-I	D	3			3	3
2	TCL531	Technical Textiles	D	3			3	3
3	TCL532	Advances in Textile Chemical Processing Machinery	D	3			3	3
5	TCLEL1	Elective - I	D	3			3	3
5	TCLEL2	Elective - II	D	3			3	3
6	TCD541	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

TCL533 Application of Plasma in Textile

TCL534 Fibre reinforced Composite

TCL535 Super Absorbant and Shape Memory Polymers

TCL536 High Performance Fibres

List of Electives -II

TCL537 Advanced Computer Programming and Applications

TCL538 .Application of biotechnology in textile processing

TCL539 Clothing Performance and Comfort

TCL540 Selected Topics in Textile Chemical Processing

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

Sr. No.	Course Code	Name of the Course	Group	Teaching Scheme				Credit
				Theory Hrs / week	Practical Hrs / week		Total	
7	TCL542	Advanced Textile Chemical Processing-II	D	3			3	3
8	TCL543	Coating and lamination	D	3			3	3
9	TCL544	Design of Experiments and Statistical Application in Textiles	A	3			3	3
10	TCLEL3	Elective - III	D	3			3	3
11	TCLEL4	Elective - IV	D	3			3	3
12	TCD553	Mini Project -II	F		7*		7	7
Total				15	7		22	22

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

List of Electives –III

TCL545 Energy Management and Water Conservation in Chemical processing

TCL546 Science and Technology of Nano Materials in Textiles

TCL547 Medical Textiles

TCL548 Project Preparation. Appraisal and Implementation

List of Electives -IV

TCL549 Environmental Engineering in Textiles

TCL550 Application of natural Dye on Textiles

TCL551 Processing of Unconventional Fibrous Material

TCL552 Theory and Practices of Textile Finishing

M. Tech. (Textile Chemistry) Semester – III Structure

Sr. No.	Course	Name of the Course	Group	Teaching Scheme				Credit
				Theory	Tutorial	Practical		
				Hrs / week	Hrs / week	Hrs / week	Total	
1	TCD601	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 Chemistry) Semester – IV Structure

Sr. No.	Course	Name of the Course	Group	Teaching Scheme				Credit
				Theory	Tutorial	Practical		
				Hrs / week	Hrs / week	Hrs / week	Total	
1	TCD602	Dissertation Phase 2	F	----	----	28*	28	28
Total				----	----	28	28	28

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

M. Tech. (Textile Chemistry) Semester - I

Differences in the University and Autonomy syllabus-structure

Shivaji University Subject Name	Autonomy Subject Name	Remarks/ Major changes in Syllabus
First Year Semester-I		
Advanced Textile Chemical Processing-I	Advanced Textile Chemical Processing-I	This subject consists of recent developments in textile processing – pre-treatments, dyeing, bio-technology application and specialty fabric processing. The contents are essential, therefore, the same matter along with tile has used for autonomous syllabus.
Hi Tech Fibre - I	Advances in Textile chemical Processing Machinery	Hi-Tech Fibres is shifted to Elective – I as high performance fibres with some modification. This is important subject dealing with base material. Comparatively important subject of developments in machinery is added. Content includes developments, energy and water saving etc.
Technical Textile	Technical Textile	The recent trend of textile in its technical use was included in the subject. The same is used in autonomous syllabus.
Elective-I 1. Physical Methods of Analysis and Eco-Testing 2. Nano-Technology in Textile	Elective –I 1. Tex. Reinforced Composite 2. Super Absorbent and Shape Memory Polymers 3. Application of Plasma in Textile 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 composites, SAP and shape Memory polymer, Plasma Application in Textile and high performance fibres are also introduced in the electives of autonomy structure. The content of separate subject PMA & ET including Physical analytical method and Eco testing is distributed to relevant subjects. The nano-technology is shifted as elective - III
Advanced Computer Applications In Textiles	Elective –II 1. Advanced Computer Programming and Applications 2. Application of Bio-Technology in Textiles 3. Clothing Performance and Comfort 4. Selected topics in Textile Chemical Processing	In university syllabus, there was no concept of elective –II, and students were required to study Advanced Computer Applications In Textiles subject mandatory. 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. The new subjects are focusing on recent developments in detail with fundamental and application aspects.
Seminar-I	Mini Project -I	Mini project concept is introduced in autonomy structure and has replaced earlier seminar. Mini project imparts more exposure to the experimental work and students will have good

		knowledge of conducting experiments. Earlier seminar was giving only theoretical exposure to students.
First Year Semester-II		
Advanced Textile Chemical Processing-II	Advanced Textile Chemical Processing-II	This subject consists of recent developments in textile processing – Printing, Garment and introduction to relatively new application techniques. The contents are essential, therefore, the same matter along with tile has used for autonomous syllabus.
Hi Tech Fibre - II	Coating and lamination	The essential contents of Hi-Tech fibres – II were incorporated in the course - high performance fibres. The recent trend of coating and Lamination is introduced in this course – including coating methods, chemistry, few application and evaluation of coated material. Lamination - technology and application.
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.
Environmental Engineering	Elective –III 1. Energy management and water conservation in textile chemical processing 2. Science and Technology of Nano-Materials in Textile 3. Medical Textiles 4. Project Preparation, Appraisal & Implementation	The Environmental Engineering subject is shifted as one of the elective – IV subjects, with few modifications. The concerns and issues of environment are considered. In the place of this subject Elective –III group is introduced. Therefore, students will have more subjects to choose.
Elective-II 1. Project Preparation, Appraisal & Implementation 2. Management of Textile Production	Elective –IV 1. Environmental Engineering in Textile Chemical Processing 2. Application of Natural Dyes on Textiles 3. Processing of Unconventional fibrous Material 4. Theory and Practices in Textile finishing.	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. (Textile Chemistry) Semester - I

TCL 530: ADVANCED TEXTILE CHEMICAL PROCESSING - I

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

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

Course Objectives:

1. To describe process modification in pre-treatments and application of bio-tech based solutions in pre-treatment
2. To discuss the new developments in dyeing
3. To explain denim dyeing operation, explain fabric and garment finishing sequence
4. To discuss processing of speciality textile materials

.

Course Outcomes:

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

1. Apply basics and illustrate the modifications in pre-treatment operation
2. Describe the developments in various dyes and dyeing process
3. Summarize denim dyeing in detail and explain/predict operation sequence for expected results
4. Summarize and illustrate processing operations for terry towel, carpet, lyocell and spandex containing textiles.

Course Contents

Unit 1. **Process modifications in Pre-treatment** **4 Hrs.**

Eco-friendly peracetic acid bleaching, Eco-friendly retting of Jute, Redox H2O2 bleaching, Concept of Eco-friendly stabilizers for H2O2 bleaching. Combined operations like desizing- scouring- bleaching, solvent scouring, Hot and ammonia mercerization, add-on mercerization.

Unit 2. **Use of biotechnology in Pre-treatment** **6 Hrs.**

Developments in singeing, desizing and its eco-aspects, size recovery, bleaching and its eco-aspects, classification of enzymes, Mode of action of enzyme, Factors affecting efficiency of enzyme treatment. Enzyme retted flax using different formulations, influence of enzymatic pre-treatment on the colours of bleached and dyed flax fibers, combined bio scouring and bleaching of cotton fibers, effect of ultrasound on the performance of industrial enzymes used in cotton bio-preparation/bio-finishing applications, Enzymatic degumming, enzymatic H2O2 bleaching, nanobiotechnology.

Unit 3. **Developments in Dyeing** **6 Hrs.**

Dyeing and its eco-aspects, new dyes and their advantages. Eco-friendly dyeing with sulphur & 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. Super critical CO2 dyeing – concept, mechanism, methods and techno economical features.

Ultrasound in dyeing - Concept, mechanism, methods and techno-economical features.

Low temperature dyeing - concept, mechanism, methods and techno economical features.

Unit 4. **Processing of Denim** **8 Hrs.**

Introduction to denim, types of Denim fabrics, chemistry and processes of warp dyeing with indigo. Indigo dyeing equipments – warp sheet and rope dyeing machine. Dyeing with mixture of indigo and other dyes.

Processing of Denim Fabrics and Processing of Denim Garments. Different wash down effects

Unit 5. **Processing of Terry towel and Carpet** **6 Hrs.**

Process sequence and machines used for terry towel manufacturing, essential properties of terry towel fabrics like pile properties. Type and application of terry fabrics. Different stages of towel processing and finishing.

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

Unit 6. **Processing of specialty fabrics** **6 Hrs.**

Processing of Lyocell - General properties and uses of lyocell (Tencel). Pre-treatment, dyeing and finishing of lyocell. Concept of fibrillisation, its causes and remedies.

Processing of Fabric containing spandex - Properties and uses of spandex fibres and blends. Wet processing of Cotton / Spandex, polyester / Spandex fabrics.

REFERENCE BOOKS

1. Biotechnology in Textile processing, by Georg M. Guebitz, Artur Cavaco-paulo, Ryszard Kozlowski, The Hawarth Press, Inc.
2. Denim a Fabric for All by dr. Parmar, NITRA
3. Manufacturing of Terry Towel by Subhash J. patil, Universal Book Corporation, Mumbai
4. Interior Furnishing by Mortimer O'shea, Textile Progress, Vol. 11, No. 1, Textile Institute
5. Textile Floorocovering by G. H. Crowshaw, Textile Progress, Vol. 9, No. 2, Textile Institute. Carpet Surface by H. Pointon, Textile Trade Press, UK
6. Wool science and Technology by W. S. Simpsion, G. H. Crowshaw, Woodhead Publishing, Textile Institute
7. Trouble shooting in Wet Processing: Acetate, Reyon / Lyocell and Spendex Blends, AATCC.

8. Handbook of Jute by T C Ranjan
9. Environmental Issues – Technology option for Textile Industry Edited by R. B. Chavan, Indian Journal of Fibre & Textile Research Special Issue - March, 2001
10. Eco-friendly Textiles Challenges to Textile Industry – Textile Committee
11. Environmental Success – America Textile Industry, AATCC Symposium – 1996
12. The Textile Industry: Achieving Our Environmental Commitment – AATCC Symposium – 1994
13. Textile Energy & Waste Seminar – Textile Institute, 1997

M. Tech. (Textile Chemistry) Semester - I

TCL 531: 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 technical textile market and trend in general, classification
2. To describe chemistry and technology of coating and lamination
3. To discuss application of textile in various industrial application
4. To explain various properties of functional textile used for military applications and other field

.

Course Outcomes:

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

1. Illustrate technical textile market and status in general
2. Explain chemistry and technology of coating and lamination
3. Explain various technical applications of textile like filtration, medical, composite and transportation
4. Illustrate the fabric properties and requirements for military applications and other properties like insulation, electrical, sport etc.

Course Contents

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

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

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

Filtration Application – Introduction –Fabric construction & Finishing Treatments, Solid-liquid separation, liquid – liquid filteration, liquid-gas separation, Mechanism of filteration,.

	Medical Textiles – Introduction – Non implantable materials, Extra corporeal devices – Implantable materials - Health care / hygiene products. Textile Reinforced Composite Materials – Introduction to composite materials – Textile reinforcement – Applications of composites in brief. Textiles in Transportation – Introduction, Textiles in passenger cars – Textiles in other road vehicles – Rail applications – Textiles in Air crafts – Marine application.	
Unit 4.	**Textiles in Defence –** Introduction, Historical Background – Criteria for modern military textiles materials – various application of Textiles in various areas of defence such as environmental protection, thermal insulation, water proof water vapour permeable materials – ballistic protection – heat protection – biological and chemical warfare protection, High altitude fabrics, etc.	**6 Hrs.**
Unit 5.	**Miscellaneous Applications –** Electrical insulation – Battery separators – synthetic turf and sports application – sound insulation –power transmission, parachute textiles, ropes, cordage and twines.	**8Hrs.**
Unit 6.	Case studies related to Product development in Technical Textiles	**4Hrs.**

REFERENCE BOOKS

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

M. Tech. (Textile Chemistry) Semester - I

TCL 532: ADVANCES IN TEXTILE CHEMICAL PROCESSING MACHINERY

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 yarn and fabric dyeing machinery and developments
2. To discuss printing machinery and developments
3. To discuss drying and finishing machinery
4. To discuss garment processing and ancillary machinery

.

Course Outcomes:

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

1. Explain yarn and fabric dyeing machinery and developments
2. Explain printing machinery and developments
3. Explain drying and finishing machinery
4. Summarize garment processing and ancillary machines

Course Contents

Unit 1. **Fiber and Yarn dyeing machinery** **4 Hrs.**

Advances in fiber dyeing machine - Advances in cheese dyeing machine- importance of winding in yarn dyeing — calculation of winding density — various yarn dyeing defects caused by cheese dyeing machine - detailed maintenance schedule for cheese dyeing machines

Unit 2. **Fabric dyeing machine** **6 Hrs.**

Advances in Beam dyeing - Advances in soft flow dyeing machines, Advances in jet dyeing machines — Developments in jiggers, Continuous dyeing machineries & its developments— Various dyeing defects caused by the above machineries

Unit 3. **Printing machines** **6 Hrs.**

Advances in flat bed machines, rotary printing machines. Developments in printing screens and manufacturing of screens. Transfer Printing machine Digital printing technique. Printing of garments with different methods

Unit 4. **Drying and finishing machines** **8 Hrs.**

Hydro extractor, Rope opener RF dryer, Yarn dryer, Knitted fabric dryer, Hot flue dryer, Stenter & its type. Sanforising machine, Compacting machines, peach finishing machines

Unit 5. Garment processing **6 Hrs.**

Garment dyeing machines, Tumble dryer, Fusing machines, Backfilling machine, Importance of maintenance of processing machineries, Machineries used for foam application. Preparation of screens for Rotary Printing machines

Unit 6. Ancillary equipments **6 Hrs.**

Auto dosing stations, rotating stations. Developments in material handling equipments, methods to reduce time and damage of textile material during material handling. Equipments for online quality control on various machines

REFERENCE BOOKS

1 R.S.Bhagwat, _Wet Processing Machineries'.Mahajan Publications, 2000
2 Usenko V. Processing of man made fibres 1975, M.I.R. Publishers, Moscow
3 Gokhale S.V. & Dhingra A.K. maintenance in chemical processing department of textile mills, ATIRA.1994
4 Patel, Textile Wet processing machineries- ATIRA.1995.

M. Tech. (Textile Chemistry) Semester - I

TCLEL1 (TCL 533): APPLICATION OF PLASMA IN TEXTILE

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 generation and properties of plasma
2. To discuss various low pressure cold plasma techniques for textile application
3. To discuss various applications of plasma on textile
4. To discuss various application of plasma on textile – cotton, wool and silk and other fibres

.

Course Outcomes:

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

1. Explain generation and properties of plasma
2. Explain various low pressure cold plasma techniques for textile application
3. Explain various applications of plasma on textile
4. Illustrate various application of plasma on textile – cotton, wool and silk and other fibres

Course Contents

Unit 1. **Introduction:** Introduction to Gases, Plasma, Plasma Chemistry, Plasma-surface collisions, Discharge Electrical Characteristics, Electrical Plasma Diagnostics, Plasma Mass Spectrometry, Optical Emission Spectroscopy, Principle of Plasma processes, Advantages & problems of plasma treatments for textiles, Industrial Application **6 Hrs.**

Unit 2. **Low-Pressure Cold & Atmospheric- Pressure Plasma Processing Technology:** Low-pressure vacuum Plasma technology, Equipment for Low-pressure Vacuum Plasma technology, Plasma Activation in Technical Textile & Nonwoven Industries, Plasma deposition on Nonwoven materials, Economics of Vacuum Plasma treatment for fabrics & nonwovens, Atmospheric- Pressure Plasma Processing Technology- Basic manufacturability needs from Plasma Technology, Atmospheric- Pressure Plasma Types for textile processing, Atmospheric- Pressure Plasma Surface Properties for textile products, The Atmospheric- Pressure Plasma Audit **6 Hrs.**

Unit 3.	**Corona & Dielectric Barrier Plasma Processing Technology:** Introduction, Special adaptations of DBD technology to textiles, Plasma Induced surface activation of fibres, Deposition of nano-layers by gas polymerization, combination of DBD treatments and liquor deposition, Future trends, Nano-scale plasma technology for textiles like Plasma cleaning, Plasma Metallisation, Plasma Polymerisation, Plasma co-polymerisation	**6 Hrs.**
Unit 4.	**Plasma Treatment of textiles for water & oil repellency:** Requirement for water & oil repellency, Theory & Testing of water & oil repellency, Current solutions for rendering textiles water & oil repellent, Use of plasma for imparting liquid repellency, Future aspects, Plasma treatment for biomedical application, Plasma treatment for interfacial engineering of technical textiles, Plasma Reactor Techniques	**6 Hrs.**
Unit 5.	**Plasma Modification of Wool:** Introduction regarding application of plasma systems to wool, Plasma- induced chemical & morphological changes, Textile properties of Plasma-treated Wool, Finishing performance of plasma treated Wool, Future trends & source of further information	**6Hrs.**
Unit 6.	**Plasma modification of natural Cellulosic Fibres:** Introduction to natural & man-made cellulosic fibres, Mechanisms of interactions between Plasmas and cellulosic-based fibres, Plasma modification of cotton for textile applications, Plasma surface modification in cellulosic fibre based composites, plasma modification of solid wood & wood pulp fibres, Plasma modification of man-made cellulosics	**4Hrs.**

REFERENCE BOOKS

1 Plasma Technology for Textiles by Roshan Shishoo, CRC Publication
2 Plasma Surface Modification and Plasma Polymerization – Norihiro Inagaki: CRC Press
3 Plasma Kinetic Theory –Donald Gary – CRC Publication
4 Proceedings 2 : The 5th Asian Textile Conference Kyoto Research Park, Kyoto Japan by Federation of Asian Professional Textile Association

M. Tech. (Textile Chemistry) Semester - I

TCLEL1 (TCL 534): FIBRE REINFORCED COMPOSITE

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 **8 Hrs.**

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, alumina and alumino silicates.

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, characterisation of fiber orientations in a plane.

Short fibers: fiber orientation distributions in three dimensions, fiber length distributions.

Unit 2. Fabrication: **6 Hrs.**

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

Unit 3. **The interface region:** **6Hrs.**

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

Unit 4. **Strength of composites:** **6 Hrs.**

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.

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. **6Hrs.**

Thermal conduction mechanism like heat transfer, conductivity of composites and interfacial thermal resistance.

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

Reference Books

1. Physical Texting of Textiles by B. P. Saville.
2. Fabre reinforced composites by P. K. Mallick
3. Composite materials: Engineering & science by F. L. Mathew & R. D. Rawlings.
4. Micro structural Characterisation of fibre reinforced composites by John Summerscales.
5. New millennium fibres by T. Hongu & G. O. Phillips.
6. Effects of mechanical & Physical properties on fabric hand by H. M. Behery
7. 3-D Textile reinforcements in composite materials by Prof. A. Miravete
8. Mechanics of Textile & Laminated composites by A. E. Bogdanovich & C. M. Pastore.
9. Textile Testing & Analysis by B. J. Collier.
10. Handbook of Technical Textiles by A. R. Horrocks & S. C. Anand.

11. Nanofibers & nanotechnology in textiles by P. J. Brown & K. Stevens.
12. 3-D Textile reinforcements in composite materials by Prof. A. Miravete

M. Tech. (Textile Chemistry) Semester - I

TCLEL1 (TCL 535): SUPER ABSORBENT AND SHAPE MEMORY POLYMERS

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 concept of super absorbent and shape memory polymers
2. To discuss manufacturing and properties of Sap and SM polymenrs
3. To explain application and properties of Sap and SM polymer applied textile
4. To discuss evaluation of polymers

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Course Outcomes:

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

1. Explain concept of super absorbent and shape memory polymers
2. Explain manufacturing and properties of Sap and SM polymers
3. Explain application and properties of Sap and SM polymer applied textile
4. Explain evaluation of polymers

Course Contents

Unit 1. **Super Absorbent Polymer:** **6 Hrs.**

Concept of Ionic Polymers, High Temperature & Fire Resistant Polymers, Polymers with Electrical & Electronic Properties, Polymers for Biomedical Applications, Polymeric Binders for Rocket Propellants polymer supported reagents, polymers in telecommunication & power transmission – Polymers as Insulators electrical breakdown strength capacitance, Dielectric loss and cable alterations – polymers in Telecommunication – Submarine – Cable Insulation – low fire risk material – Polymers in Power Transmission – Optical Fibre Telecommunication Cables

Unit 2. **General characteristics of SAP:** Need of SAP, Concept of SAP, general features of SAP, Various mechanism of swelling of SAP, various field of application of SAP **6 Hrs.**

Preparation of SAP: Preparation, Properties and Uses of SAP based on Acrylonitrile, Methyl Meth Acrylate, Chitosan & their combinations using solution and inverse suspension polymerization technique

Unit 3. **Shape Memory Polymer** **6 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 4. **Structure & Properties of Shape Memory Polyurethane Ionomer :** 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 **6 Hrs.**

Unit 5. **Properties and evaluation** **6 Hrs.**

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

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

Unit 6. **Characterization of Polymers:** Principle, working procedure & application of Gel permeable chromatography, DSC, TGA, DTA, DMA, Light Scattering & Ultra centrifuge technique, AFM, SEM, TEM, FTIR **6 Hrs.**

REFERENCE BOOKS

1 Polymeric Materials by S. Radhakrishna, A.K. Arof
2 Introduction to Industrial Polymers by Henri Ulrich
3 Polymer science & technology of Plastics & Rubbers by Premamoy Ghosh
4 Polymer Data Handbook by James E. mark
5 Concise Polymeric Materials Encyclopedia by Joseph C. Salamone
6 Polyimides fundamentals and application by Malay K. Ghosh, K. L. Mittal
7 Polymer Manufacturing Technology & Health Effects by Radian Corporation
8 Shape Memory Polymer and Textiles by Jinlian HU
9 Shape Memory Materials Edited by Otsuka K & Wayman C.M., Cambridge University Press
10 Encyclopedia of Polymer Science & Technology, 3rd edn, Edited by Kroschwitz J.I., John Wiley & Sons, New York
11 Smart Structures & Materials, San Diego, Artech House Publisher, CA
12 Polyurethane Handbook, Hanser Publication, New York

M. Tech. (Textile Chemistry) Semester-I

TCLEL1 (TCL 536): 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 explain requirements of high performance fibres and examples
2. To discuss manufacturing, properties and application of aramide and gel spun fibres
3. To discuss manufacturing, properties and application of carbon and glass fibres
4. To explain properties and application of functional fibres like chemical resistance and thermal resistance

.

Course Outcomes:

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

1. Demonstrate the requirements of high performance fibres and examples
2. Summarize manufacturing, properties and application of aramide and gel spun fibres
3. Summarize manufacturing, properties and application of carbon and glass fibres
4. Illustrate properties and application of functional fibres like chemical resistance and thermal resistance

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 **8Hrs.**

fibres: PVDC Fluorinated Fibres: PTFE, PVF, PVDF and FEP Poly (entheretherketones): PEEK Poly (phenylene sulphide): PPS Poly (ether imide) : PEI, PBI, and PBO

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

Reference Books

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

M. Tech. (Textile Chemistry) Semester-I

TCLEL2 (TCL 537): 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 organizational transaction, the credit transaction trade cycle. Advantages & disadvantages of Electronic markets. Application of E-commerce in textile industries. **6 Hrs.**

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 **6rs.**

	Life Cycle Management, Supply Chain Management (SCM), Customer Relationship Management (CRM). Use of ERP in Textile Industry.	
Unit 5.	**SAP: Architecture** of SAP R/3, SAP Integrated- Analysis, Implementation, and Design, Three-Tier Architecture, Need of Multi-tier Architecture, Integrating Environments.	**4 Hrs.**
Unit 6.	**Business Intelligence System:** Technical Architecture overview, Back room Architecture, Presentation Server Architecture, Front room Architecture, Metadata, Standard Reports, Dashboards and Scorecards	**6 Hrs**

Reference Books

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

M. Tech. (Textile Chemistry) Semester - I

TCLEL2 (TCL 538): APPLICATION OF BIO-TECHNOLOGY IN TEXTILE 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. To discuss various industrial application of enzyme, its advantages and limitations
2. To discuss various applications of enzymes in pre-treatments and fibres
3. To discuss use of bio-technology in effluent treatment
4. To discuss hygiene and health usage of biotechnology and biomaterials

.

Course Outcomes:

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

1. Illustrate various industrial application of enzyme, its advantages and limitations
2. Illustrate various applications of enzymes in pre-treatments and fibres
3. Explain use of bio-technology in effluent treatment
4. Explain hygiene and health usage of biotechnology and biomaterials

Course Contents

Unit 1. **Introduction:** Introduction to Enzyme Technology**,** Enzymes & their Classification, Enzyme structure & catalysis, Enzyme kinetics & their reactions, Present & Future Trends in biotechnology, Introduction to Industrial enzymes, Enzyme manufacturing process, application of enzymes in detergents, paper, leather & food industries, Drawback of conventional textile processing, Application of Enzymes in Textile Industry and their features **4 Hrs.**

Unit 2. **Use of Biotechnology in Pretreatments:** Developments in singeing, desizing and its eco-aspects, Size Recovery, bleaching and its eco-aspects, factors affecting efficiency of Enzyme Treatment, Enzyme retted flax using different formulations, Influence of enzymatic pretreatment on the colours of bleached & dyed flax fibres, Effect of ultrasound on the performance of Industrial enzymes used in cotton bio-preparation/bio-finishing applications, Enzymatic degumming, Enzymatic Hydrogen Peroxide bleaching, nano-biotechnology **8 Hrs.**

Unit 3. **Bioprocessing of Fibres:** Introduction, Bioprocessing of cotton & their Characteristics, Bioprocessing of Jute & their characteristics, Bioprocessing of Flax & their characteristics, Bioprocessing of Wool & their characteristics**,** Bioprocessing of Silk & their characteristics, Bioprocessing of Polyester & their characteristics, Bioprocessing of Polyamide & their characteristics, Bio processing of Regenerated Cellulosics & their characteristics, Biodegradability **6Hrs.**

of Plastics

Unit 4.	**Enzymes in Textile Effluents:** Introduction, Textile processing Operations, Textile Effluent Characteristics, Present technology in Treating waste Effluents, Treatment of textile effluents by various methods, difficulties of operating effluent plants, Advanced Technologies in effluent treatment practices, Role of Enzymes in decolouration, Prospects and future research **Safety & Precautions in Handling Enzymes:** Introduction, Enzyme safety Program, Safe handling of enzymes, Symptoms of Enzyme exposure, Practical aspects- handling and safety, first-aid treatment, safety in enzyme therapy, roots of exposure & possible controls, medical monitoring program for enzyme workers, safety Measures	**8 Hrs.**
Unit 5.	**Bio processing of Organic cotton Textiles:** Introduction, Organic cotton, Biodesizing of organic cotton fabrics with alphas amylase, Bio scouring of Organic Cotton with alkaline pectinase, Bio scouring of Organic cotton fabric using Protease enzyme, Bio scouring of Organic cotton fabric using Lipase enzyme, Binary Enzyme treatment on Bio scouring of Organic cotton fabric, Bio scouring of Organic cotton fabric through specific mixed enzymatic system, Sonication and aerodynamic principles on Enzyme Activity, Bio preparation of Organic Cotton fabric.	**6 Hrs.**
Unit 6.	**Biotechnology and Biomaterials for hygienic & Health care Textiles:** Introduction, Medical Textiles, Modern Wound Dressing, Enzymes in medical application, advanced biopolymer materials, future trends in medical textiles	**4Hrs.**

REFERENCE BOOKS

1 Advances in Textile Biotechnology by V.A. Nierstrasz and A. Cavaco-Paulo
2 Wastewater Microbiology by Gabriel Bitton
3 Handbook of Sustainable Textile Production by Marion I. Tobler-Rohr
4 Bioprocessing of Textiles by Dr. C. Vigneswaran, Dr. M. Ananthasubramanian & Dr. O. Kandhavadivu
5 Biotechnology in Textile Processing by Georg M. Guebitz, Artur Cavaco-Paulo & Ryszard Kozlowski
6 Biodegradable and sustainable fibres by R.S. Blackburn
7 Advances in the Dyeing & Finishing of Technical Textiles by M. L. Gulrajani

M. Tech. (Textile Chemistry) Semester-I
TCLEL2 (TCL 539): CLOTHING PERFORMANCE & 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 explain clothing classification system, Planning and organization of clothing production including concept of fabric comfort
2. To describe clothing production management and Quality requirements for clothing materials.
3. To explain role of fabric properties in the clothing-manufacturing process.
4. To describe fabric sourcing and selection.

Course Outcomes:

At the end of the course students will be able to

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

Course Contents

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

Introduction to clothing biosensory engineering

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

Psychology and sensory comfort

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

Clothing sizing systems

Clothing size and designation systems: a chronological review, European and international sizing systems, ISO clothing sizing systems, European designation of clothing sizes, The JUS clothing sizing system

Unit 2. **Planning and organization of clothing production:** Production **8 Hrs.**

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

Reference Books

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

M. Tech. (Textile Chemistry) Semester - I

TCLEL2 (TCL 540): SELECTED TOPICS IN TEXTILE 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. To explain theoretical aspect of dyeing and related thermodynamics
2. To discuss theoretical aspect of dyeing of natural fibres
3. To discuss theoretical aspect of dyeing of synthetic fibres
4. To discuss detailed aspect of measurement of colour

.

Course Outcomes:

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

1. Illustrate theoretical aspect of dyeing and related thermodynamics
2. Interpret theoretical aspect of dyeing of natural fibres
3. Interpret theoretical aspect of dyeing of synthetic fibres
4. Explain detailed aspect of measurement of colour

Course Contents

Unit 1. **Theoretical Aspects of Dyeing:** **6 Hrs.**
Relation between dye molecules and polymeric chains of the fibres, Substantively and affinity, Thermodynamic derivations of affinity equations, Kinetics of dyeing, Factors affecting kinetics of dyeing, Derivations of various absorption isotherms, Electrical effects in dyeing equilibrium. Monolayer technique and continuous variable method to identify dye – fibre bonds

Unit 2. Glass transition temperature and its effect on dyeability and dye diffusion, Factors affecting dye diffusion, Fick's first and second laws of diffusion, Concepts of equilibrium absorption, diffusion coefficient and time of half dyeing, Derivation of William Landel ferry (WLF) equation and its significance **6 Hrs.**

Unit 3. **Dyeing of Natural Fibres** **4 Hrs.**
Morphological structure of cotton, wool, silk, viscose and lyocel fibres.
Exhaustion, fixation with direct, reactive, acid, basic and vat dyes

Unit 4. **Dyeing of Synthetic fibre** **4 Hrs.**
Morphological structure of Synthetic fibres, Drawing and Heat setting effect; Free volume and solubility parameter theory of dyeing, Various theories of

carrier dyeing. Concept of partition coefficient

Unit 5. **Colour Measurement** **8 Hrs.**

Theories of colour vision, Colour primaries and colour mixing – Additive and subtractive, Colour specification – Munsell colour order system, Ostawald colour system, CIE system, CIE lab, System, Hunter lab, Tristimulus values, Standard observer; Metamerism and Dichroism

Unit 6. Sample preparation for CCM Application to textile processing, Advantages & limitations of CCM, Colour difference, shade sorting, relative dye strength and tone analysis, Assessment of whiteness, yellowness and brightness, Computing and analyzing CCM results, Recipe formulation, batch correction, shade library **8 Hrs.**

REFERENCE BOOKS

1 Physical chemistry of dyeing by Thomas Vickerstaff
2 Theory of Coloration of Textiles by Alan Johnson, Society of Dyers and Colourists
3 Computer colour analysis: Textile applications by Dr. A.D. Sule
4 Instrumental colour measurements and computer aided colour matching for textiles by Dr. H. S. Shah & Dr. R. S. Gandhi
5 Colour Physics for industry by Roderick Mc Donald
6 Chemical Processing of Synthetic fibres by Dr. K. V. Datye & A. A. Vaidya

M. Tech. (Textile Chemistry) Semester-I

TCD541: 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. (Textile Chemistry) Semester - II

TCL 542: ADVANCED TEXTILE CHEMICAL PROCESSING - II

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

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

Course Objectives:

1. To explain principle, mechanism and techno-economical features of transfer and digital printing
2. To discuss various printing and finishing effects generation on textile
3. To discuss various application of nanotechnology and plasma in textiles
4. To explain various developments in finishing

.

Course Outcomes:

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

1. illustrate principle, mechanism and techno-economical features of transfer and digital printing
2. Explain various printing and finishing effects generation on textile
3. Explain various application of nanotechnology and plasma in textiles
4. Summarize various developments in finishing

Course Contents

Unit 1. **Digital Printing** **4 Hrs.**

Concept, methods of inkjet printing, colour separation, selection of dyes and developments in inks, techno-economical features

Unit 2. **Transfer Printing** **6 Hrs.**

Concept, selection of dyes and paper, mechanism of dye transfer, process sequences, techno-economical features, various transfer printing machines

Unit 3. **Special Printing Effects** **6 Hrs.**

Advantages and disadvantages of pigment printing, various developments to overcome the problems, Special print recipes for fashion & garments. Khadi, Metallic, Floc, Plastizol, Reflective, Pearl, Fluorescent Printing, High Density Printing, Puff Printing, Foil Printing, Plastic Printing, Label Printing Defects, Garment defects

Unit 4. **Speciality Finishes on Garments** **8 Hrs.**

Finishing of woven / knitted garments – stone wash, stoneless stone wash effects – mud wash, Ion wash, chalk wash etc. , various softening treatments, Bio polishing, Leather Finish, Protective Finishes – Antimicrobial, Deodorizing etc., Functional Finishes – Cool finish, Thermocat finishes, Wrinkle free finishes

Unit 5. **Application of Nanotechnology and Plasma in Textiles** **6 Hrs.**

Definition, various methods of manufacturing nano materials and their characterization, Nanofinishes - Super hydrophobicity and lotus effect, self cleaning, UV protection, Antimicrobial finishes

Concept, types of plasma and their generation, Plasma treatment of textile for water and oil repellency, Interfacial engineering of functional textiles for biomedical applications, plasma modification of wool, plasma modification of natural cellulosic fibers, characterization of plasma treated textiles.

Unit 6. **Development in Finishing** **6 Hrs.**

Various Low liquor and minimum application techniques in textile finishing, their advantages and limitations, wrinkle free finishing – concept of wet and moist cross linking, various eco-friendly resin finishes, Concept of UV-A and UV-B, factors affecting UV protection. Various UV- protection finishes and their evaluation, antimicrobial finishes – mode of action, factors affecting, various antimicrobial finishes

REFERENCE BOOKS

1 Handbook of Textile processing machinery by R.S. Bhagwat
2 Dyeing of polyester & its blends by Prof. M. L. Gulrajani
3 Engineering in Textile coloration by C. Duckworth
4 Norms for Textile Machinery – N.T.C
5 Technology of Printing by Dr. V.A. Shenai
6 Technology of finishing by J.T. Marsh
7 Energy Conservation in Industries – Vol.I & II, Centre of Plant Engg. Services Hydrabad
8 Conventional Energy Technology – By S.B. Pandya
9 ATIRA – Circular Report June, 1988, Mill Endavours to conserve electricity by D.H. Shah, J.S. Parajia.
10 Energy Consumption & Conservation in Fibre Producing & Textile Industries – Textile Progress Vol.13, No.3.
11 Renewable Energy Resources by John Twidell
12 Economy Energy & Environment in Textile Wet Processing by Editor S.S. Trivedi
13 Chemical after treatments of textile by Marks, Atlas & Wooding
14 Textile finishing by A.J. Hall
15 Introduction to textile finishing by J.T. Marsh
16 Technology of finishing – Vol. X by Dr. V.A. Shenai
17 Chemical processing of polyester/cellulosic blends by R.M. Mittal and S.S. Trivedi
18 Silk dyeing, printing and finishing by Prof. M.L. Gulrajani

M. Tech. (Textile Chemistry) Semester - II

TCL 543: COATING AND LAMINATION

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 concept of coating and chemistry of base material
2. To discuss coating and lamination technology
3. To discuss water proof and breathable coating, and various applications of coated and laminated products
4. To discuss functional material involved in coating and environmental issue in coating and lamination technology

.

Course Outcomes:

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

1. Explain concept of coating and chemistry of base material
2. Illustrate coating and lamination technology
3. Explain water proof and breathable coating, and various applications of coated and laminated products
4. Explain functional material involved in coating and predict environmental issue in coating and lamination technology

Course Contents

Unit 1. Introduction **4 Hrs.**

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 2. Coating Methods **8 Hrs.**

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

Unit 3. Waterproof Breathable Fabrics **6Hrs.**

Rheology of Coating-Rheological behavior of fluids, Bingham Body Behavior, Dilatancy & Pseudoplasticity, Thixotropy & Rheopexy, Rheology of Plastisols, Hydrodynamic Analysis of Coating, physical properties of Coated fabrics.Clothing Comfort, Mechanism of Water Proof Breathability, Parameters of Water Proof Breathability, Designing of Water Proof Breathability Fabric, Types of Water Proof Breathability Fabric, Application & Evaluation of Water Proof Breathability Fabrics

Unit 4. Products from Coated & Lamination Fabrics **6 Hrs.**

Protective clothing- Sports & Industrial, Industrial & Functional Products, Automotive applications in Interiors & Air bag fabrics, Marine applications, Building & Architecture, Medical & Military Use, Synthetic leather – Compact coated fabrics, Promeeries, Porous Vinyls, PTFE Laminate, Architectural Textiles- material & structure, Fluid Containers, Tarpaulins, Carpet backing, Flocking, Fusible Interlining

Unit 5. Coating with Functional Materials **8Hrs.**

Microencapsulation, Thermochromic Fabrics, Temerature – Adaptable Fabrics, Fragrance Release Fabric, Fabrics for Chemical Protection, Camouflage Nets, High Visibility Garments, Intumescent Coating, Metal & Conductive-polymer coated fabrics, Coating of Smart Polymers & Nanomaterials

Unit 6. Coating and Lamination Effects on the Environment **4Hrs.**

The effect of pollution, Environmental legislation, Manufacturing concerns, Sustainable developments, Future developments of coating & Lamination with eco-friendly concern

REFERENCE BOOKS

1 Coated Textiles by A.K. Sen, CRC Press
2 Handbook of Technical Textile by Horrocks And Anand
3 Handbook of Industrial Textiles by S. Adanur
4 Coated & Laminated Textiles by Walter Fung

M. Tech. (Textile Chemistry) Semester- II

TCL544: DESIGN OF EXPERIMENTS & STATISTICAL APPLICATION 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 as two-way ANOVA. LSD & examples of LSD. **6 Hrs.**

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

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

Unit 5. **Transportation and Assignment Problems:** Introduction, Methods **6 Hrs.**

for finding initial solution and U-V method of finding optimum solution of transportation problem and Examples.Hungerian method of solving assignment problem and Examples.

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

Reference Books

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

M. Tech. (Textile Chemistry) Semester - II

TCLEL3 (TCL 545): ENERGY MANAGEMENT AND WATER CONSERVATION IN 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. To explain basics of energy and fuel and its utilisation equipmetns
2. To explain generation, distribution and utilisation of thermal energy in form of steam and thermic fluid; electric energy in textile processing units
3. To explain energy audit and means for conservation of energy and water
4. To introduce non-conventional energy source and its use in textile applications

.

Course Outcomes:

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

1. Analyse basics of energy and fuel and its utilisation equipmetns
2. Illustrate generation, distribution and utilisation of thermal energy in form of steam and thermic fluid; electric energy in textile processing units
3. Demonstrate energy audit and means for conservation of energy and water
4. Explain non-conventional energy source and its use in textile applications

Course Contents

Unit 1. **Basics of Energy Basics of Energy**: **4 Hrs.**

Types and sources of Energy, Forms of energy and units of measurement, Concept and need of Energy Management, Various Energy Sources required in Textile Processing like thermal, electrical and compressed air

Unit 2. **Fuels and Thermal Energy** **8 Hrs.**

Classification of Fuel, Types and Quality of fuels, Efficiency of fuel, Calorific value of fuel and its measurement

Need of thermal energy in textile, Basics of thermal energy,

Steam- Thermal behavior of water, heat balance equation, Methods of generation of Steam and its quality requirement, efficient steam generation / boiler, Distribution and Its utilization, size of steam pipe line, accessories in steam distribution line, Calculation related to measurement of thermal energy – Direct heating, Indirect heating, Batch process unit operations, Continuous process and thermopac, Calculation related to measurement of Steam Consumption in textile processing

Thermopac -Need and concept, design of system, rating and energy calculations Drying of Textile and its economics, machinery required Co-generation and its economics, advantages

Unit 3. **Electrical Energy and Compressor** **6Hrs.**

Methods of Electricity Generation, Quality of Electric Supply, Leakages, voltage Fluctuations their reasons and economical aspects, Power Transmission and cables, Power Factor, Calculations related to measurement of electrical energy. Types, working and quality requirements of compressed air

Unit 4. **Energy Audit** **6 Hrs.**

Need of energy audit, method & types of energy audits, Energy audit performance, instruments required, Energy consumption of various textile machines, Thermal energy for Batch operation, Thermal energy for Continuous operations, Electricity consumption

Unit 5. **Energy Conservation** **8Hrs.**

Thermal Energy - Methods of energy conservation in various departments of process house with regards to thermal energy,

Electrical Energy - Methods of energy conservation in various departments of process house with regards to electrical energy, Energy conservation for lighting, compressed air and water, Concepts of Reduce, Reuse and Recycle with textile specific examples, Energy saving through process modification, machine modification or alternative chemical / technology with textile specific examples

Water Conservation – methods and approaches for water conservation – altering machinery, process sequence, chemicals. Low liquor application and methods for extraction of water.

Unit 6. **Non Conventional Energy Sources** **4Hrs.**

Non conventional energy sources and their application areas in textile like Wind, Biogas and Solar energy either for thermal or electrical energy generation

REFERENCE BOOKS

1 Energy Conservation in Industries – Vol.I & II, Centre of Plant Engg. Services Hydrabad
2 Conventional Energy Technology – By S.B. Pandya
3 ATIRA – Circular Report June, 1988, Mill Endavours to conserve electricity by D.H. Shah, J.S. Parajia
4 Energy Consumption & Conservation in Fibre Producing & Textile Industries Textile Progress Vol.13, No.3
5 Renewable Energy Resources by John Twidell
6 Economy Energy & Environment in Textile Wet Processing by Editor S.S. Trivedi

M. Tech. (Textile Chemistry) Semester - II

TCLEL3 (TCL 546): 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 nano technology concept and synthesis methods for nano particle
2. To explain characterization of nano material and evaluation of applied surface
3. To discuss development, properties and uses of nano fibres
4. To discuss various nano engineered textile products

.

Course Outcomes:

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

1. Explain nano technology concept and synthesis methods for nano particle
2. Explain characterization of nano material and evaluation of applied surface
3. Understand discuss development, properties and uses of nano fibres
4. Understand various nano engineered textile products

Course Contents

Unit 1. **Introduction to Nanotechnology** — **4**

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

Unit 2. **Synthesis and Properties of Nanoparticles** — **8**

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.

Unit 3. **Characterization of Nanoparticles** — **8**

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 4. **Electro spinning of Nanofibers** — **8**

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 nanofibresviz,

tissue engineering, filter media.

Unit 5. **Nanocomposites** **6**

Carbon nanotube / nanofibre polymer composites, development of functional polymer nanocomposites, Nano filled polypropylene nanocomposites and Dyeable PP.

Unit 6. **Nanoengineered Textiles** **8**

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.

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. (Textile Chemistry) Semester - II

TCLEL3 (TCL 547): 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 orthopaedics 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. (Textile Chemistry) Semester - II

TCLEL3 (TCL 548): 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. (Textile Chemistry) Semester - II

TCLEL4 (TCL 549): 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 explain eco-system and environmental management system
2. To explain various air and noise pollution concept, measurement, hazards in textile industry
3. To explain water pollution, effluent generation in textile
4. To explain effluent treatment methods, steps involved and characteristics of water

.

Course Outcomes:

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

1. Explain eco-system and environmental management system
2. Illustrate various air and noise pollution concept, measurement, hazards in textile industry
3. Illustrate water pollution, effluent generation in textile
4. Demonstrate effluent treatment methods, steps involved and characteristics of water

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** **8 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** **6Hrs.**

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** **6 Hrs.**

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.

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** **8Hrs.**

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

Unit 6. **Effluent Treatments** **4Hrs.**

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

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. (Textile Chemistry) Semester - II

TCLEL4 (TCL 550): APPLICATION OF NATURAL DYES ON 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 history, concept, market status and advantages/dis-advantages of natural dyes. Methods of extraction of natural dyes.
2. To discuss mordants, their properties and application
3. To discuss application, colour development using natural dyes
4. To discuss eco-friendliness of natural dyes

.

Course Outcomes:

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

1. explain history, concept, market status and advantages/dis-advantages of natural dyes. Methods of extraction of natural dyes.
2. Explain mordants, their properties and application
3. Illustrate application, colour development using natural dyes
4. Explain eco-friendliness of natural dyes

Course Contents

Unit 1. Introduction **4 Hrs.**

History of Natural Dyes – Introduction, Pre-Vedic Period, Vedic Period, Post-Vedic Period, Epic Period, The Classical Period, The Medieval Period, Down fall of Natural dyes, Revival of Natural Dyes, Present status, Classification of Natural Dyes, Limitation of Natural dyes, Future of Natural dyes, Microbial Dyes

Unit 2. Method of Extraction **8 Hrs.**

Introduction, Raw Materials, Size Reduction, Batch Extraction, Phase Separation, Fine Filtration, Precipitation/Concentration/Dyeing, Characterization, Conventional Aqueous Extraction, Solvent Extraction, Super critical Carbon Dioxide extraction, Efficacy of Extraction of Coloring Matter from natural sources

Unit 3. Mordants & their Application **6Hrs.**

Introduction, Synthetic mordants based on metallic salts, Natural Mordants, Eco-friendly mordants, Application of Mordants, Use of mordants for development of different hues, Mordanting of Cotton, Mordanting of Wool, Mordanting of Silk

Unit 4.	**Dyeing with Natural Dyes** Introduction, Preparation of Fibre for Dyeing of Cotton, Silk & Wool, Dyeing by traditional methods, Dyeing by standardized method, Dyeing by machinery and modern technology, Dyeing by use of super critical carbon dioxide.	**6 Hrs.**
Unit 5.	**Colour Evaluation of Dyed Textiles** Introduction, Colour and Appearance, Measurement of colour, Shade matching and recipe prediction, Application of CCM in Natural Dyes, Colour fastness properties, Concept of Standards and standardization, International standards for color fastness of textiles, Improvement of fastness characteristics, Identification of natural dyes	**8Hrs.**
Unit 6.	**Eco-friendliness of natural dyes and dyed textiles** Introduction, German ban and eco-norms, Detection of heavy metals and pesticides in natural dyes and dyed textiles	**4Hrs.**

REFERENCE BOOKS

1 Handbook of Natural Dyes & Pigments by Har Bhajan Singh & Avinash Bharati
2 Natural Dyes for Textiles and their Eco-friendly Application by Niyati Bhattacharyya
3 Natural Dyes & Their Application to Textiles by M.L. Gulrajani & Deepti Gupta
4 The Chemistry of Natural Coloring Matters by F. Mayer & A.H. Cook, Reinhold Publishing Corporation, New York
5 Biotechnology for Agro Industrial Residues Utilization by Poonam Singh, Springer, 2009
6 Colours From Nature Silk Dyes Using Natural Dyes Vol. I & Vol. II

M. Tech. (Textile Chemistry) Semester - II

TCLEL4 (TCL 551): PROCESSING OF UNCONVENTIONAL FIBROUS MATERIAL

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 processing sequence, method, precaution and details of knit goods
2. To explain processing sequence, methods, finishing of Denim fabric and Denim Garments
3. To explain processing of terry towel and carpet product
4. To discuss processing of jute, linen and spandex containing material

.

Course Outcomes:

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

1. Explain processing sequence, method, precaution and details of knit goods
2. Explain processing sequence, methods, finishing of Denim fabric and Denim Garments
3. Explain processing of terry towel and carpet product
4. Explain processing of jute, linen and spandex containing material

Course Contents

Unit 1. Knit goods **4 Hrs.**

Concept of warp knits, weft knits, courses, wales, stitch and loop density. Factors to be considered in knit processing, process sequences in tubular and open width form. Pretreatment like singeing, scouring, bleaching and mercerization. Dyeing with direct, reactive, vat and sulphur using winch and soft flow dyeing machines. Chemical and mechanical finishing. Shearing, raising, drying and compacting. Faults in knit goods

Unit 2. Processing of Denim **8 Hrs.**

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

Unit 3. **Terry towel** **6Hrs.**

Process sequence and machines used for terry towel manufacturing, essential properties of terry towel fabrics like pile properties, water absorbency. Type and application of terry fabrics. Different stages of towel processing and finishing. Defects in terry fabrics

Unit 4. **Carpet Processing** **6 Hrs.**

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

Unit 5. **Jute and linen** **8Hrs.**

General properties and uses of jute and linen fibres. Their pretreatment and dyeing processes. Woollenisaion of jute

Unit 6. **Processing of Fabric containing spandex** **4Hrs.**

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

REFERENCE BOOKS

1 Processing of cotton knitted fabrics by M. Chakraborty, Amit Dayal and Prof. M. L. Gulrajani.
2 Denim a Fabric for All by Dr. Parmar, NITRA
3 Manufacturing of Terry Towel by Subhash J. Patil, Universal Book Corporation, Mumbai.
4 Textile Floor covering by G. H. Crowshaw, Textile Progress, Vol. 9, No. 2 Textile Institute.
5 Interior Furnishing by Mortimer O'shea, Textile Progress, Vol. 11, No. 1, Textile Institute.
6 Carpet Surface by H. Pointon, Textile Trade Press, UK.
7 Textile Printing by L.W.C. Miles, SDC Publication.

M. Tech. (Textile Chemistry) Semester - II

TCLEL4 (TCL 552): THEORY AND PRACTICES OF TEXTILE FINISHING

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 modern trends in finishing technique for water conservation and use of bio-technology – enzyme
2. To explain functional finishes
3. To discuss novel finishing chemistry and technology
4. To explain nano technology based various finishing products

.

Course Outcomes:

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

1. Illustrate modern trends in finishing technique for water conservation and use of bio-technology – enzyme
2. Explain functional finishes
3. Summarize novel finishing chemistry and technology
4. Explain nano technology based various finishing products

Course Contents

Unit 1. **Finishing Application techniques** **4 Hrs.**

Application of chemical finishes, Drying of wet textiles ,Curing of chemical finishes ,Coating and laminating, Various Low liquor and minimum application techniques in textile finishing, their advantages and limitations

Unit 2. **Finishing with enzymes: bio-finishes for cellulose** **8 Hrs.**

Action of cellulose enzymes on cellulose, Chemistry of enzyme finishing, Evaluation of bio-finishing, Troubleshooting for bio-finishing

Unit 3. **Ultraviolet protection finishes** **6Hrs.**

Mechanism of UV protection, Chemistry of UV protection finishes, Evaluation of UV protection finishes, Troubleshooting for UV protection finishes and combinability

Unit 4. **Functional Finishes** **6 Hrs.**

Wrinkle free finishing – concept of wet and moist cross linking, various eco-friendly resin finishes, antimicrobial finishes – mode of action, factors affecting, various antimicrobial finishes, Flame retardant finishes – mode of action, factors affecting, various flame retardant finishes, eco-friendly flame retardant finishes

Unit 5. **Novel finishes** **8Hrs.**

Anti-odour and fragrance finishes using microencapsulation, Fibre surface modifying finishes using plasma and radiation technologies, Elastomeric finishes, Fibre surface modification by sol–gel finishes with inorganic oxide films, Insect resist and mite protection finishes, Finishes to improve colour fastness.

Unit 6. **Nanoengineered Textiles** **4Hrs.**

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.

REFERENCE BOOKS

1 Chemical Finishing of Textiles by W. D. Schindler and P. J. Hauser
2 Biotechnology in Textile processing, by Georg M. Guebitz, ArturCavaco-paulo, Ryszard Kozlowski, The Hawarth Press, Inc.
3 Textile Finishing by Derek Heywood
4 Nanosols and textiles by B. Mahltig, T. Textor
5 Chemistry and technology of fabric preparation and finishing by Dr. C. Tomasino, NCSU, USA.
6 Nanofibres& Nanotechnology in Textiles by P.J. Brown & K. Stevens.
7 The Nanoscope, Encyclopaedia of Nano Science & nanotechnology Vol.-I to VI, Dr.Parag Diwan & Ashish Bharadwaj.
8 Coated and laminated textiles by Walter Fung

M. Tech. (Textiles Chemistry) Semester - II
TCD 553: MINI PROJECT –II

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

Course Objectives:

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

Course Outcomes:

At the end of the course students will be able to

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

Rationale:

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

Guidelines:

1. Students should select a problem which addresses some textile industry problem, or other product developments in textiles. One mini project per semester per student.
2. The selected topic for mini project should be based on development/fabrication of innovative product which he/she learnt during course work.
3. Students should understand testing of various instruments relating to topic of mini project.
4. Execution of mini project should be carried out by students only under guidance of allotted faculty. One faculty per student.
5. Students should develop a necessary product with product specifications with reference to end use.
6. Students should see that final product submitted by them is in working condition.

7. 15-20 pages report to be submitted by students in prescribed guide lines. Presentation is for 10 minutes.
8. Group of students cannot be permitted to work on a single mini project. Individual student has to carry out mini project.
9. A demonstration and internal oral examination on the mini project also should be done at the end of the semester.

DKTE Society's

TEXTILE & ENGINEERING INSTITUTE

Rajwada, Ichalkaranji - 416115

(An Autonomous Institute)

DEPARTMENT: TEXTILES

CURRICULUM

M. Tech. (Textile Chemistry)

Second Year

With Effect From

2017-18

DKTE

Promoting Excellence in Teaching
Learning & Research

M. Tech. (Textiles Chemistry) Semester - III
TCD601: DISSERTATION PHASE 1

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

Course Objectives:

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

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

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

Rationale:

The Dissertation work is divided into 2 phases. Phase 1 will involve the finalization of topic of project, Literature survey, Plan of action and at least half of the project trials (50%) should be completed.

The project will be chosen with reference to design, development, construction, and fabrication of innovative product/system approved by the department/Guide. This is a laboratory oriented course which will provide a platform to students to enhance their practical knowledge and skills by development of novel and intelligent product. Each student must keep a project notebook

Guidelines for Dissertation Phase I:

1. Students should select a project which addresses some textile industry problem, or other product developments in textiles. Duplicate work is not allowed in any case.
2. The selected topic for project should be based on development/fabrication of innovative product which he/she learnt during course work. The selected project title has to verify by any means so as to avoid repeated type of work which is not allowed.
3. Students will be working under 2 guides. One guide is Main guide and second is co-guide. Both should have guide ship, recognized by University.

4. Students should carry out the in depth literature survey covering total spectrum of data from different sources.
5. Students should propose suitable plan of work in the form of flow chart considering the available resources at Institute.
6. In case of shortage of resources, they can access to the outside textile world for the procurement of raw material or trails on desired machines or testing etc.
7. Students should take prior permission to utilize the available resources in the institute.

M. Tech. (Textile Chemistry) Semester-IV

TCD602: DISSERTATION PHASE II

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

Course Objectives:

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

Course Outcomes:

At the end of the course students will be able to

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

Rationale:

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

Guidelines for Dissertation Phase II:

1. Students should complete and compile the trials, testing.
2. Students should propose a complete thesis writing with given guidelines
3. Students will be ready for the internal Viva with synopsis, objectives, plan of work and results and discussion.
4. The results and discussion will be as per in line with the plan of work. No deviation is allowed.
5. The students have to present their work infront of the internal dissertation evaluation committee.
6. The suggestions from internal experts should be incorporated in the soft copy of the final thesis.
7. Sufficient time of 2 weeks will be given for the corrections.

8. The corrected soft copy can be verified from the allotted faculty. If it is OK as per the guidelines, then thesis will be printed, bound.
9. The bound copies will be submitted to the institute for further action on the externals.