Department of Textile and Fibre Engineering

TXL130 Polymer Chemistry
3 Credits (3-0-0)
The course will deal with chain and step growth polymerization methods, polymer’s macromolecular architecture, molecular weight of polymers, copolymerization, cross-linked polymers, general structure and characteristics of polymers, properties of fibre forming polymers and their applications.

TXL111 Textile Fibres
3 Credits (2-0-2)
Classification of fibres. Basic structure of a fibre. General properties of a fibre such as moisture absorption, tenacity, elongation, orientation, performance, yield point, toughness, elastic recovery. Relationship between polymer structure and fibre properties. Detailed chemical and physical structure of natural fibres: cotton, wool and silk, their basic properties. Introduction to important bast and leaf fibres. Basic introduction to Fibre spinning. Introduction Mannmade and synthetic fibres: Viscose, Acetate, Acrylic, Nylon, polyester. High Performance Fibres. Laboratory exercises would include experiments on fibre identification through physical appearance, microscopic (optical, SEM), and burning behaviour. Chemical identification through solvent treatment and elemental analysis.

TXL211 Structure and Physical Properties of Fibres
3 Credits (3-0-0)
Pre-requisites: TXL130

TXL212 Manufactured Fibre Technology
3 Credits (3-0-0)
Pre-requisites: TXL211

TXP221 Yarn Manufacture Laboratory-I
1 Credit (0-0-2)
Pre-requisites: TXL211
Experiments related to the lecture course entitled "Yarn Manufacture I (TXL221)".

TXL222 Yarn Manufacture-II
3 Credits (3-0-0)
Pre-requisites: TXL221

TXL231 Fabric Manufacture-I
3 Credits (3-0-0)
Pre-requisites: TXL111

TXL221 Yarn Manufacture-I
3 Credits (3-0-0)
Pre-requisites: TXL111

TXL232 Fabric Manufacture-II
3 Credits (3-0-0)
Pre-requisites: TXL231
Shuttleless looms: Principles of weft insertion in projectile, rapier, air-jet and water-jet looms, comparison of various weft insertion systems, principles of two phase, multiphase, circular and narrow fabric weaving. Leno weaving, Triaxial weaving, different types of selvages, common fabric defects, Knitting: Basic weft and warp knitted
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constructions, cans and needles, different weft and warp knitted structures and their properties, weft and warp knitting machines. Nonwovens: Definitions and classifications, production technology, selection criteria and important properties of fibres used, different types of web information and bonding techniques, production and properties of needle punched, adhesive bonded, thermally bonded, hydroentangled, spun bonded and meltblown fabrics. Braided structures: Types of braiding processes, classification of braids, braid geometry, structure-property relationship, over braiding.

TXX301 Professional Practices
2 Credits (0-1-2)
Pre-requisites: TXX421/TXX422/TX423/TX423 and EC65

TXX301 Independent Study
3 Credits (0-3-0)
Pre-requisites: EC65

TXX321 Multi and Long Fibre Spinning
3 Credits (3-0-0)
Pre-requisites: TXX222
Blending of fibres during staple fibre spinning, Characteristics of manmade fibres and their spinnability, Blending at draw frame, Fundamentals of strictly similar yarns, Processing of manmade fibres and blends on staple fibre spinning system, Properties of blended yarns, Spinning of dyed fibres, Mêlée yarns, Worsted / semi-worsted/Woolen spinning, Jute and Flax Spinning, Tow to top Conversion, Bulk yarn, Spin silk yarn.

TXX331 Woven Textile Design
3 Credits (3-0-0)
Pre-requisites: TXX232
Elements of woven design, Construction of elementary weaves; plain, twill, satin weaves and their derivatives, Rib and cord structures, Construction of standard woven fabrics; poplin, sheeting, denim, drill and jean, gabardine, granite, diamond and diaper weaves, Honeycomb, Huckaback and Mockeno weaves, Colour effect on woven design, Dobby design, stripes and checks, Construction of jacquard design, Figuring with extra threads, Damasks and Brocades, Double cloths, Multilayer fabrics, Tapestry structures, Gauze and Leno structures, Whip cord and Bedford cord, Pique and Wadded structures, Terry pile structures, Velvet and velveteen, Axminster carpet structures, Indian traditional designs, Introduction to CAD for woven designs.

TXX361 Evaluation of Textile Materials
3 Credits (3-0-0)
Pre-requisites: TXX422 and TXX423
Introduction to textile testing, Sampling and basic statistics: Selection of samples for testing, Random and biased samples, Different types of sampling of textile materials, The estimation of population characteristics from samples and the use of confidence intervals, Determination of number of tests to be carried out to give chosen degree of accuracy, Test of significance of means and variance, Related numerical, Quality control charts and their interpretation, Standard tests, analysis of data and test reports, Correlation and coefficient of determination, Analysis of variance (ANOVA).

Testing methods: Measurement of length, fineness and crimp of fibres, Determination of maturity, foreign matter, and moisture content of cotton, Principles of AFIS, HVI etc., Measurement of twist, linear density and hairiness of yarn, Evenness testing of silvers, rovings and yarns, Analysis of periodic variations in mass per unit length, Uster classimat, Spectrogram and V-L curve analysis, Tensile testing of fibres, yarns and fabrics, Automation in tensile testers, Tearing, bursting and abrasion resistance tests for fabrics, Pilling resistance of fabrics, Bending, shear and compressional properties of fabrics, fabric drape and handle (KESF, FAST etc), Crease and wrinkle behavior, Fastness characteristics of textiles, Matching of shade, Air, water and water-vapour transmission through fabrics, Thermal resistance of fabrics, Testing of interlaced and textured yarns, Special tests for carpets and nonwoven fabrics, Testing of special yarns (textured yarns, core yarn, ropes, braids etc), Testing of special fabrics (different types of nonwovens, carpets, different types of technical textiles like bullet proof fabrics, UV protective fabrics, EMS fabrics etc.).
TXP361 Evaluation of Textiles Lab  
1 Credit (0-0-2)  
**Pre-requisites:** TXL222 and TXL232  
Introduction to textile testing; Experiments related to the lecture course entitled “Evaluation of Textile Material”.

TXL371 Theory of Textile Structures  
4 Credits (3-1-0)  
**Pre-requisites:** TXL222 and TXL232  

TXL372 Speciality Yarns and Fabrics  
2 Credits (2-0-0)  
**Pre-requisites:** TXL222 and TXL232  

TXL381 Costing and its Application in Textiles  
4 Credits (3-1-0)  
**Pre-requisites:** TXL211/TXL221/TXL231 and EC 75  

TXD401 Major Project Part I  
4 Credits (0-0-8)  
**Pre-requisites:** TXL361/TXP361/TXL371/TXL372 and EC 100  
Formation of project team (up to two students and up to two faculty guides); formulation of work plan completing targeted work for the semester and presentation of complete work of progress for award of grade.

TXD402 Major Project Part II  
8 Credits (0-0-16)  
**Pre-requisites:** EC100 and Minimum B Grade in TXD401  
Continuation of planned tasks started in Major Project Part I, TXD411, to completion, thesis writing and presentation of complete work of progress for award of grade.

TXL601 Basics of Textiles  
0 Credits (2-0-0)  
This is an audit bridge course designed for M.Tech and Ph.D students with non-Textile background. The program is not available for B.Tech students. The course is divided into four modules giving an overview on a) Fibre Science: Polymers, Textile Fibres and their classification, Homopolymer, copolymers and graft polymers; their molecular weight, distribution, architecture, configuration and confirmations, amorphous and crystalline phases, glass transition, crystallization and melting, Step growth and chain polymerization; Basic Introduction to Fibre structure, general properties such as moisture absorption, tenacity, elongation, initial modulus, yield point, toughness and elastic properties, Spinning, Melt spinning, Solution Spinning and Electrospinning; Introduction to manmade and synthetic fibres: viscose, acetate, acrylic, nylon, polyester, introduction to high performance fibers and their applications.  

b) Yarn: Classification of yarn, filament and staple, yarn specifications, yarn counting system, yarn diameter, twist and yarn physical and mechanical characteristics; Flow chart of cotton spinning process, Importance of fibre characteristics, Impurities in natural fibres, Cleaning principles, Mixing and blending of fibres; sliver formation by card; Cardic mechanic configuration; Fibre configuration in card sliver. Drafting process, roller and apron drafting; Objectives of combing, Principle of fibre fractionation; Principle of roving preparation and yarn formation, Drafting and different methods of twisting.  

c) Fabric: Yarn to fabric conversion, Basic principles, Introduction to various Fabric formation principles, weaving, knitting, nonwoven and braiding; Weaving principles-stages of woven fabric manufacturing winding, warping, sizing, Drawing in primary and secondary motions, Shuttle and shuttle less looms, Basic fabric design as plain, matt, rib, twill and satin; Knitting: basics warp and weft constructions, different knitting structures and their properties, weft and warp knitting machines; Nonwovens: definitions, classifications, production technology and applications; Braided structures and their technologies and applications.  

d) Textile Chemical Processing: Natural and added impurities in Textiles, singeing, desizing, scouring, bleaching, mercerization of cotton; Carbonisation, scouring and bleaching of wool, Degumming of silk and Assessment processes; principles of dyeing and printing of textile materials, basic characteristics of dyes, chemical structures of dyes, classification, dyeing of cotton, polyester, wool/nylon; Methods of printing, preparation of printing pastes, Direct discharge and resist printing styles; Introduction to chemical and mechanical finishes; chemical finishes for hand modifications; Easy oil, water and soil repellency; Fire retardant and antimicrobial finishes.

TXL700 Modelling and Simulation in Fibrous Assemblies  
3 Credits (2-0-2)  
**Pre-requisites:** TXL232 and EC 75  
Introduction to Textile Modelling and Simulation, types of model. Curve Fitting Techniques: Prediction of mechanical properties of fibrous assemblies.  


Stochastic and Stereological Methods: Random fibrous assemblies, anisotropy characteristics, two and three-dimensional fibrous assemblies. Statistical Mechanics: Monte Carlo simulation of random fibrous assemblies.  

Multiscale Modelling: Geometrical modelling of textile structures, modelling of properties of fibrous assemblies.  

Computational Fluid Dynamics: Newtonian and Non-Newtonian Fluids and their applications in extrusion processes, Computer simulation of fluid flows through porous materials, heat and mass transfer in fibrous assemblies.  

TXV701 Process Cont. and Econ. in Manmade Fibre Prod.  
1 Credit (1-0-0)  
**Pre-requisites:** TXL211/TXL221/TXL222/TXL231/TXL232 and EC 75  
Introduction to manmade fibres. Consumption pattern in India.

**TXL710 High Performance and Specialty Fibres**
3 Credits (3-0-0)

*Pre-requisites: TXL212 and EC75*
Definition, classification and structural requirements of high performance and specialty fibres. Polymerization, spinning and properties of aramids, aromatic polyesters, rigid rod and ladder polymers such as PBZT, PBO, PBI, PIPD. Manufacture of carbon fibres from polycarbonitrile, viscose and pitch precursors. Concept of gel spinning and spinning of UHMPE fibres. Elastomeric polymers and fibres, Lyocell fibre production. Conducting fibres, Thermally and chemically resistant polymers and fibres. Methods of synthesis, production and properties of: glass and ceramic fibres. Speciality fibres: profile fibres, optical fibres, bicomponent fibres and hybrid fibres. Superabsorbent polymers and fibres.

**TXL711 Polymer and Fibre Chemistry**
3 Credits (3-0-0)
The course will deal with chain and step growth polymerization methods, polymer's macromolecular architecture, molecular weight of polymers, copolymerization, cross-linked polymers, general structure and characteristics of polymers, spectroscopic analysis of polymers, properties of fibre forming polymers and their applications.

**TXP711 Polymer and Fibre Chemistry Laboratory**
1 Credit (0-0-2)
Identification of fibres by chemical and burning tests, polymerization of vinyl monomers such as styrene, acrylamide using bulk polymerization, solution polymerization, emulsion polymerization, radiation induced polymerization. Condensation polymerization and interfacial polymerization of nylon-6, Molecular weight measurement. Intrinsic viscosity and end group analysis, preparation of phenol-formaldehyde resin. Analysis of chemical structure by FTIR, UV spectroscopy.

**TXL712 Polymer and Fibre Physics**
3 Credits (3-0-0)
Molecular architecture, configuration, conformation of ideal and real chains, Random Walk models of polymer conformations, Gaussian chain, Self-avoiding walks and excluded-volume interaction, the amorphous phase and its chemical-physical aspects, the glass transition phenomenon, the WLF-equation, crystalline state and its chemical-physical aspect, cross-linked polymers and rubber elasticity, behaviour of polymers in solutions and mixtures, viscoelasticity and rheology of polymers, mechanical properties, physical properties of fibres: moisture absorption properties, mechanical properties, optical properties, thermal properties.

**TXP712 Polymer and Fibre Physics Laboratory**
1 Credit (0-0-2)
Laboratory Experiments on Characterization of fibres by Infrared spectroscopy, Density measurements; Thermal analysis: Thermogravimetric Analysis (TGA), Differential Scanning calorimetry (DSC) and Thermo-Mechanical Analysis (TMA); Dynamic Mechanical Analysis (DMA); Sonic modulus; X-ray diffraction studies; Birefringence measurement; Optical microscopy studies; Scanning Electron Microscopy (SEM) of fibres: Creep and Stress Relaxation study, Mechanical property testing such as tensile and flexural rigidity.

**TXL713 Technology of Melt Spun Fibres**
4 Credits (3-1-0)
Importance of transport phenomena in fibre manufacturing; Fundamentals of momentum transfer, heat transfer, mass transfer, building differential equations using shell balance and generalized equations; Polymer rheology- shear flow, elongational flow; Melt spinning lines for filament and staple fibre; Role of spin finish; Necessary conditions for fibre formation, elasticity versus plasticity of melts; Melt instabilities; Thermodynamic limitations; Force balance and heat balance in melt spinning; Low speed melt spinning; Necking and stress induced crystallization in high speed melt spinning; Effect of process parameters on fibre spinning and structure of nylon 6, PET and PP; Drawing Process and its necessity; Neck or flow

**TXV702 Management of Textile Business**
1 Credit (1-0-0)
*Pre-requisites: TXL222/TXL223 and EC 75*

**TXV703 Special Module in Textile Technology**
1 Credit (1-0-0)
*Pre-requisites: TTXL222/TXL232 and EC 75*
The course aims at introducing special topics in textile technology. The course topics and content are likely to change with each offering depending upon the current requirement and expertise available with the department including that of the visiting professionals.

**TXV704 Special Module in Yarn Manufacture**
1 Credit (1-0-0)
*Pre-requisites: TXL222 and EC 75*
The course aims at introducing new or highly specialized technological aspects in yarn manufacture. The course topics and content are likely to change with each offering depending upon the current requirement and expertise available with the department including that of the visiting professionals.

**TXV705 Special Module in Fabric Manufacture**
1 Credit (1-0-0)
*Pre-requisites: TXL232 and EC 75*
The course aims at introducing new or highly specialized technological aspects in fabric manufacture. The course topics and content are likely to change with each offering depending upon the current requirement and expertise available with the department including that of the visiting professionals.

**TXV706 Special Module in Fibre Science**
1 Credit (1-0-0)
*Pre-requisites: TXL211/TXL221/TXL222/TXL231/TXL232 and EC 75*
The course aims at introducing new or highly specialized technological aspects in fibre science. The course topics and content are likely to change with each offering depending upon the current requirement and expertise available with the department including that of the visiting professionals.

**TXV707 Special Module in Textile Chemical Processing**
1 Credit (1-0-0)
*Pre-requisites: TXL211/TXL221/TXL222/TXL231/TXL232 and EC 75*
The course aims at introducing new or highly specialized technological aspects in textile chemical processing. The course topics and content are likely to change with each offering depending upon the current requirement and expertise available with the department including that of the visiting professionals.

**TXV708 Management of Textile Business**
1 Credit (1-0-0)
*Pre-requisites: TXL222/TXL223 and EC 75*

**TXV709 Special Module in Textile Technology**
1 Credit (1-0-0)
The course aims at introducing special topics in textile technology. The course topics and content are likely to change with each offering depending upon the current requirement and expertise available with the department including that of the visiting professionals.

**TXV710 Special Module in Yarn Manufacture**
1 Credit (1-0-0)
The course aims at introducing new or highly specialized technological aspects in yarn manufacture. The course topics and content are likely to change with each offering depending upon the current requirement and expertise available with the department including that of the visiting professionals.

**TXV711 Special Module in Fabric Manufacture**
1 Credit (1-0-0)
The course aims at introducing new or highly specialized technological aspects in fabric manufacture. The course topics and content are likely to change with each offering depending upon the current requirement and expertise available with the department including that of the visiting professionals.

**TXV712 Special Module in Fibre Science**
1 Credit (1-0-0)
The course aims at introducing new or highly specialized technological aspects in fibre science. The course topics and content are likely to change with each offering depending upon the current requirement and expertise available with the department including that of the visiting professionals.

**TXV713 Special Module in Textile Chemical Processing**
1 Credit (1-0-0)
The course aims at introducing new or highly specialized technological aspects in textile chemical processing. The course topics and content are likely to change with each offering depending upon the current requirement and expertise available with the department including that of the visiting professionals.
deformational drawing; Drawing machines; Effect of parameters on structure development in nylon 6, PET, PP; Types of heat setting; Effect of setting parameters on structure and properties; Concept of bulking/texturing.

**TXL714 Advanced Materials Characterization Techniques**
1 Credit (1-0-0)

Relevance of advanced characterization techniques in material development; scattering techniques (SAXS/WAXS); advanced surface characterization techniques (X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), secondary ion mass spectroscopy (SIMS)); microscopy techniques: basics of electron-materials interaction; SEM combined with FIB techniques; TEM and cryo-TEM; chemical analysis utilizing microscopy techniques; AFM; confocal laser microscopy.

**TXL715 Technology of Solution Spun Fibres**
3 Credits (3-0-0)

**Pre-requisites:** TXL711/TXL713

PAN properties; Solution rheology and its dependence on parameters. Effect of parameter-separation entanglement density, fibre spinning and sub-chain drawing; Various solvent systems; Dope preparation; Wet and dry spinning processes; Effect of process parameters such as dope concentration, bath concentration, temperature and jet stretch ratio on coagulation rate, fibre breakage and fibre structure; Modeling of coagulation process; properties and structure of dry and wet spun fibres; Dry jet wet spinning. Solution spinning of PAN.

Bicomponent and bulk acrylic fibres. Acrylic fibre line, crimping and annealing, tow to top conversion systems; Viscose rayon process, Spinning with and without zinc sulfate; Polynosics and high performance cellulose fibres; Non viscose processes, Lyocell spinning process, structure and properties; Gel spinning of PE, Gel spinning of PAN and PVA. Introduction to high performance fibres and their spinning systems such as rigid rod polymer, liquid crystalline polymers, polylactic acid and spandex fibre manufacturing.

**TXP716 Fibre Production and Post Spinning Operation Laboratory**
2 Credits (0-0-4)

Experiments related to fibres production processes. Effect of moisture and temperature on MF1 of PET and PP. Melt spinning of PET, PP & nylon-6 filament yams on laboratory spinning machines. Single and two stage drawing of the as-spun yams or industrial POY. Demonstration of high speed spinning machine. Wet and dry heat setting of PET and nylon drawn yams. Effect of temperature and tension on heat setting. Determination of structure and mechanical properties of as spun, POY, draw and heat set yams using DSC, X-ray, FTIR, density, sonic modulus. Effect of shear rate, temperature on polymer solution viscosity using Brookfield Rheometer and ball-fall method. Wet spinning or dry jet wet spinning of PAN copolymers. False twist and air jet texturing processes. Determination of structure of textured yam under microscope.

**TXL719 Functional and Smart Textiles**
3 Credits (3-0-0)

**Pre-requisites:** TXL212/TXL221/ TXL231 and EC75

Definition and Classification of Functional and Smart textiles; Introduction to Composites: Theory, Types, Properties; High Performance fibres, thermoplastic and thermosetting Resins; Composite Manufacturing and Applications; Coated and laminated Textiles: materials, formulations, techniques and applications; Protective Textiles- Materials, design, principles and evaluation for protection against fire, harmful radiation, chemicals and pesticides; Sportswear: design, testing and materials – fibers, yarns, fabrics for temperature control and moisture management; Medical textiles: Classification, types and products, Health and Hygiene Textiles—protection against microbes, Wound management- dressings, suture and bandages, Implants and drug delivery systems; Smart and Intelligent Textiles: Passive and Active functionality, stimuli sensitive textiles, Electronic Textiles: wearable computers, flexible electronics.

**TXL721 Theory of Yarn Structure**
3 Credits (3-0-0)

General description of yarn structure, Packing of fibre arrangement in yarns, Fibre directional arrangement in yarns, Geometry of pores in yarns, Relationship among yarn count, twist, and diameter, Helical model of fibers in yarns, Yarn retraction, Limits of twisting, Radial migration of fibers in yarns, Model of ideal fibre migration, Model of equidistant migration, Tensile mechanics of yarns, Yarn tensile behavior in light of helical model, Relationship between tensile behaviors of fiber and yarn, Yarn strength as a function of gauge length, Bending mechanics of yarns, Mass uneveness of yarns, Martindale’s model of mass irregularity, Model of hierarchical structure of fibre aggregates, Hairiness of staple fiber yarns, Single- and double-exponential models of yarn hairiness, Structure and mechanics of plied yarns.

**TXL722 Mechanics of Spinning Processes**
3 Credits (3-0-0)

**Pre-requisites:** TXL221/TXL222 and EC75

Principles of texturing and modern classification; False twist texturing process- mechanisms and machinery, optimization of texturing parameters, barre'; structure-property correlation of textured yarns; Draw-texturing- the need and fundamental approaches; Friction texturing- the need and development, mechanics of friction texturing, latest development in twisting devices, optimization of quality parameters. Noise control in texturing.

Air jet texturing- Principle, mechanisms, development of jets and machinery, process optimization and characterization, air jet texturing of spun yarns. Air interlacement-Principle and mechanism, jet development and characterization. Bulked continuous filament yarn- Need, principle, technology development. Hi-bulk yarns- Acrylic Hi-bulk yarn production, mechanism and machines involved, other such products. Solvent and chemical texturing- Need, texturing of synthetic and natural fibres.

**TXL724 Textured Yarn Technology**
3 Credits (3-0-0)

**Pre-requisites:** TXL212/TXL221 and EC75

Principles of texturing and modern classification; False twist texturing process- mechanisms and machinery, optimization of texturing parameters, barre'; structure-property correlation of textured yarns; Draw-texturing- the need and fundamental approaches; Friction texturing- the need and development, mechanics of friction texturing, latest development in twisting devices, optimization of quality parameters. Noise control in texturing.

**TXL725 Mechanics of Spinning Machines**
3 Credits (3-0-0)

**Pre-requisites:** TXL212/TXL221/ TXL231 and EC75


**TXP725 Mechanics of Spinning Textile Machines Laboratory**
1 Credit (0-0-2)

Students will do design analysis of various machine elements on textile machines.
TXL731 Theory of Fabric Structure
3 Credits (3-0-0)

TXL732 Advanced Fabric Manufacturing Systems
3 Credits (3-0-0)
Fabric manufacturing systems, Yarn quality and weavability, Yarn Preparation for High speed weaving, Preparation of high performance fibres/tows for weaving, Sizing of filament yarn, Shuttle less weaving systems: Advancements in each system with respect to productivity, yarn characteristics and fabric quality, energy requirement, design flexibility, applications and limitations, Specialty weaving: 3D weaving, Multi-layer weaving, Spacer weaving, Profiling weaving, Polar and Spiral fabric, Circular Weaving, Honeycomb weaving, Denim manufacturing, Multiaxial weaving, Multiphase weaving, Terry weaving, Leno Weaving, Filament Weaving, Properties and applications of fabrics produced in these systems. Weft and warp knitted structures for technical applications, Braiding: biaxial and triaxial braids, 3D braiding, Structure, properties and applications of braided fabrics, Developments in nonwoven technologies, Stitch bonding methods, Nonwoven composite fabrics, Electrosprinning, 3D nonwovens.

TXL734 Nonwoven Processes and Products
3 Credits (3-0-0)
Pre-requisites: TXL232 and EC 75

TXL740 Science & App. of Nanotechnology in Textiles
3 Credits (3-0-0)
Pre-requisites: EC75
Introduction to Nanoscience and Nanotechnology: Size and surface dependence of their physical and chemical properties such as mechanical, thermodynamical, electronic, catalysis etc; Synthesis of Nanomaterials used in Textiles such as carbon nanotube, fullerences, metal and metal oxide nanoparticles i.e. nano silver, nano silica, nano titania, nano zinc oxide, nano magnesium oxide etc.; Surface functionalization and Dispersion of nanomaterials; Nanotoxicity, Characterization techniques i.e. XRD, AFM, SEM/TEM, DLS etc.; Nanomaterial applications in textiles and polymers; Nanocomposites: definition types, synthesis routes; nanocomposite fibres and coatings e.g. gas barrier, antimicrobial, conducting etc.; Nanofibres: preparation, properties and applications i.e. filtration, tissue engineering etc.; Nanofinishing: self-cleaning, antimicrobial, UV protective etc.; Nanocoating on textile substrates: Plasma Polymerisation, Layer-by-layer Self Assembly, Sol-Gel coating etc.

TXL741 Env. Manag. in Textile and Allied Industries
3 Credits (3-0-0)
Pre-requisites: TXL212/TXL241/TXL242 and EC 75

TXL747 Colour Science
3 Credits (3-0-0)
Pre-requisites: EC 75
Colour and chemical constitution, physics and chemistry of light, vision, colour. Physics of light sources, measurement of colour Colorimeters and Spectrophotometers, Standard observer experiments, CIE system, Tristimulus values, and different colourorder systems. Principle of recipe prediction and demonstration, visual and instrumental evaluation of whiteness, shade sorting, colour uncertainty, colour constancy and metamerism, colour difference formulae, How we see colour, colour in visual displays and use of colour in design.

TXL748 Advances in Finishing of Textiles
3 Credits (3-0-0)

TXP 748 Textile Preparation and Finishing Lab
1 Credit (0-0-2)
Pre-requisites: TXL747/TXL753
Preparatory and finishing related project based experiments, Chemistry and principle of each treatment and analysis of results.

TXL 749 Theory and Practice of Dyeing
3 Credits (3-0-0)
Pre-requisites: EC 75
Advances in dyes, Speciality dyes: photochromic, thermochromic, electrochromic, mechatronic; Fluorescent and near IR dyes; Dyes for camouflage; Banned dyes; Safe and eco-friendly dyes, natural dyes; Mechanisms of dyeing; Thermodynamics of dyeing; Kinetics of dyeing; Dye-fibre interactions; Role of fibre structure in dyeing; Advances in dyeing processes: low liquor, salt free, low energy intensive dyeing; Dyeing of blends; Mass coloration of man-made fibres; Dyeing of speciality fabrics: stretch fabrics, light weight, textured, garment dyeing, micro-denier fabrics, fibre dyeing; Effect of finishes on shade and fastness; Dyeing faults and case studies.

TXP 749 Textile Coloration Lab
1 Credit (0-0-2)
Pre-requisites: B Tech. Textile/ BE Textile/ MSc Textile
Project based experiments in dyeing and colouration, dyeing of fabric,
visual and instrumental assessment of shade variation. Subjective vs objective evaluation, Shade sorting, whiteness index. Azo dye synthesis and characterization.

**TXL750 Science of Clothing Comfort**
3 Credits (3-0-0)
Pre-requisites: TXL361 and EC75

**TXL751 Apparel Engineering and Quality Control**
3 Credits (2-0-2)
Pre-requisites: TXL211/TXL221/TXL222/TXL231/TXL232 and EC75

**TXP 751: Characterization of Chemicals and Finished Textiles Lab**
1 Credit (0-0-2)
Pre-requisites: B Tech. Textile/ BE Textile/ MSc Textile
Evaluation, characterization and analysis of textile auxiliaries, chemicals, dyes, and water. Project based experiments for evaluation of the dyed and finished textiles.

**TXS751: Research Seminar**
1 Credit (0-0-2)
Pre-requisites: TXT800
Presentation and discussion based on work done during internship or selected topics on current and future technologies.

**TXL752 Design of Functional Clothing**
3 Credits (3-0-0)
Pre-requisites: EC75

**TXR752 Professional Practices**
1 Credit (0-0-2)
Pre-requisites: EC 75
Interaction and discussion with experts from industry and academia in the field of textiles and allied industries for sharing best practices followed in the industry including case studies, Exposure to a variety of topics and issues related to professional ethics.

**TXL753 Advanced Textile Printing Technology**
2 Credits (2-0-0)
Pre-requisites: EC 75
Historical development in textile printing techniques and machines; limitations thereof; theoretical concepts of transfer printing and scope; transfer printing inks, transfer paper, machines and process conditions; concept of digital printing, technology and challenges thereof, machines and principles, continuous jet verses drop-on-demand, suitability of inks for different class of fibre/fabrics, auxiliaries needed, issues related to standardization, pre- and post-printing operations, scale and economics of operation. Printing faults and related process control principles, novel printing methods, raised, plasma, fancy, 3-D effects.

**TXL 754 Sustainable Chemical Processing of Textiles**
2 Credits (2-0-0)
Pre-requisites: EC 75

**TXL 755 Textile Wet Processing Machines: Automation and Control**
3 Credits (3-0-0)
Pre-requisites: EC 75
Basic concepts of fluid flow, heat and mass transfer with specific emphasis on textile processes, Feedback control principles and systems, Sensors and transducers used in chemical processing machines; Machinery for processing of textiles in fibre, yarn and fabric form, batch and continuous machines. Machines for pre-treatment, dyeing, printing and finishing, developments in machinery for improving the effectiveness of treatment and reduction in chemical, energy and water consumption, mechanical finishing machines, garment processing.

**TXL756 Textile Auxiliaries**
3 Credits (3-0-0)
Pre-requisites: EC 75
TXP761 Evaluation of Textile Materials
2 Credits (0-0-4)
Evaluation of clothing comfort, flammability, bursting strength, bandage pressure, UPF, impact resistance, pore size and filtration efficiency.

TXL771 Electronics and Controls for Textile Industry
4 Credits (3-0-2)

TXL772 Computational Methods for Textiles
3 Credits (2-0-2)

TXL773 Medical Textiles
3 Credits (3-0-0)
Pre-requisites: TXL211/TXL221/TXL222/TXL231/TXL232 and EC75
Natural and synthetic polymers and Textile-based techniques used for medical application, Fibrous extracellular matrix of human body and their characteristic features, Cell-Polymer interaction, Non-implantable materials (Wound-dressing, related hydrogel and composite products, Bandages, Gauges), Implantable biomedical devices (Vascular grafts, Sutures, Heart valves), Extra-corporeal materials (Scaffolds for Tissue engineering, Rapid prototyping, Cartilage, Liver, Blood Vessel, Kidney, Urinary bladder, Tendons, Ligaments, Cornea), Healthcare and hygiene products (Surgical Gowms, masks, wipes, Antibacterial Textiles, Super absorbent polymers, Dialysis, Soluble factor release), Safety, Legal and ethical issues involved in the medical textile materials.

TXL774 Process Control in Yarn & Fabric Manufacturing
3 Credits (3-0-0)
Pre-requisites: TXL222/TXL232 and EC 75

TXL775 Technical Textiles
3 Credits (3-0-0)
Pre-requisites: TXL222/TXL232 and EC 75

TXL776 Design and Manufacturing of Textile Structural Composites
3 Credits (3-0-0)
Pre-requisites: TXL222/TXL232 and EC 75

TXL777 Product Design and Development
3 Credits (3-0-0)
Pre-requisites: TXL222/TXL232 and EC 75

TXL781 Project Appraisal and Finance
3 Credits (3-0-0)
Pre-requisites: TXL222/TXL232 and EC 75
TXL782 Prod. & Operations Management in Textile Industry
3 Credits (3-0-0)
Pre-requisites: TXL222/TXL232 and EC 75

TXL783 Design of Experiments and Statistical Techniques
3 Credits (3-0-0)
Pre-requisites: TXL211/TXL221/TXL231 and EC75

TXL784 Supply Chain Management in Textile Industry
3 Credits (3-0-0)
Definition, objectives, stages and metrics of textile supply chain; Life cycle of textile products, demand and fashion forecasting, forecasting techniques, bull-whip effect, aggregate forecasting in apparel industry; Designing of textile supply chain network, make vs buy and location decisions of textile SCM, reverse logistics in textile SCM; Risk mitigation in global textile supply chain, coordination among fabric, apparel and accessories manufacturers, role of dominant power; Transportation and distribution strategies; Supplier selection in textile SCM, quantitative models; Lean, agile and leagile textile supply chains and their enablers, designing resilient textile supply chain; Push-pull supply chain, decoupling point in textile SCM; Green and low carbon textile supply chain; Case studies related to textile and apparel supply chains.

TXS805 Independent Study (Textile Engineering)
3 Credits (0-3-0)
Student should undertake a research oriented activity including software development, machine design & development, product & process development, instrumentation and in-depth study of a subject which is outside the regular courses offered in the program. This study should be carried out under the guidance of a faculty member. The subject area chosen by the student should be sufficiently different from the area of major project being pursued by the student.

TXD804 Major Project Part-II (TXF)
12 Credits (0-0-24)
To learn about preparation of research plan and systematically carry out research project.

TXD805: Major Project Part I (TCP)
6 Credits (0-0-12)
Pre-requisites: TXL747/TXL748/TXL749/TXL753
Project work related to the area.

TXD806: Major Project Part II (TCP)
12 Credits (0-0-24)
Pre-requisites: TXL747/TXL748/TXL749/TXL753
Project work related to the area.

TXS805 Independent Study (Textile Engineering)
3 Credits (0-3-0)
Student should undertake a research oriented activity including software development, machine design and development, product & process development, instrumentation and in-depth study of a subject which is outside the regular courses offered in the program. This study should be carried out under the guidance of a faculty member. The subject area chosen by the student should be sufficiently different from the area of major project being pursued by the student.

TXD806 Independent Study (TTF)
3 Credits (0-3-0)
Student should undertake a research oriented activity including software development, machine design and development, product & process development, instrumentation and in-depth study of a subject which is outside the regular courses offered in the program. This study should be carried out under the guidance of a faculty member. The subject area chosen by the student should be sufficiently different from the area of major project being pursued by the student.

TXL807 Seminar (Textile Engineering)
2 Credits (0-2-0)
A comprehensive literature review on a research topic of current interest or futuristic, pertaining to a textile process or product or technology. Student should perform a comprehensive literature review on a research topic of current interest or futuristic, pertaining to a textile process or product or technology. The student should give an outline of the review and get approval from the program coordinator for registration of this course. The student registered for this course should give one mid-term presentation followed by a final presentation before a committee constituted by the program coordinator.

TXD809 Mini Project (Textile Engineering)
4 Credits (0-0-8)
This is an open ended course where the students are expected to design and develop a product or equipment or instrument relevant to the field of textile technology. In this process, the students are expected to demonstrate their ability to think on their own in design and development of hardware item. They are also expected to put down their thinking process in a report form with relevant literature background, methodology of design and development process and should have conducted some experiments with the developed hardware system. Finally, they need to present their work for the award of grade.