

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 fiber 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, initial modulus, yield point, toughness, elastic recovery. Relationship between polymer structure and fiber 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 Manmade 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

Molecular architecture. Configuration. Conformation. Amorphous and crystalline phases. Glass transition. Crystallization. Melting. Structures in natural and synthetic fibres. Characterization techniques. Fibre properties. Moisture absorption properties. Mechanical properties. Fibre friction. Optical properties. Thermal properties.

TXL212 Manufactured Fibre Technology

3 Credits (3-0-0)

Pre-requisites: TXL211

Polymer rheology in shear as well as extension. Polymer entanglements. Flow instabilities in polymer fluids. Principles of solidification. Heat and mass transfer. Melt spinning. Force and momentum balance in spinline. Stress induced crystallization. Experimental observations from melt spinning of polyamides and polyesters. Solution spinning. Dry and wet spinning. Transport phenomena. Kinetic and thermodynamic effects in solution spinning. Solution spinning of viscose and acrylic fibres. Dry jet wet spinning. Post spinning processes. Drawing and heat setting. Stress-strain-structure relationship. Effect of post spinning operations on fibre structure and properties. Spin finish applications. Introduction to electrospinning.

TXP212 Manufactured Fibre Technology Lab

1 Credit (0-0-2)

Pre-requisites: TXL212

The laboratory experiments are planned to provide knowledge on fibre formation of selected synthetic polymers and the characterization of fibres/tapes produced. Melt-spinning, extrusion, wet spinning and dry-jet wet spinning techniques are used to produce fibres or tapes. The evaluation of structure through thermo-mechanical properties, polymer solution rheology and microscopic analysis of materials is carried out using established methods.

TXL221 Yarn Manufacture-I

3 Credits (3-0-0)

Pre-requisites: TXL111

Impurities in natural fibres. Separation of trash and lint. Pre-baling operations for staple fibres. Purpose of opening, cleaning, mixing and blending of fibres. Blow room machinery and operating elements. Principles of fibre opening and cleaning in blow room. Transportation of fibre mass. Influence of process parameters on opening and cleaning. Analysis of opening and cleaning processes. Principles and

methods of fibre mixing and blending. Principles of carding. Machine elements and operations in card. Sliver formation, Sliver packaging, fibre configurations in sliver. Objectives, principles and methods of roller drafting. Purpose and principle of condensation of fibres. Causes of mass variation of sliver and control. Automation and recent developments in blowroom, card and draw frames. Fibre opening, carding and drawing for wool, jute and other fibres. Modification in process parameters for processing blended fibres in blowroom, card and drawframe.

TXP221 Yarn Manufacture Laboratory-I

1 Credit (0-0-2)

Pre-requisites: TXL111

Experiments related to the lecture course entitled "Yarn Manufacture I (TXL221)".

TXL222 Yarn Manufacture-II

3 Credits (3-0-0)

Pre-requisites: TXL221

Fibre fractionation and combing. Preparation of fibre assembly for combing. Principle of operations of a rectilinear comber. Combing machine elements. Timing diagram theory of fibre fractionation. Roving formation: Elements of roving frame, drafting, twisting and winding in roving frame, principle and mechanism of builder motion in roving frame. Yarn formation: Elements of ring frame, drafting, twisting and winding in ring frame, design aspects of spindles, rings and travellers, builder motion in ring frame. Spinning geometry. Twist and yarn strength. Yarn doubling : Purpose of doubling and plying of yarns, ring doubling, two-for-one and three for one twisting. New spinning methods: Principles of yarn formation in rotors, friction, airjet, and vortex spinning. Yarn structure and property comparison.

TXP222 Yarn Manufacture Laboratory-II

1 Credit (0-0-2)

Pre-requisites: TXP221

Experiments related to the lecture course entitled "Yarn Manufacture II (TXL222)".

TXL231 Fabric Manufacture-I

3 Credits (3-0-0)

Pre-requisites: TXL111

Introduction to various fabric forming principles: weaving, knitting, nonwoven and braiding. Stages of woven fabric manufacturing: winding, warping, sizing, drawing and tying in and weaving. Winding: principles, precision and random winding, digicone winding, yarn tensioning and clearing. Warping: direct and sectional warping. Sizing: size materials, sizing machines, process and quality control, modern trends. Drawing and tying in. Basic fabric designs: plain, matt, rib, twill and satin, drafting and lifting plans. Primary motions of shuttle looms: cam shedding, cam designs, dobby and jacquard systems, picking systems, loom timing, beat up, sley eccentricity. Secondary and auxiliary motions: take up, let off, warp and weft stop and warp protecting motions.

TXP231 Fabric Manufacture Laboratory-I

1 Credit (0-0-2)

Pre-requisites: TXL111

Experiments related to the theoretical paper TXL231.

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

constructions, cams 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.

TXP232 Fabric Manufacture Laboratory-II

1 Credit (0-0-2)

Pre-requisites: TXP231

Experiments related to the theoretical paper TXL232.

TXL241 Technology of Textile Preparation & Finishing

3 Credits (3-0-0)

Pre-requisites: TXL111

Natural and added impurities in textiles. Singeing, desizing, scouring, bleaching, mercerisation and optical whitening of cotton. Combined preparatory processes Carbonisation, scouring and bleaching of wool, degumming of silk. Preparation of synthetic fibres and blends, heat setting. Machinery for preparation of textiles. Surfactants and their application. Introduction to chemical and mechanical finishes. Chemical finishes for hand modification. Biopolishing, easy care, oil, water and soil repellent finishes. Fire retardancy, antimicrobial finishes. Finishes for wool. Mechanical finishes like shrink proofing and calendaring; Raising, sueding and emerising. Low liquor application techniques and machinery; Stenters and dryers.

TXP241 Technology of Textile Preparation & Finishing Lab

1.5 Credits (0-0-3)

Pre-requisites: TXL111

Natural and added impurities in textiles. Singeing, desizing, scouring, bleaching, mercerization and optical whitening of cotton. Combined preparatory processes Carbonization, scouring and bleaching of wool, degumming of silk. Chemical finishes for hand modification. Bio-polishing, Resin finishing, Water and Oil repellent finishes. Fire retardant finish, Antimicrobial finish, Weight reduction of cotton.

TXL242 Technology of Textile Coloration

3 Credits (3-0-0)

Pre-requisites: TXL241

The principles of dyeing and printing of textile materials. Basic characteristics of dyes, chemical structure of dyes, and classification of dyes. Dyeing equipment and the specific dyes and procedures used to dye textiles. Evaluation of Fastness. Methods of printing namely, roller, screen, transfer, ink jet and the preparation of printing paste. Direct, discharge and resist printing styles. Physical chemistry of fibre/fabric dyeing. Physicochemical theories of the application of dyestuffs to textile and related materials, including the thermodynamics and kinetic principles involved.

TXP242 Technology of Textile Coloration Lab

1.5 Credits (0-0-3)

Pre-requisites: TXL241 and TXP241

The principles of dyeing and printing of textile materials. Dyeing equipment and the specific dyes and procedures used to dye textiles. Evaluation of Fastness. Methods of printing namely, screen, transfer, ink jet and the preparation of printing paste. Direct, discharge and resist printing styles.

TXD301 Mini Project

3 Credits (0-0-6)

Pre-requisites: TXL211/TXL221/TXL222/TXL231/TXL232 and EC65

TXR301 Professional Practices

2 Credits (0-1-2)

Pre-requisites: TXL211/TXL221/TXL222/TXL231/TXL232 and EC65

TXS301 Independent Study

3 Credits (0-3-0)

Pre-requisites: EC65

TXL321 Multi and Long Fibre Spinning

3 Credits (3-0-0)

Pre-requisites: TXL222

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. Mélange yarns. Worsted / semi-worsted/Woolen spinning. Jute and Flax Spinning. Tow to top Conversion. Bulk yarn. Spun silk yarn.

TXL331 Woven Textile Design

3 Credits (3-0-0)

Pre-requisites: TXL232

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, Honey comb, Huckaback and Mockleno 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.

TXL361 Evaluation of Textile Materials

3 Credits (3-0-0)

Pre-requisites: TXL222 and TXL232

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

Basic characteristics of yarn structure. Koechlin's theory relating yarn count, twist, packing density, and diameter. Helical model of fibres in yarns. Radial migration of fibres in yarns. Tensile behavior of yarns. Theory of yarn mass variation in spun yarn. Theory of plied yarn. Basic characteristics of fabric structure. Flexible and rigid thread models of woven fabric geometry. Tensile, bending, and shear deformation of woven fabric. Geometry of knitted structures and basic nonwoven structures.

TXL372 Speciality Yarns and Fabrics

2 Credits (2-0-0)

Pre-requisites: TXL222 and TXL232

Design, manufacture, characterization and applications of speciality yarns. Hybrid yarns. High bulk yarns. Electro-conductive yarns. Technical sewing threads. Coated yarns. Reflective yarns. Elastomeric yarns. Yarn quality requirement. Yarn preparation & production technology. Structural design, properties-Performance and applications of speciality fabrics. Denim. Pile fabrics. Narrow fabrics. 3D fabrics. Spacer fabrics. Profiled fabrics. Contour fabrics. Polar fabrics. Spiral fabrics. Multi-functional fabrics, Leno fabric.

TXL381 Costing and its Application in Textiles

4 Credits (3-1-0)

Pre-requisites: TXL211/TXL221/TXL231 and EC 75

Importance of costing. Material costing in textile industry. Methods of inventory costing. Economic order quantity, price discount, safety stock, lead time. Allocation of labour cost-shift premium, overtime, idle time, rush orders in garment industry. Allocation of overheads in composite mills. Job order costing in garment industry. Economic batch quantity. Process costing in mill. Unit cost of yarns, fabric and processing. Joint and by-product costing. Absorption costing. Variable costing for decision making. Profit planning in textile industry, variation of price, costs etc., breakeven capacity. Standard costs of fibres, yarns, labour etc. HOK, OHS, UKG etc. Cost variance analysis-iteration of actual costs of fibre, labour and overhead with respect to standard costs. Work allocation to spinner. Balancing of machine for optimizing product mix in a spinning mill. Financial information-balance sheet, profit/loss account, balance sheet. Ratio analysis.

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.

Artificial Neural Network (ANN): Mathematical models of artificial neurons, ANN architecture, Learning rules, Back propagation algorithm, Applications of ANN. Fuzzy Logic: Crisp and fuzzy sets, Operations of fuzzy sets, Fuzzy rule generation, Defuzzification, Applications of fuzzy logic. Genetic Algorithm (G.A.): Basics of G.A., G. A. in fabric engineering.

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

and World. Factors affecting their growth. Economics of manmade fibre production. Modern polyester manufacturing plant technology. Capacities, raw materials and economics. Process and parameters at polymerization. Melt spinning and draw line. Control of modulus, tenacity, crimp properties, Dye affinity during production. Typical properties of polyester staple fibre. Partially oriented yarn and fully drawn yarn. Commodity and specialty polyester fibres. Recycled polyester staple fibres. Bio-degradable polyester PLA. Applications, properties and selection of fibres as per end uses.

TXV702 Management of Textile Business

1 Credit (1-0-0)

Pre-requisites: TXL222/TXL232 and EC 75

The textile industry of India : Past & its evolution to the present day. The structure of the Indian textile industry. Cotton textile sector, Jute textile sector. Silk textile sector. Manmade textile sector. Wool textile sector. Statistics of Indian textile business (domestic & export) and world textile trade. Textile policy 2000. Govt. of India. World trade practices. Norms, barriers etc. Various pertinent issues prevailing impacting textile industry and trade. Corporate social responsibility. Other compliances. ISO accreditation, etc. Retailing in textiles vis-a-vis consumer trend and behaviour. The challenging future of the Indian textile industry and trade.

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.

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 polyacrylonitrile, 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. Specialty 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 fiber 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

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 on entanglement density, fibre spinning and subsequent 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 cellulosic fibre; 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 MFI of PET and PP. Melt spinning of PET, PP & nylon-6 filament yarns on laboratory spinning machines. Single and two stage drawing of the as-spun yarns or industrial POY. Demonstration of high speed spinning machine. Wet and dry heat setting of PET and nylon drawn yarns. Effect of temperature and tension on heat setting. Determination of structure and mechanical properties of as spun, POY, drawn and heat set yarns 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 yarn 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 fibers, 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 unevenness 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)

Principles of bale management. Forces acting on fibres during opening and cleaning, analysis of fibre compactness and blending in blowroom. Carding process, cylinder load and transfer efficiency, design of high production card, fibre shedding and card wire geometry, fibre configuration in card and drawn sliver. Fibre movement in drafting field, drafting wave, drafting force, roller slip, roller eccentricity and vibration, autolevelling. Fibre fractionation in comber, combing performance. Analysis of forces on yarn and traveller, spinning tension in ring and rotor spinning, spinning geometry, twist flow in ring and rotor spinning, end breaks. Mechanism of drafting and yarn formation in high speed spinning systems.

TXL724 Textured Yarn Technology

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 yarns- 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.

TXL725 Mechanics of Spinning Machines

3 Credits (3-0-0)

Drive systems, belt drives, belt tensions, power transmission, variable, PIV and reversing drives. Polygonal effect in chain drives. Gear types, design aspects, interference and periodic faults, thrust loads and elimination, gear selection, planetary gear trains in spinning machines. Design of cone pulleys, design of transmission shafts and drafting rollers-materials, design against torsional & lateral rigidity. Clutches and brakes-design, torque transmission capacity and application in textile machines. Bearings- bush bearings, theory of lubrication, rolling contact bearings in spinning machines. Machine balancing- static, couple and dynamic unbalance, balancing of card cylinder, plane transposition, practical aspects of balancing, Cams in roving and ring spinning machines.

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)**

Engineering approach to fabric formation. Fibre, yarn and fabric structure- property relationships. Crimp interchange in woven fabric. Elastica model for fabric parameters and crimp balance. Concept of fabric relaxation and set. Practical application of geometrical and elastica models, Uniaxial and biaxial tensile deformation of woven fabric. Bending deformation of woven fabric, bending behaviour of set and unset fabrics and bending in bias direction. Bending, Shear and drape properties of woven fabric. Buckling and compressional behaviour of woven fabrics. Mathematical models and their application in the study of tensile, bending, shear, compressional and buckling deformation of woven fabrics. Structure and properties of knitted fabrics, Structure-property relationship of nonwoven fabrics, Mechanical behavior of braided structures, Theory of fabric low stress mechanical properties and fabric hand, Fabric formality.

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, Multilayer weaving, Spacer weaving, Profiled 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, Electrospinning, 3D nonwovens.

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

Definitions of nonwoven and their scopes and limitations. Staple fibre preparation processes. Staple fibre web formation processes: carding, air-laying, and wet-laying. Staple fibre web stacking processes: parallel-laying, cross-laying, and perpendicular-laying, Mechanical bonding processes: needle-punching and hydroentanglement. Thermal bonding processes: calendar, through-air, impingement, infra-red, and ultrasonic bonding. Chemical bonding process. Spunmelt processes: spunbonding and meltblowing, Medical nonwovens, Hygiene nonwovens, Nonwoven wipes, Nonwoven filters, Geononwovens, Automotive nonwovens, Case studies.

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, fullerenes, 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*

Importance of ecological balance and environmental protection. Definition of waste and pollutant. Pollutant Categories and types. International and Indian legislation and enforcing agencies in pollution control. Waste management approaches; Environmental Management Systems' ISO 14000. Environmental impact along the textile chain from fibre production to disposal. Toxicity of intermediates, dyes and other auxiliaries etc. Pollution load from different wet processing operations. Textile effluents and their characterization. Technology and principles of effluent treatment. Advanced colour removal technologies, Recovery and reuse of water and chemicals. Air and noise pollution and its control. Eco labeling schemes. Industrial hygiene and safe working practices. Analytical testing of eco and environmental parameters. Eco friendly textile processing: waste minimization. Standardization and optimization, process modification. Safe & ecofriendly dyes and auxiliaries. Organic cotton, natural dyes, naturally coloured cotton, Solid (fibre & polymer waste) recycling recovery of monomers, energy recovery and chemical modification of fibre waste.

TXL 747 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 colour order 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)**

Overview of textile processing industry- current and future trends. Merging of technologies for creative solutions. Advances in preparatory processes- bioscouring, combined processes, bleaching and mercerisation. Reducing water and energy consumption - Efficient liquor extraction, Low wet pick up and drying technologies. Classification of finishes. Advance in mechanical finishes - calendaring, raising, emerising, softening. Principles and chemistry of Chemical finishes - easy care, antimicrobial, anti UV, antistat, softening, Flame retardant, water repellent. Principle of repellency, oil, water and soil, self-cleaning textiles. Wellness finishes for aroma, health and hygiene. New technologies - microencapsulation, plasma, nanotechnology. Finishing of technical textiles. Membranes and laminates.

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, mechanochromic; 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

Clothing Comfort: Brief introduction to the various processes related to comfort, Application of science of clothing comfort. Psychology and comfort: basic concepts, Psychological research techniques, General aspects and measurement of aesthetic properties, changes in aesthetic behaviour. Neurophysiological Processes of Comfort: Neurophysiologic basis of sensory perceptions, Perceptions of sensations related to mechanical, thermal and moisture stimuli. Thermal transmission: Thermoregulatory mechanisms of human body, heat transfer theories, thermal conductivity of fibrous materials, steady state measurement techniques for heat transfer, transient heat transfer mechanism: warm-cool feeling. Moisture Transmission: transfer of liquid moisture and vapour transfer through fibrous materials. Dynamic Transmission of heat and moisture: Relationship of moisture and heat, multiphase flow through porous media, moisture exchange between fibre and air, temperature and moisture sensations: theories and objective measurement techniques, impact of microclimate. Tactile Aspects of Comfort: Fabric mechanical properties and tactile- pressure sensations like fabric prickliness, itchiness, stiffness, softness, smoothness, roughness and scratchiness, fabric hand value, clothing comfort aspects in relations with garment size and fit.

TXL751 Apparel Engineering and Quality Control

3 Credits (2-0-2)

Pre-requisites: TXL211/TXL221/TXL222/TXL231/TXL232 and EC75

Introduction to clothing manufacture, Apparel Engineering Concept in Garment Industry, Need of Apparel engineering, Role and Methodology of Apparel Engineering, Industrial engineering concept in apparel engineering, Standardization and Production scheduling, Sewing Dynamics, Mechanics of sewing operation, Measurement and controls in sewing operation, Automation in sewing process, Modeling of sewing machine and operation, Fabric quality assessment for clothing industry, Evaluation and Application of low stress mechanical properties for making up process, Fabric mechanical properties and sewing operation interaction, Concept of Tailorability, Formability and Lindberg theory, Quality control in apparel manufacturing, Determination of sewability, Effect of sewing on fabric mechanical and aesthetic properties, Fabric defects and their impact on garment quality, Quality inspection and defects in apparels, Evaluation of sewing threads, Evaluation of clothing accessories, Material Functionality in clothing, Engineering of functional clothing.

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

Functional clothing - definition and classification. Techniques in design of functional clothing - 3D body scanning, human motion analysis,

2D/3D CAD and 3D modelling. Design of patterns, garment assembling methods. Ergonomics in design of functional clothing. Principles and practice of Anthropometrics. Biomechanical considerations in design of clothing. Performance evaluation of performance clothing - subjective and objective methods, modeling and simulation. Human mechanics and operational performance. Modelling, optimization and decision making techniques in design of functional clothing. Certification and standardization. Case studies - swimwear, sportswear, pressure garments, space suit, military clothing with a view to study specific design and manufacturing considerations.

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 versus 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

Concept of Sustainability, Green processing technologies – low liquor technologies, ozone, super critical carbon dioxide and ultrasound technologies. Technologies using organic and natural fibers, process technologies using new enzymes and foam technology, lowsalt reactive dyes, combined dyeing and finishing, Industrial hazardous waste management, in-plant management, reduction, recycling and disposal of waste. Hazards involved in chemical processing and laws related to environmental protection. Life cycle analysis with case studies, compliance, certification, social accountability and ethical practices. Concept of eco-labels, ISO 14024:2018.

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

Auxiliaries in textile chemical processing; Surfactants, emulsifiers, wetting agents, dispersing agents, foaming agents. Buffers, Electrolytes, Sequestering agents, enzymes, Sizing agents, thickeners, Binders, Fluorescent brightening agents, Oxidising and reducing agents, discharging agents, stain removing agents. Environmental assessment.

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)

Overview of electronics and controls in modern textiles equipments and machines. Overview of basic analog electronics: Elements (R, L, C, V, I), circuit laws and theorems. Overview of basic digital electronics: Gates and ICs. Sensors and transducers (displacement, position, force, temperature, pressure, flow). Control elements, systems and examples. Data acquisition, analysis, control and automation by microprocessors and micro controllers. Motor and power drives. Power control devices. Some applications of data acquisitions and control systems in textiles and case studies.

TXL772 Computational Methods for Textiles

3 Credits (2-0-2)

Numerical analysis, First-degree approximation methods, Linear algebraic equations, ordinary differential equations, interpolation, Fundamentals of Computer Programming, Programming Methodology: Structured Programming and concepts of Object-Oriented Programming. Programming in C++ - Statements and Expressions, Control statements. Structure, Functions: Function Overloading etc. C++ as Object-Oriented Programming Language- Classes and Objects, Data Abstraction, Inheritance - Multilevel and Multiple inheritance etc., Polymorphism - operator overloading and virtual functions, file handling. Application development using C++.

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, Gauzes), 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 Gowns, 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

Basics of automatic control, Statistical considerations in process control. Online and offline control measures in spinning. Control of yarn quality attributes. Spinning process performance. Post spinning problems. Control of winding, warping, sizing, weaving and knitting processes. Control of fabric defects and value loss. Yarn quality requirement and assessment for weaving.

TXL775 Technical Textiles

3 Credits (3-0-0)

Pre-requisites: TXL222/TXL232 and EC 75

Definition, classification, products, market overview and growth projections of technical textiles. Fibres, yarns and fabric structures in technical textiles and their relevant properties. Type and important characteristics of sewing threads, cords, ropes, braids and narrow fabrics. Textile and other filter media for dry and wet filtration. Fibre and fabric selection for filtration. Types and application of geosynthetics. Fibres and fabric selection criteria for geotextile applications. Application of textiles in automobiles. Requirement and design for pneumatic tyres, airbags and belts. Clothing requirements

for thermal protection, ballistic protection. Materials used in bullet proof and cut resistant clothing. Material, method of production and areas of application of agrotexiles. Different types of fabrics used for packaging. Methods of production and properties of textiles used in these applications.

TXL776 Design and Manufacturing of Textile Structural Composites

3 Credits (3-0-0)

Pre-requisites: TXL222/TXL232 and EC 75

Definition of composites, textile composites and textile structural composites, Textile materials for composites, Matrix and Reinforcements, Classification of Textile Reinforced Structures based on axis and dimension; non-axial, mono-axial, biaxial, triaxial and multiaxial structures, UD, 2D,3D structures, Structural anisotropy, parallel arrangement and series arrangement of components, Chopped strand and Milled fibres, Hybrid fabrics, Non-crimp fabrics, Laminates, Stitched structure, Embroidery structures, Composite Rope, Design, manufacture and applications of reinforcements, Manufacture and characterization of extra-light 3D hollow textile structures for composites, Methods of composite processing, Manufacturing techniques of complex structural Composites, Characterization of structural Composites, Theory of composites, Composite concepts and theory, Rule of mixture, the synergy effect, Logarithmic mixing rule, Geometry of reinforcement, Particular, granular, fibrillar, lamellar, Properties of components, properties of interface, mechanism of adhesion, Mechanics of composite, Failure theory, Damage analysis, Modeling and simulation of various reinforcement structures and their composites, Applications of Textile structural composites, Textile Reinforced Concretes, Fibre concrete bonding, textile structure reinforcement concrete architecture, Characterization and applications of reinforced concretes.

TXL777 Product Design and Development

3 Credits (3-0-0)

Pre-requisites: TXL222/TXL232 and EC 75

Introduction to product development, distinguishing features of textile products, and its classification. Generic product development process, identifying customer need and its analysis, development of specification, need to metric conversion. Concept generation methodology, concept selection. Material selection, performance characteristics of apparel, home textile and technical products, criterion for material selection. Role of fibre, yarn and fabric and finishing process on product performance. Industrial design, ergonomics and aesthetics, Product architecture, Anthropometric principles, fit. Principles of prototyping, 3 D computer modeling, free-form fabrication. Design options for improving properties and functional attributes of different products. Design logic for developing selected products, Analysis of products; Calculation of design parameters for a given end use, developing detail specification for each structural element.

TXL781 Project Appraisal and Finance

3 Credits (3-0-0)

Pre-requisites: TXL222/TXL232 and EC 75

Introduction to Project Finance - Description of Project Finance Transaction, difference between corporate finance and project finance, Indian Financial system, Structuring the Project, Limited Resource Structures, Capital Investments : Importance & Difficulties, CPV analysis, Financial statements, Financial statement analysis, Working capital management, Inventory management, Project cycle, Project Formulation, Project Appraisal, Financial appraisal, Economic Appraisal, Social Cost Benefit Analysis- Shadow Prices and Economic rate of return, Financing Projects, Sources of funding, Valuing Projects, NPV, IRR, MIRR, Real Options, Decision Trees and Monte Carlo Simulations, Financial Estimates & projections, Technical Analysis, Market & Demand Analysis, Investment Criteria, Cost of capital, Project Risk analysis, Sensitivity Analysis, Leverage analysis, Environment Appraisal of the project and Detailed Project Report, Case studies on Textile projects.

TXL782 Prod. & Operations Management in Textile Industry

3 Credits (3-0-0)

Pre-requisites: TXL222/TXL232 and EC 75

Indian textile industry scenario. Textile Policy. Production and operations management function. Operation strategy. Facility location and capacity planning. Production planning and control, aggregate planning, scheduling, PERT and CPM, product mix linear programming concepts. Inventory models, optimal order quantity, economic manufacturing batch size, classification of materials, materials requirement planning, Just in time concept. Supply chain Management. Maintenance management. Plant modernisation. Motion and time study. Job evaluation and incentive scheme. Productivity, partial and total productivity, machine, labour and energy productivity, efficiency and effectiveness, benchmarking, measure to increase productivity. Forecasting, methods of forecasting. Total quality management and Six Sigma. Product pricing. Financial and profit analysis, investment decisions. Management information system.

TXL783 Design of Experiments and Statistical Techniques

3 Credits (3-0-0)

Pre-requisites: TXL211/TXL221/TXL231 and EC75

Objectives, principles, terminologies, guidelines, and applications of design of experiments. Completely randomized design. Randomized block design. Latin square design. Two level and three level full factorial designs. Fractional factorial designs. Robust design. Mixture experiments. Central composite and Box-Behnken designs. Response surface methodology. Multi-response optimization. Analysis of variance. Statistical test of hypothesis. Analysis of multiple linear regression. Use of statistical software packages.

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.

TXL800: Industrial Summer Training*Non-Credit Mandatory for TCP**Pre-requisites: TXL747/TXL753/TXL749*

Non-Credit course. The students will be required to undergo summer internship in a textile industry and present the experience of internship.

TXD801 Major Project Part-I (TXE)

6 Credits (0-0-12)

To learn about preparation of research plan and systematically carry out research project.

TXD802 Major Project Part-I (TXF)

6 Credits (0-0-12)

To learn about preparation of research plan and systematically carry out research project.

TXD803 Major Project Part-II (TXE)

12 Credits (0-0-24)

To learn about preparation of research plan and systematically carry out research project.

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 & 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.

The student should submit a detailed plan of work to the program coordinator before approval of registration for the 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.

TXS806 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.

The student should submit a detailed plan of work to the program coordinator before approval of registration for the 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.

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.