

# Department of Textile Technology

## **TXL 747: Colour Science**

---

**3 credits (3-0-0)**  
**Prerequisites: EC 75**

Colour and chemical constitution, physics and chemistry of colour, measurement of colour Colorimetry and CIE system, Qualities of Colorants, Colour-order systems, Colour Sensors, Physiology of Colour Vision, Visual and instrumental evaluation of whiteness, shade sorting, colour uncertainty

## **TXL748: Advances in Finishing of Textiles**

---

**3 credits (3-0-0)**  
**Prerequisites: EC 75/TXL747/TXL753**

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 - calendering, raising, emerising, and 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)**  
**Prerequisites: 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)**  
**Prerequisites: 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)**  
**Prerequisites: 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

### **TXP 751: Characterization of Chemicals and Finished Textiles Lab**

---

**1 credit (0-0-2)**

**Prerequisites: 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)**

**Prerequisites: TXT800**

Presentation and discussion based on work done during internship or selected topics on current and future technologies

### **TXR752: Professional Practices**

---

**1 credit (0-0-2)**

**Prerequisites:**

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)**

**Prerequisites: 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)**

**Prerequisites: EC 75**

Sustainability, Green Processing technologies, which require fewer chemicals, consume less energy and water and release cleaner effluent, Technologies using organic and natural fibers, Bio composites, Process technologies using new enzymes, ozone, and foam technology, Low-salt reactive dyes, Combined dyeing and finishing, Industrial Hazardous Waste Management, in-plant management, reduction, recycling and disposal of waste, Laws related to

environmental protection specially with reference to textile industry, Compliance, certification, social accountability and ethical practices.

### **TXL 755:** **Textile Wet Processing Machines: Automation and Control**

---

**3 credits (3-0-0)**  
**Prerequisites: 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)**  
**Prerequisites: 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.

### **TXT800:** **Industrial Summer Training**

---

**Non-credit Mandatory for TCP**  
**Prerequisites: TXL747/TXL753/TXL749**

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

### **TXD805:** **Major Project Part I (TCP)**

---

**6 Credits (0-0-12)**  
**Prerequisites: TXL747/TXL748/TXL749/TXL753**

Project work related to the area

### **TXD806:** **Major Project Part I (TCP)**

---

**12 Credits (0-0-24)**  
**Prerequisites: TXL747/TXL748/TXL749/TXL753**

Project work related to the area

### **TTL711:** **Polymer and Fibre Chemistry:**

---

**3 credits (3-0-0)**

Introduction to natural and synthetic polymers. Terms and fundamental concepts. Step-growth polymerization, Carother's equation. Functionality; Crosslinking. PET manu-facturing. Chain growth polymerization, Free radical

polymerization, Kinetics of free-radical polymerization, initiator, termination, chain transfer, Mayo's equation, cage effect, auto-acceleration, inhibition and retardation. Polypropylene manufacturing. Acrylic manufacturing. Atom transfer radical polymerization, ionic polymerization, ring opening polymerization. Nylon-6 manufacturing. Copolymerization and its importance. Copolymer equation, reactivity ratio, tailor making of copolymer properties. Techniques of chain polymerization. Bulk, solution, emulsion, microemulsion and suspension polymerization. Chemical Modification of fibres. Polymer solution, Flory's theory. Interaction parameter. Molecular weight and its distribution by End group analysis, osmometry, light scattering, ultra centrifugation, gel permeation chromatography, intrinsic viscosity. Spectroscopic methods of polymer characterization such as, FTIR. UV, NMR.

#### **TTP 711:**

#### **Polymer and Fibre Chemistry Laboratory**

---

#### **1.5 credits (0-0-3)**

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.

#### **TTP 712:**

#### **Polymer and Fibre Physics Lab:**

---

#### **1.5 credits (0-0-3)**

Characterization of fibres by Infrared spectroscopy, Density measurements, Thermal analysis such as Thermogravimetric Analysis (TGA), Differential Scanning calorimetry (DSC) and Thermo-Mechanical Analyser (TMA), Dynamic Mechanical Analysis (DMA), Sonic modulus, X-ray diffraction studies, Birefringence measurement, Optical microscopy studies, Scanning Electron Microscopy (SEM) of fibres.

#### **TTL 712:**

#### **Polymer and Fibre Physics:**

---

#### **3 credits (3-0-0)**

Molecular architecture in polymers, Configuration and conformation. Nature of molecular interaction in polymers, Cumulative interaction, Entanglement, Random chain model and rms end-to-end distance. Glass transition temperature (T<sub>g</sub>), Factors affecting T<sub>g</sub>. WLF equation. Rubber Elasticity. Melting and Crystallization. Models describing fibre structure, Fringed fibrillar and fringed micellar model, One phase model. Requirement of fibre forming polymers. Crystallinity and orientation. X-ray diffraction measurement of crystallinity, orientation, crystal size, small angle X-ray scattering. Measurement of density of fibres, Density crystallinity, Infrared spectroscopy for determination of orientation, crystallinity etc. Optical microscopy for measurement of birefringence. Internal and surface structure by electron microscopy. Thermal methods DSC TGA and TMA for structural investigation. Morphological structure of Cotton, Wool, Silk, Regenerated Cellulose, Polyester, Nylon, Polypropylene, Polyacrylonitrile.

#### **TTL713:**

#### **Technology of Melt Spun Fibres:**

---

#### **4 credits (3-1-0)**

#### **TTL714:**

#### **Physical Properties of Fibres:**

---

#### **3 credits (3-0-0)**

Introduction to fibre structure and requirements of fibre forming polymers Moisture Relations: Moisture sorption and desorption in fibres Sorption isotherms, Heats of sorption, Swelling and theories of moisture sorption. Mechanical

properties: Mechanism of deformation in fibres. Principles of elasticity and viscoelasticity. Creep and stress relaxation. Boltzmann superposition principle. Dynamic mechanical properties. Model theory of visco-elasticity. Time-temperature superposition principle. Stress- strain relations. Yield and fracture. Fibre friction, its nature, theory, application and measurement. Optical properties; Polarizability and refractive index. Birefringence and its measurement. Thermal Properties; Thermal expansion. Thermal conductivity, Electrical Properties: Dielectric properties, effect of frequency and temperature on dielectric constant. Electrical resistance and its measurement. Static electricity and measurement of static charge in fibres.

**TTL 715:**  
**Technology of Solution Spun Fibres:**

---

**3 credits(3-0-0)**

PAN properties. Solution rheology and its dependence on parameters. Effect of parameters on entanglement density, fibre spinning and subsequent drawing. Various solvent systems. Dope preparation. Wet and dry spinning processes. Effect of 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 of PAN and its advantages. Gel spinning. Melt spinning of PAN. Bicomponent and bulk acrylic fibres. Acrylic fibre line, crimping and annealing, tow to top conversion systems. Viscose rayon process, wet spinning. Zinc sulfate spinning. Polynosics and high performance fibre. Lyocell process, structure and properties. Gel spinning of PE, introduction to high performance fibres and their spinning systems such as rigid rod polymer, liquid crystalline polymers, polylactic acid and spandex fibre manufacturing.

**TTP716:**  
**Fibre production and post-spinning operations 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.

**TTL717:**  
**Advances in Manufactured Fibres:**

---

**3 credits (3-0-0)**

Profile fibres, hollow & porous fibres, spandex fibres. Biodegradable fibres, polyglycolic acid fibres, polylactic acid fibres, chitosan fibres, their preparation properties and applications. Bicomponent fibres, blended fibres. Fibres in medicine and biotechnology. Aesthetic fibres, bio-mimicking fibres. Membranes. Smart fibres. Comfort fibres. Fibres for Ballistic protection. Microdenier fibre. Spun Bonded and Melt blown nonwovens. Photochromatic fibres. Plasma processing of textiles. Processes for manufacturing of tapes and films.

**TTL718:**  
**High Performance Fibres and Composites:**

---

**3 credits (3-0-0)**

**TTL721:**  
**Theory of Yarn Structure:**

---

**3 credits (2-1-0)**

Types of yarn. Role of yarn structure on yarn and fabric properties. Structural parameters of yarn. Twisting forms

and yarn contraction. Morphology of staple yarns. Fibre characteristics in sliver, roving and yarns. Comparative analysis of structural characteristics of various types of spun yarns. Influence of fibre characteristics on yarn structure. Tensile behaviour of filament, spun, core spun and elastic yarns. Bending behaviour of yarns. Frictional behaviour of yarns. Rupture behaviour of filament and spun yarns. Geometry of plied structure. Tensile properties of plied structures.

**TTL 722:**  
**Mechanics of Spinning Processes:**

---

**3 credits (3-0-0)**

Cotton fibre selection through bale management. Forces on fibres during opening and cleaning processes and its effect. Carding process. Analysis of cylinder load and transfer efficiency. Technological considerations in the design of high production card. Card wire geometry, Fibre configuration in card and drawn sliver. Hook removal and its significance. Sliver irregularity. Fibre movement in drafting field. Suppression of drafting wave. Drafting force. Roller slip. Roller eccentricity and vibration. Fibre fractionation in comber. Combing performance. Principles of autolevelling. Blending of fibres, evaluation of blending efficiency. 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 during spinning. False twisting principles.

**TTL723:**  
**Selected Topics in Yarn Manufacture:**

---

**3 credits (2-1-0)**

Spinning of micro denier fibre. Synthetic fibre spinning on cotton spinning system. Spinning of dyed fibres. Principle of woollen and worsted spinning systems. Influence of high draft on yarn quality. Optimization of production speeds. Production of core and elastic yarns, sewing thread, acrylic bulk yarn, carpet yarn and fancy yarns. Waste fibre spinning. Mechanical and electrical drives. Energy conservation and saving through process optimization. Yarn conditioning. Yarn clearing devices. Selection criteria for aprons, cots and top rollers. Design of bottom drafting rollers. Future expected innovations. Control systems in spinning machinery.

**TTL724:**  
**Textured Yarn Technology:**

---

**3 credits (3-0-0)**

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.

**TTL731:**  
**Theory of Fabric Structure:**

---

**3 credits (2-1-0)**

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 and nonwoven fabrics.

### **TTL 732:** **Computer Aided Fabric Manufacturing:**

---

**3 credits (2-0-2)**

Electronic Dobby: Working principle, constructional variants, design of the electronic dobby, drive arrangement, systems for pattern data transfer. Electronic Jacquard: Working principle, constructional variants, various electronic jacquard systems, selection system, pattern data transfer and management. CAD for dobby, jacquard, label weaving and carpet: Development of Jacquard designs, process of drafting and sketch design, development of figures, composition of design, geometric ornamentation, arrangement of figures, weave simulation. **Laboratory:** Working on electronic dobby and electronic Jacquard, working on CAD, development of various designs on CAD and development of design samples.

### **TTL733:** **Selected Topics in Fabric Manufacture:**

---

**3 credits (2-0-2)**

Development trends in winding, warping and sizing machines for improving quality of preparation and cost, reduction with specific reference to shuttleless weaving machines. Tension control and automation in sizing. Loom development trends and objectives. Single phase and multiphase looms. Kinematics of sley and heald motion with reference to shuttleless looms. Theoretical analysis of weft insertion in shuttleless looms. Mechanism of warp breakage; Cloth fell position, beat up force and pick spacing. Analysis of let off mechanism, electronic let off and take up. Electronic jacquards. Developments with reference to energy saving, noise reduction and waste control. Electronic data acquisition in a loom shed.

**Knitting:** Dynamics of knitted loop formation. Design and performance of high speed knitting cams. Developments in knitting machines. Developments in processing machineries for knitted fabrics. Yarn feeding devices on circular knitting machines and design features of positive feeders.

**Nonwovens:** Fibre/filament arrangement in web and its effect on mechanical properties of nonwoven fabrics. Failure mechanism in different nonwoven fabrics. Effects of machine, fibre and process variables on properties of nonwoven fabrics. Production of spun bonded and melt blown fabrics.

### **TTL741:** **Coloration of Textiles:**

---

**3 credits(3-0-0)**

Developments in dyes and dyeing processes for the dyeing of various textile substrates with various dye classes. Dyeing of blends. Mass coloration of man-made fibres. Development in printing methods and machines. Direct, resist and discharge styles of printing. Printing of blends. Transfer printing. Physicochemical theories of the application of dyestuffs to textile and related materials, including the thermodynamics and kinetic principles involved. Dye-polymer interactions. Role of fibre structure in dyeing.

### **TTL 742:** **Theory and Practice of Textile Finishing:**

---

**3 credits(2-0-2)**

General overview of the recent technological developments in the area of textile finishing. Special emphasis will be on formaldehyde free finishes for wash-n-wear and durable press applications, fire retardants for apparel and industrial textiles, silicon and amino silicon softeners, fluoro-chemicals for water repellency and soil release functions, water proof breathables principles and technology involved in their production, surface modifications of textiles and their impact on various functional properties, antistats for synthetic fibres / fabrics, microencapsulation and its relevance in textile finishing application, , new finishes for different functional and aesthetic requirements.

**TTL743:**  
**Principles of Colour Measurement and Communication:**

---

**3 credits (2-0-2)**

**TTL744:**  
**Environmental Management in Textile & Allied Industries:**

---

**3 credits (3-0-0)**

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. standardisation and optimisation, 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.

**TTL 751:**  
**Apparel Engineering and Quality Control:**

---

**3 credits (2-0-2)**

Mechanics of sewing operation: Feeding mechanism, mechanism of generation of needle thread tension, feed dog setting mechanism, stresses and heat generated during sewing, interaction of feed and pressure, sewing dynamics. Measurement and controls in sewing operation: Pressure, sewing speed, thread tension, needle temperature, needle penetration force. Automation in sewing operation. Fabric quality assessment for clothing industry: Fabric quality requirement for high quality garments, low stress fabric mechanical properties and their effect on sewing operation. Use of FAST and KES system. Fabric mechanical properties and sewing operation interaction: Tailorability and formability. Lindberg theory, optimization of sewing parameters by using fabric mechanical property, optimization of finishing parameters such as steam, pressure, vacuum, for getting desired effect. Fabric defect analysis for clothing industry: Defect identification, bow and skewness, correlating defect with back process, value loss. Quality control in apparel manufacturing: Determination of sewability, seam pucker, seam slippage and needle cutting index, evaluation of cutting defect, fusing defect, sewing defect, inspection of dimension, appearance, drape, change in color, shape and spots. Measurement and selection of sewing thread properties for different fabrics: Optimization of sewing parameters such as ticket number, needle number, yarn tension, stitch density and stitch type for desired sewability. Selection of lining and interlining fabrics for various shell fabric: Evaluation of lining and interlining fabric, determination of compatibility. Packaging of finished garment, final random inspection of finished garments, packaging method, safety norms. Accessories: Buttons, hook and eye, jips, velcro.

**TTL761:**  
**Costing, Project Formulation and Appraisal:**

---

**3 credits (2-1-0)**

Cost Concepts: Direct/indirect, Fixed/ variable, Total cost. Inventory costing: FIFO, LIFO, Weighted average methods. **System of costing:** Job, order, batch, process, unit & operating cost joint & byproduct. Cost Standards in **Textiles:** Cost structure in textile industry, Cost of raw material/labour/utilities. **Cost Control:** Standard costs, variance analysis, determination of cost per kg of yarn, per kg(metre) of fabric, measures for cost reduction, selling price decision for yarn/ fabric. **Profit planning:** Cost volume - profit analysis, Break Even point. Budgeting, Definition, purpose, types. Financial Statement & Investment Analysis : Profit & Loss account and Balance sheet analysis, Fund flow statement, Ratio analysis, Concept of cost of capital, IRR, DRC, DSCR, ERR, payback period and techniques for calculation.

**Project Cycle:** Phases of project cycle identification, preparation evaluation, documentation & Supervision. Various functions in project cycle - Technical, commercial, financial, economic, and managerial. Project formulation and Appraisal: Appraisal concept, Need for appraisal, Methodology, Various aspects - market, management, technical, financial and economic, Key financial indicators in appraisal, Investment decision from appraisal report, Post-project appraisal. Evaluation of Technological Content of Textile

**Projects:** The choice of Technology and their assessment, operating constraint, appropriateness of technology, factors influencing selection, various aspects of technology transfer. Project Utilities and Environmental Aspects for Textile projects: Power, Steam, Fuel, Water, Compressed air, Air conditioning, Pollution (air, water, ground noise). Special Appraisals: For Modernisation projects, balancing equipment, expansion and diversification projects (including backward & forward integration).

### **TTP 761:**

#### **Evaluation of Textile Material I:**

##### **1 credits (0-0-2)**

Characterization of Fibre : Birefringence, sonic modulus, density measurements, thermal analysis, X-rays (orientation and crystallinity).

Yarn Testing: Tensile properties, hairiness, cross-sectional studies and yarn preparation.

### **TTP 762:**

#### **Evaluation of Textile Material II:**

---

##### **1 credits(0-0-2)**

Evaluation of spliced yarn and sized yarn. Testing of technical textile ; coated fabrics, geo-textiles, filter fabrics. Simulation of knitted and woven structure, comfort properties of fabric, water repellency. Computer colour matching, measurement of U-V protective character of textile material.

### **TTL762:**

#### **Management of Textile Production:**

---

##### **3 credits (2-1-0)**

Indian Textile Industry: Structure, production and exports. Textile Policy. Sickness of Textile Industry- Analysis and options. Essentials of production management, production systems, classification. Material management: Role of material management techniques, purchase management, acceptance sampling and inspection, vendor rating system, inventory management. Production, planning and control: types of production systems and problems of planning and control, product section design, process planning, forecasting, planning of batch, mass and job shop system. Machine balancing. Layout and material handling. Machine assignment and allocation of jobs.

Maintenance management: maintenance concepts, maintenance strategies, maintenance planning. Productivity and improvement techniques. Quality management: Introduction to TQM, concepts of value and quality assurance, total quality control, quality circles, ISO 9000. Marketing management: fundamental of industrial marketing, industrial buyer behaviour model. Marketing: systems selling, role of service, marketing planning and marketing strategies. Enterprise resource planning: Role of information in managerial decision making, information needs for various levels of management, decision makers, management information system, resource monitoring and control. Product mix. Case studies.

### **TTL763:**

#### **Technical Textiles:**

---

##### **3 credits (2-1-0)**

Definition, classification, products, market overview and growth projections of technical textiles. Fibres, yarns and fabric structures in technical textiles and their relevant properties. Filtration: Textile and other filter media for dry and wet filtration. Mechanisms of separation. Requirements for good filter media and filtration. Fibre and fabric selection for filtration. Geotextiles: Types and application of geosynthetics. Functions and application areas of geotextiles. Fibres and fabric selection criteria for geotextile applications. Mechanics of reinforcement, filtration and

drainage by geotextiles. Soil characteristics. Methods of long term prediction of geotextile life and survivability in soil. Automotive Textiles: Application of textiles in automobiles. Requirement and design for pneumatic tyres, airbags and belts. Methods of production and properties of textiles used in these applications. Sewing threads, cords and ropes: Types, method of production and applications. Functional requirements, structure and properties. Miscellaneous: Functional requirements and types of textiles used for paper making, agricultural, architectural, packaging and footwear.

#### **TTL764:**

#### **Process Control in Spinning & Weaving:**

---

#### **3 credits (3-0-0)**

Optimum fibre-mix for various end use requirements. Yarn realization. Waste control in blowroom and card for all types of fibres spun on cotton system. Minimising lea count variation. Controlling yarn irregularity, imperfections and faults. Yarn tenacity and elongation. Hairiness. Machinery audit. Indices of productivity. Production of high quality export yarns. Trouble Shooting, some case studies. Role of ambient temperature and humidity. Life of accessories. Workload. Principles for control of productivity in different sections, Contribution of control in yarn, winding, warping, sizing & weaving to the cost of production in fabric manufacture. Splicing, machine allocation and load distribution, Control of migration in sizing, size droppings, sizing materials. Loom allocation. Control of value loss in fabrics through evaluation & grading of fabric defects. Temperature and humidity control & its effect on performance. Control of loom accessories. Control of loss of efficiency by snap study. Controls in the process of high twist yarns, blended yarns, filament yarns in warp and weft. Controls in the winding for processing yarns for dyeing & knitting. Controlling sloughing off during winding, warping & weaving. On-line data system and its use in controls.

#### **TTL765:**

#### **Product Development:**

---

#### **3 credits (2-1-0)**

Overview of developments. Scope of product development in textiles and clothing. Designing for functions aesthetics. Designing for apparel, clothing and industrial applications. Product improvement and product innovations in textiles. Demand estimation and product development objectives. Interaction between properties of fibre, yarn, fabric and garments properties. The product development process - requirements, key characteristics, recourses, conceptual design, technology selection, material selection, sampling, design and evaluation. Design logic, specifications, costing, manufacturing strategies and evaluation of new products. Standards, testing and specifications for new products. Case studies from the point of view of developing textile products for selected end use applications.

#### **TTL771:**

#### **Electronics and Controls for Textile Industry:**

---

#### **4 credits (3-0-2)**

Overview of electronics and controls in modern textiles equipment 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). Signal Conditioning. 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.

**Laboratory:** Experiments on sensors and transducers (displacement, position, strain, temperature, rotational speed). Basic analog circuits with diodes and transistors. Basic digital Gates. SCR and TRIAC control of motor speed. Data acquisition and control with microprocessors/ microcontrollers.

**TTL772:**  
**Computer Programming and its Applications:**

---

**3 credits (2-0-2)**

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++.

**TTL773:**  
**Design of Experiments and Analytical Techniques:**

---

**3 credits (3-0-0)**

Sampling techniques, sample size, Principles of experimental design. Selecting a statistical design. Running experiments in Blocks, Latin squares. Factorial Designs & Analysis. Fractional factorial experiments. Use of replicates. Techniques of optimisation. Response surface designs. Statistical principles in data analysis. Fitting data. Linear regression with one, and several variables. Polynomial models. ANOVA. Use of Computers. Software packages. Rank correlation, Coefficient of concordance. Sampling inspection.

**Acceptance sampling:** OC curve, Acceptance sampling by variables, Producer risk condition. Control Chart: Average run length, Modified control limits for averages, Cusum chart.

**TTL 866:**  
**Functional and High Performance Textiles:**

---

**3 credits (2-1-0)**

**Protective clothing:** Clothing requirements for thermal protection, ballistic protection, UV-protection, protection from electro-magnetic radiation and static hazards, protection against micro-organisms, chemicals and pesticides. Design principles and evaluation of protective clothing.

**Medical Textiles:** Textiles in various medical applications. Application oriented designing of typical medical textiles. Materials used and design procedures for protecting wounds, cardiovascular application, sutures etc.

**Sportswear:** Clothing requirements for different sports. Development of highly functional fibres, yarns and fabrics for temperature control and moisture management. Stretch, bulky and light weight fabrics.

**Composites:** Two and three dimensional fabrics and triaxially braided materials for composites. Production and properties of performs and composites. Properties and uses of rigid composites. Stimuli sensitive intelligent textiles - their production, properties and applications. Smart textile incorporating functional devices.

**Miscellaneous:** Glass, ceramic and metallic fibres and their textile products.

**TTS 890:**  
**Independent Study (Fibre Science & Technology):**

---

**3 credits (0-3-0)**

Student should undertake a research oriented activity including software development, machine design and development, instrumentation, product and process development or indepth study of a subject of outside the regular courses offered in the programme. 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 persued by the student. The student must submit a detailed plan of work for the programme coordinator before approval of registration for the course.

**TTS 891:**  
**Independent Study (Textile Engineering):**

---

**3 credits (0-3-0)**

Student should undertake a research oriented activity including software development, machine design and development, instrumentation, product and process development or in depth study of a subject of outside the regular courses offered in the programme. 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 must submit a detailed plan of work for the programme coordinator before approval of registration for the courses.

**TTD891:**  
**Major Project Part-I (Fibre Science & Technology):**

---

**6 credits (0-0-12)**

**TTD892:**  
**Major Project Part-II (Fibre Science & Technology):**

---

**12 credits (0-0-24)**

**TTD893:**  
**Major Project Part-I (Textile Engineering):**

---

**6 credits (0-0-12)**

**TTD894:**  
**Major Project Part-II (Textile Engineering):**

---

**12 credits (0-0-24)**