The Fragile Yarn—Skilful Achievements

Florance, by manufacturing her own cloth, became a reputed industrial town in the Fifteenth Century. Growth of Florance helped development of banking and academics. Invention of the steam engine and the spinning machine by Arkwright helped establishment of the first textile mill in 1771. Subsequently, Kay’s flying shuttle and Hargreave's Spinning Jenny enabled yarn to be produced to keep pace with demand. Crompton imparted fineness to the yarn and Cartwright and Harrock improved spinning. Coal production also had to be increased to feed the boilers of steam engines for the cotton mills. Benjamin Gott established a factory in 1792 to apply cotton textile techniques to the woollen industry.

Work on the development of manmade fibre by Edison, Swan, Hyatt, Stearn, Topham, Cross and Bevan resulted in the production of ‘viscose’ in 1892 by Courtaulds. Topham invented spinning of such viscose fibres.

Indian Textile—Pride of Centuries

Even in ancient times, Indian textiles were famous the world over for colour and quality. The origin of the mechanised cotton textile industry, in India, dates back to 1818 when the first cotton mill was established at Fort Gloster, near Kolkata. The Swadeshi Movement enabled the industry to make rapid strides. Similarly, the jute industry, a major foreign exchange earner, was born when the first power-driven jute mill was established at Rishra near Kolkata in 1859.

The textile industry occupies a position of pride amongst organised industries. Mumbai, Ahmedabad, Sholapur, Kanpur, Nagpur, Indore, Madurai, Coimbatore, etc. are the main centres. In the small scale sector too, millions of people living in rural areas are engaged in the production of textiles. India earns a reasonable foreign exchange from export of textile goods. A number of government departments, research organisations, educational institutions and co-operatives are actively involved to further the industry. When Slater’s version of the Arkwright machinery was set up in Ezekiel Carpenter’s mill, a maddening problem developed. One of the two carding machines began rolling up fibers into a massive tangle instead of delivering them in a roll for the drawing and roving machines. Slater uttering deep sighs was frequently shedding tears. Those present asked, ‘Art thou sick, Samuel?’ He explained his problem, adding, ‘If I am frustrated in my carding machine, they will think me an imposter’. The trouble was that Pliny Earle’s experience was with hand cards, and he did not fully realize that a different technique was necessary for the machine!

Textile engineering is concerned with the processing of natural fibres (cotton, silk, wool, jute, coir, flax, sisal, manila, hemp, etc.); synthetic and/or man-made fibres (nylon, terylene, orlon, vinyon, velon, rayon, acrylic, etc.) and other fibres (made from glass, etc. but not metallic) in appropriately designed machines relevant to the type of fibre (to be processed) to produce yarns (ply, core and covered), fabrics for general and lustrous clothings, furnishing and decorative fabrics, packaging and industrial fabrics, special textile (for use in hospital, parachute, filtration, etc.), knitted and non-woven fabrics, ropes, geotextile, etc. The design of textile machinery, dyeing of yarn, printing of cloths, production of garments—all these facets come under the purview of textile engineering to certain extent.
TEXTILE ENGINEERING

Compulsory Subjects
I C 402 Engineering Management
TX 403 Textile Fibres and Testing
TX 404 Yarn Manufacture
TX 405 Fabric Manufacture and Design
TX 406 Chemical Processing and Finishing
TX 407 Design and Mechanisms of Textile Machines

Optional Subjects
(Any three from any one group)

Group I Mechanical Processing (Spinning)
TX 411 Advanced Yarn Manufacture
TX 412 Modern Yarn Production and Control Systems
TX 413 Engineering Design of Textile Structures
TX 414 Textile Machinery and Maintenance
TX 415 Mill Organisation, Process Economics & Quality Control

Group II Mechanical Processing (Weaving and Knitting)
TX 421 Advanced Fabric Manufacture and Design
TX 422 Non-woven, Knitting and Industrial Fabrics
TX 423 Engineering Design of Textile Structures
TX 424 Textile Machinery and Maintenance
TX 425 Mill Organisation, Process Economics and Quality Control

Group III Chemical Processing
TX 431 Advanced Chemical Processing & Finishing
TX 432 Garment Technology
TX 433 Chemistry and Technology of Man-made Fibres
TX 434 Energy Conservation, Environmental and Pollution Control
TX 435 Mill Organisation, Process Economics and Quality Control

Project Work
and
Laboratory Experiments
[10 (ten) experiments are to be undertaken from the prescribed list]
TEXTILE ENGINEERING

IC 402
ENGINEERING MANAGEMENT

TX 403
TEXTILE FIBRES AND TESTING

Group A
Classification of textile fibres according to their nature and origin. Geographical distribution, growth.
Cultivation, grading, physical and chemical structures.
Properties and uses of natural fibres such as cotton, flax, jute, silk and wool.
Brief outline of the process involved in the conversion of these fibres into yarn.
Brief outline of manufacturing processes of important man-made fibres (rayons, polyamides, polyessters and acrylics).
Chemical nature of man-made fibres.
Methods of producing fibres by wet, dry and meltspinning processes.
Properties and uses of important man-made fibres.

Group B
Sampling techniques for testing of fibres, yarns and fabrics.
Measurement of fibre length and fineness.
Principle and operation of various equipment for measuring moisture regain in textile materials.
Measurement of twist and linear density of yarn.
Evenness testing of slivers, rovings and yarns.
Principles of operation of CRL, CRT and CRE tensile testing machines for fibres, yarns and fabrics.
Methods of testing fabric thickness, weight, shrinkage, stiffness, drape, tear resistance, abrasion resistance, bursting strength, air permeability and crease recovery.

Recommended Books

Group A
Mixing, opening and cleaning: Bin mixing and mixing by automatic blenders, construction and working of machines of single process blow-room line.
Different types of conventional feeders, openers and cleaners.
Use of air currents for cleaning and transportation, blow—room sequences for different natural and man-made fibres.
Drawing: Objects of doubling and drafting. Construction and working of conventional draw frame. Roller weighting and setting. Stop motions, sliver irregularity, drafting wave, roller slip, etc.
Combing: Objects, construction and working of conventional sliver lap and ribbon lap machines and Nasmith comber, settings and maintenance of comber.

Group B
Speed frames: Objects, construction and working of conventional flyframes, twisting, winding and building mechanisms. Speed and settings to suit different fibres. Stop motions.
Spinning: Construction and working of conventional ring frame. Ring and traveller assembly. Spindles, building motions, etc. Specification of ring frame to suit different counts. Brief description of mule, cap and pot spinning frames.
Reeling, bundling and balling: Different forms to which yarns are converted for marketing. Brief study of machines used.
Doubling: Preparation of yarn for doubling. Manufacture of various types of folded and cabled yarns. Yarn finishing. Sewing thread and various fancy yarns.
Yarn preparation and methods of yarn conditioning. Calculations pertaining to the machines and products dealt within the process.

Recommended Books
- Manual of Cotton Spinning. Textile Institute, Manchester, UK.
**Group A**


Beam and sectional warping processes and mechanisms. High speed warping, planning of patterned warps.

Print winding. High speed print winding machines—schweiter, hacoba, scharer, auto-copser, etc. Bunch building mechanisms.

Study of all types of sizing machines. Sizing ingredients, size recipes for different materials. Control of size pick-up. Slasher speed and drying efficiency. Sizing waste and stretch control.

Methods of drawing in, twisting and knotting.

**Group B**


Mechanisms of different types of negative and positive dobby motions including cross-border, paper and cam types. Multiple box motions. Pick-at will motions.

Calculations pertaining to the above machines and products dealt within the process.

Fabric classification and weave notation. Plain weave, its variations and ornamentation. Ordinary and steep twills. Twill derivatives—pointed, broken, combination, diamond.


Constructional particulars of various types of fabrics produced, employing the weaves studied. Computer-aided design and manufacture of textile structures.

ISI standards for important mill-made and handloom fabrics using different materials.

**Recommended Books**

- M K Talukdar. An Introduction to Winding & Warping.
- Mark and Robinson. Principles of Weaving. Textile Institute, Manchester, UK.
- A Armored. Weaving Technology and Operation. Textile Institute, Manchester, UK.

**CHEMICAL PROCESSING AND FINISHING**

**Group A**

Principles of fabric preparation. Introduction to various wet-processing treatments such as de-sizing, scouring, bleaching and after-treatment processes.

Surface agents—its mechanism and application, etc.

Procedure for application of various dyes as natural and man-made fibres and after-treatment dyes. Methods and styles of printing and printing procedure of different fibres; fabrics with various classes of dyes and after-treatment processes.

**Group B**


Setting of synthetic fabrics by dry heat and steam and their effect on physical and chemical properties.

Introduction to finishing machines such as scutchers, mangles, drying ranges, hot air dryers, stenters, calenders, raising, craping, plating and pressing machines.

**Recommended Books**

**GROUP A**

**Effectiveness of different openers and cleaners in blowroom line.** Study of the principles in designing modern openers and blenders.


**Group B**

Study of the principle, design and operation of modern winding, warping and sizing machines. Theory and design principles of latest automatic controls in sizing.


Principles underlying non-conventional weaving machinery designs. Kinematics of weft propulsion in nonconventional weaving machinery.

Design features of dust control units used in textile mills.

**Recommended Books**


**GROUP B**

**Man-made staple-fibre spinning.** Modification of spinning machinery for processing man-made fibres and their blends with cotton and other natural fibres.

Effect of fibre characteristics and processing parameters on yarn properties. Yarn hairiness.

Study of blended yarns and their properties. Structure and properties of staple spun yarns.


A brief study of non-conventional spinning methods.

**Recommended Books**


**GROUP A**

**Tow conversion processes.**

Introduction to the texturing of man-made fibre yarns. Study of twist-set-untwist, false twisting edge, crimping, stuffer-box crimping and air bulking processes of producing textured yarns.

Properties and application of textured yarns.

Causes leading to advent of open-end spinning. Study of drum, air-vortex and electrostatic spinning techniques for the formation of break-spun yarns. Quality of break-spun yarns.

Studies of yarn formation by air jet and friction spinning.
Yarn characteristics. Effect of different parameters on processing and yarn properties.

Methods of production of self-twist and twistless yarns, their properties and applications.

Production of industrial yarns such as core-spun, tyre-cord, monofilament and tape yarns.

Modern processes for texturising/bulk/intermingling. Modern process for tow to top conversion. Modern machines and processes for staple fibre yarn manufacture.

Group B

Transport of material in the blow-room. The need for transport, mechanical transport, pneumatic transport; control of material flow in B R—classification, optical regulation systems in stop–80 operation, continuous operation; Accessories and associated equipment—metal extractors, fire eliminators, waste disposal; Recycling—economy of raw material, quality of waste material, the recycling installation, on-line and off-line systems.


Monitoring and auto-leveling in drawframe. Classification of monitoring systems, monitoring devices with self-compensation and auto-leveling; classification of auto-leveling systems, evener drawframe with open loop, closed loop and combined control; correction length, evening operation.


Automation and ancillary equipment in frame. Need for automation, possibilities for automation, end break as perators, piecing devices, roving stop motions, travelling clearer; monitoring—purpose, computer-based data collection system; automatic cop treatment.

Recommended Books

- K R Salhotra, Spinning of Man-made and Blends on Cotton System. Textile Association, Mumbai.

Yarn diameter, methods of measurement.

Packing of fibres in yarn—ideal packing. Hexagonal close packing and other forms. Packing factor and its measurement.

Twist contraction, limit of twist.

Variation of fibre extension and analysis of tensile forces for low extension of continuous filaments.

Fibre migration—mechanism of migration, condition for migration to occur; frequency of migration, migration in blended yarns.

A qualitative view of spun yarn mechanics—traditional and modified qualitative approach.

Group B

Elements of fabric geometry: Cloth setting theories. Pierce’s equations and later modifications—relation of fabric properties to simple geometry, crimp interchange in woven fabrics, cover factor, weight factor, etc.

Classification of fabrics and streamlining the construction of fabrics based upon engineering design to achieve desired end-use requirements.

Application of engineering principles to product development.

Knit fabric geometry: Weft and warp knit fabrics.

Recommended Books

- F T Pierce. Cloth Geometry. Textile Institute, Manchester, UK.

Group A

Basic kinematics: Links, pairs, higher and lower pair, chains. Mechanisms and inversions of mechanisms. Velocity and acceleration diagrams of linkages of fourbar and slider-crank mechanisms; relative velocity method and instantaneous centre method.

Friction: Cone and collar friction—friction in single and multiple clutches—friction in cone clutch, power absorbed and transmitted in clutches of above types.


Cams. Types of cams and followers. Cam profiles for constant velocity, simple harmonic motion and constant
acceleration of followers. Study of tangent and convex constant.

Determination of speed ratios in simple, compound and epicyclic gear trains.

Designs of cone drums for scutchers and speed frames. Roller weighing at different stages of spinning. Inertia of a carding engine. Differential motions used in speed frames. The theory of spinning balloons. Yarn tension in ring spinning, power requirements at various stages of spinning.

Preventive and on line maintenance.

**Group B**

Mechanics of winding and tension variations in winding.

Mechanics of various mechanisms of weaving machines.

Simple harmonic motion. Balancing of revolving masses.

Designing of shedding and picking tappets.

Velocity of shuttle during acceleration and retardation.

Picking force and the study of sley eccentricity.

Warp tension and its measurement.

Power requirement for different weaving motions.

Plant maintenance. Introduction, objects of plant maintenance, importance of plant maintenance, duties, functions and responsibilities of maintenance department, organisation of maintenance department, types of maintenance, breakdown maintenance, scheduled maintenance, preventive maintenance, predictive maintenance, maintenance schedule, maintenance of plant machinery.

**Recommended Books**


**Group A**

Concept of control in production, measurement organisation, product development and design.

Classification and standardization of products and materials.

Production planning and control, plant layout. Work study, work measurement, wages and labour incentives. Costing and cost analysis. Economics of textile processes. Plant services.

Production planning and machinery balancing. To acquaint with production rates, waste and efficiency levels of good and progressive textile mills. To determine the number of machines required to produce desired quantities of end products (yarns and fabrics) taking into consideration the production rate of machines in different departments, efficiency, losses and waste levels and important processing parameters like hank, draft twist multiplier, counts, settings, etc. used at different stages of manufacturing.

Staffing of departments. Labour allocation in different departments of a textile mill. Workload standards for card tenters, speed frames and ring tenters, winders, doffers, weavers, etc., in terms of tripartite agreements and labour laws.

**Group B**


Process-wise costing including case studies.

Economics of open-end spinning.

Economics of superspeed automatic warp and weft winding machines. Economics of various labour saving mechanisms mounted on automatic looms like ‘box loader’ and ‘unfil’ systems. Economics of various labour saving mechanisms mounted on automatic looms like ‘box loader’ and ‘unfil’ systems. Economics of shuttleless looms like sulzer, air-jet, water-jet, rapier looms, etc. Comparative economics of knitted and woven structures.

Process economics of wet processing.

Quality control: General notions, basic concepts of industrial quality control, connection with the theory of statistical tests.

Methods of rapid calculation, arithmetical mean, standard deviation.

Control charts, general notions. Practical construction of control charts, efficiency of a control chart, application to control of various characteristics.

Acceptance inspection plans, general notions, the operating characteristic curve, acceptance inspection by variables, acceptance inspection by attributes, double and multiple inspection plans, sequential plans.

**Recommended Books**

- Mario Bona. Statistical Methods for the Textile Industry. TEXILIA.
Group A


Conventional automatic looms and modern automatic looms, study of special motions and attachments—their timings and settings for proper functioning. Bobbin loader and unifil loom winder attachments.

Mechanical principles of the sulzer weaving machine. Picking, beating-up, selvedge formation and shuttleless weaving with more than one weft.

Air-jet weft insertion with special reference to the Maxbo loom—essential requirements, shedding, weftmeasuring, weft-tensioning, beating-up, weft gripping, weft cutting, weft-stop motion, and selvedge formation.

Weft insertion by water-jet, general description of the water-jet looms, weft supply system, tension device, measuring device, operation of the weft-supply system, considerations in the system. Fundamental problems of hydraulic weft insertion.

The rapier system of weft insertion, weft control mechanism, special features of weft control system, general timing system, beating-up, cloth take-up motion.

Circular looms and their mechanisms, functions and utility.

Group B

Diamond mock-leno, ordinary honeycomb, brighton honeycomb, buckaaba, derivatives of mat, hopscak and crepe weaves; reversing weaves and designs giving stripes and checks.


Construction of draft, peg and denting plan of the above designs.

Recommended Books

- Ormerod. Weaving Technology and Operation. Textile Institute, Manchester, UK.

Group A


Principles of needle-bonded fabrics, their manufacture and properties. Spun-bonded and split-film fabrics.

Group B

Introduction to the manufacture and properties of industrial and knitted fabrics. Geometry of knitted structures.

Knitting. Warp and weft knitting, single jersey, double knit, interlock rib, raschel and tricot, structures and machines for knitting.

Industrial fabrics, coated fabrics, technical textiles.

Recommended Books

Classification of surface active agents, its properties and various applications in wet processing, chemistry, mechanics and theories of wetting agent, detergents, levelling and dispersing agents. Evaluation of detergency. Advances in surface active agents.

Advanced technology of bleaching.


Chemistry, technology and mechanism of dyeing natural and man-made fibres and their blends.

Physical chemistry of dyeing.

Discontinuous, semi-continuous and continuous methods of application of dyes on natural fibres and study of the dyeing machinery involved.

Faults in dyeing and their remedies. Computer colour matching, etc. Evaluation of various fastness of dyed textiles. Identification of dyes.

Group B

Advances in thickeners and assistances used in textile printing and their functions.

Printing procedures of different textiles and fabrics (including blends) with various classes of dyes pigment. Machines used for printing, drying, aging, steaming, etc.

Faults in printing and their remedies.

Transfer and foam printing. Screen preparation.

Computer-aided print design.

Chemistry and technology of finishing cotton, wool, silk, rayon and synthetic fabrics. Finishing chemical and auxiliaries— their functions and applications.

Permanent and semi-permanent finishes of different textiles, e.g., wash-n-wear, crease-resistant, anti-shrink, antistatic, water repellent finishes, mildew proofing, fireproofing, trubening, calendering, crabbing, milling, felting and stentering.

Setting of synthetic fibres. Evaluation of finished fabrics.

Damages/defects caused in finishing and their remedies.

Chemical processing, planning, including effluent treatments, water recycling, energy conservation, cost control.

Recommended Books

principles of basic drafts, etc. Introduction to fullness in pattern making and its importance, etc. Different types of seams for different samples, etc. Drafting bodies at different age levels, etc., draping.

**Group B**

Introduction of various machines and equipment used in garment manufacturing and different types of cutting machines, etc.

Different types of sewing machines.

Detailed knowledge of different types of stitches. Tables used for cutting and stitching, etc. Dyeing and printing of garments and finishing of garments and washing, etc. Garment defects and their control.

**Recommended Books**


**CHEMISTRY AND TECHNOLOGY OF MAN-MADE FIBRES**

**Group A**


Chemical and physical characteristics of fibres. Chemical composition of more common man-made fibres.

**Group B**

Introduction to manufacturing processes for man-made fibres. A study of various systems of spinning, wetspinning, dry spinning and melt-spinning, production technology of important man-made fibres, viz., viscose rayons, cuprammonium rayons, acrylonitriles, polyolefins.

**Recommended Books**