TF Textile Engineering and Fibre Science

ENGINEERING MATHEMATICS

Linear Algebra: Matrices and Determinants, Systems of linear equations, Eigen values and eigen vectors.

Calculus: Limit, continuity and differentiability; Partial Derivatives; Maxima and minima; Sequences and series; Test for convergence; Fourier series.

Vector Calculus: Gradient; Divergence and Curl; Line; surface and volume integrals; Stokes, Gauss and Green's theorems.

Differential Equations: Linear and non-linear first order ODEs; Higher order linear ODEs with constant coefficients; Cauchy's and Euler's equations; Laplace transforms; PDEs –Laplace, heat and wave equations.

Probability and Statistics: Mean, median, mode and standard deviation; Random variables; Poisson, normal and binomial distributions; Correlation and regression analysis.

Numerical Methods: Solutions of linear and non-linear algebraic equations; integration of trapezoidal and Simpson's rule; single and multi-step methods for differential equations.

TEXTILE ENGINEERING AND FIBRE SCIENCE

Section 1: Textile Fibers

Classification of textile fibers; Essential requirements of fiber forming polymers; Gross and fine structure of natural fibers like cotton, wool, silk, Introduction to important bast fibres; properties and uses of natural and man- made fibres including carbon, aramid and ultra high molecular weight polyethylene (UHMWPE) fibers; physical and chemical methods of fiber and blend identification and blend analysis.

Molecular architecture, amorphous and crystalline phases, glass transition, plasticization, crystallization, melting, factors affecting Tg and Tm; Production process of viscose and other regenerated cellulosic fibres such as polynosic, lyocell. Polymerization of nylon-6, nylon-66, poly (ethylene terephthalate), polyacrylonitrile and polypropylene; Melt Spinning processes for PET, polyamide and polypropylene; Wet and dry spinning processes for viscose and acrylic fibres; post spinning operations such as drawing, heat setting, tow- to-top conversion and different texturing methods.

Methods of investigating fibre structure e.g., Density, X-ray diffraction, birefringence, optical and electron microscopy, I.R. spectroscopy, thermal methods (DSC, DMA/TMA, TGA); structure and morphology of man-made fibres, mechanical properties of fibres, moisture sorption in fibres; fibre structure and property correlation.

Section 2: Yarn manufacture, Yarn structure and Properties

Principles of opening, cleaning and mixing/blending of fibrous materials, working principle of modern opening and cleaning equipment; the technology of carding, carding of cotton and synthetic fibres; Drafting operation, roller and apron drafting principle, causes of mass irregularity introduced by drafting; roller arrangements in drafting systems; principles of cotton combing, combing cycle, mechanism and function, combing efficiency, lap preparation; recent developments in comber; Roving production, mechanism of bobbin building, roving twist; Principle of ring spinning, forces acting on yarn and traveler, ring
& traveler designs, mechanism of cop formation, causes of end breakages; Working principle of ring doubler and two for one twister, single and folded yarn twist, properties of double yarns, production of core spun yarn; Principles of compact, rotor, air jet, air vortex, core, wrap, twist less and friction spinning.

Yarn contraction, yarn diameter, specific volume & packing coefficient; Twist factor, twist strength relationship in spun yarns; Fibre configuration and orientation in yarn; Cause of fibre migration and its estimation; Irregularity index; Structure property relationship of compact ring, rotor, air-jet and friction spun yarns.

Section 3: Fabric manufacture, Structure and Properties

Principles of winding processes and machines, random, precision and step precision winding, package faults and their remedies; Yarn clearers and tensioners; Different systems of yarn splicing; Features of modern cone winding machines; Different types of warping creels; features of modern beam and sectional warping machines; Different sizing systems, sizing of spun and filament yarns, sizing machines; Principles of pirn winding processes and machines.

Primary and secondary motions of loom, cam design & kinematics of sley, effect of their settings and timings on fabric formation, fabric appearance and weaving performance; Dobby and jacquard shedding; Mechanics of weft insertion with shuttle, warp and weft stop motions, warp protection, weft replenishment; Principles of weft insertion systems of shuttle-less weaving machines; Principles of multiphase and circular looms.

Principles of weft and warp knitting, basic weft and warp knitted structures;
Classification, production, properties and application of nonwoven fabrics, principle of web formation & bonding.

Basic woven fabric constructions and their derivatives; crepe, cord, terry, gauze, leno and double cloth constructions. Peirce's equations for fabric geometry; elastica model of plain woven fabrics; thickness, cover and maximum set of woven fabrics.

Section 4: Textile Testing

Sampling techniques, sample size and sampling errors; Measurement of fibre length, fineness, crimp; measurement of cotton fiber maturity and trash content; High volume fibre testing; Measurement of yarn count, twist and hairiness; Tensile testing of fibers, yarns and fabrics; Evenness testing of slivers, rovings and yarns; Classimat fault analysis; Testing equipment for measurement of fabric properties like thickness, compressibility, air permeability, wetting & wicking, drape, crease recovery, tear strength, bursting strength and abrasion resistance; Instruments and systems for objective evaluation of fabric hand. Statistical analysis of experimental results, frequency distributions, correlation, significance tests, analysis of variance and control charts.

Section 5: Chemical processing

Impurities in natural fibre; Chemistry and practice of preparatory processes for cotton, wool and silk; Mercerization of cotton; Preparatory processes for manmade fibres and their blends.

Classification of dyes; Dyeing of cotton, wool, silk, polyester, nylon and acrylic with appropriate dye classes; Dyeing of polyester/cotton and polyester/wool blends; Dyeing machines; Dyeing of cotton knitted fabrics and machines used; Dye fibre interaction; Introduction to thermodynamics and kinetics of dyeing; Methods for determination of wash, light and rubbing fastness.

Styles of printing; Printing thickeners including synthetic thickeners; Printing auxiliaries; Printing of cotton with reactive dyes, wool, silk, nylon with acid and metal complex dyes, Printing of polyester with disperse dyes; Pigment printing; Resist and discharge printing of cotton, silk and polyester; Transfer printing of polyester; Inkjet printing.

Mechanical finishing of cotton. Stiff, soft, wrinkle resistant, water repellent, flame retardant and enzyme (bio-polishing) finishing of cotton; Milling, decatizing and shrink resistant finishing of wool; Antistatic and soil release finishing; Heat setting of synthetic fabrics; Minimum application techniques; Pollution control and treatment of effluents.