
Syllabus for Textile Manufacture & Technology (60)

Unit 1. Basic concepts

Introduction to Textile Manufacture Sciences. Basics of polymer science, fibre manufacturing processes, physical, mechanical and chemical properties; Molecular weight and its distribution; Molecular architecture, amorphous and crystalline phases, glass transition (T_g), plasticization, crystallization, melting (T_m), factors affecting T_g and T_m ; Orientation and birefringence; visco-elastic property of fibres.

Unit 2. Textile fibres

Introduction to textile fibres and its classification; Extraction of natural (plant/animal/insect source) fibre; Principle and working of ginning; Ecofriendly Textile Fibres; Structure and morphology of natural fibres like cotton, wool, silk, jute, flax, etc.; Polymerization of nylon-6, nylon-66, poly (ethylene terephthalate), poly-acrylonitrile and polypropylene; Principle of melt spinning, wet spinning, dry spinning, dry-jet-wet spinning and gel spinning; Post spinning operations such as drawing, heat setting, spin finish and its applications; Texturing methods. Structure-property relations of fibres; Use of natural and man-made fibres; Production and consumption of natural and synthetic fibres. Grading and marketing of natural fibres.

High Performance Fibres: Glass, Carbon, Aramid – properties and applications. optical fibres, bicomponent fibres and hybrid fibres, Superabsorbent polymers and fibres.

Unit 3. Yarn manufacture, structure and properties

Concepts and working principles of opening, cleaning and blending; blow-room machines, carding, combing, roller drawing for cotton spinning; Spinning of natural fibres (cotton, jute, wool, silk) and its blends, Blending of man-made fibres with natural/synthetic fibres and their spinning; Woollen spinning and semi-worsted systems: gill box / drawing; Periodic mass variation in sliver and auto-leveler; Principles of drafting, twisting, and bobbin/cop building on roving and ring frame; Modern developments in ring spinning; Principle of ring doubler and two-for-one twister; Relationship between single yarn twist and folded yarn twist; Principles of compact, rotor, air-jet, air-vortex, friction, wrap and twist-less spinning processes and their structure-property relationship; Sustainable practices in Yarn manufacturing.

Influence of fibre configuration and orientation on yarn properties; Fibre packing density of yarn; Yarn twist and its relation to yarn properties. Stress-strain relation, Mass irregularity and fibre migration in yarns.

Specialty yarns: Design, manufacture, characterization and application of Hybrid yarns, High bulk yarns, Electro-conductive yarns, Technical sewing threads, Coated yarns, Reflective yarns and Elastomeric yarns.

Unit 4. Fabric manufacture, Structure and Properties

Principles and classification of winding processes (pirn, cone, spool), Patterning mechanism, Yarn cleaners, tensioners and yarn splicing; Principles and classification of warping and including sectional warping; Sizing of natural, synthetic and blended yarns.

Primary and secondary motions of loom; Shedding motion; Positive and negative shedding mechanisms; Type of sheds; Tappet, dobby and jacquard shedding; Shuttle picking mechanisms and checking, Beat-up: Kinematics of sley; Loom timing diagram; Tappet design; Take-up and Let-off motions; Warp and weft stop motions; Warp protector motion; Principles of weft insertion systems in shuttle-less weaving machines (projectile, rapier, water-jet and air-jet); Principles of multiphase and circular looms; Types of selvedge.

Basic woven fabric constructions and their derivatives; Crepe, cord, terry, gauze, leno, double cloth, damask, brocade constructions; Drawing and lifting plans. Woven fabric structure (Peirce's equations for plain fabric, Elastic model of plain-fabric, Thickness, cover and maximum set); Geometry of plain knitted fabric loop. Fundamentals and classification of weft (plain, rib, interlock and purl) and warp (pillar, tricot, atlas, inlay and nets) knitting; Different knit stitches such as loop, tuck and float; Swinging and shogging motion of guide bar in knitting. Nonwoven preparation and applications; Web formation and types of bonding processes (mechanical, spun, adhesive); melt-blowing technologies. Principles of braiding; Type of braids; Maypole braiding technology.

Geometrical model of woven and knitted fabrics, Mechanics of woven fabric : Tensile, bending, shear, compression properties

Specialty fabrics: 3D fabric, spacer fabric, profile fabric, multi-axial fabric, auxetic fabric/textile, leno structure, Multi-functional fabrics.

Unit 5. Textile testing

Standard conditions for textile testing; Physical and chemical methods of fibre identification and blend estimation; Methods of investigating fibre structure such as density, x-ray diffraction, birefringence, optical and electron microscopy such as SEM, I.R. spectroscopy, thermal methods such as DSC, DMA, TMA and TGA; Mechanical properties of fibres; Fibre testing instruments, equipment & standards; Calibration; Fibre structure-property correlation.

Sampling techniques for fibres, yarns and fabrics; Sample size and sampling errors. Moisture in textiles; Fibre length, fineness, crimp, maturity, uniformity ratio and trash content; Tensile testing of fibres; High volume fibre testing.

Linear density (direct and indirect systems) of sliver, roving and yarn; Twist and hairiness of yarn; Tensile testing of yarns; Evenness testing; Fault measurement and analysis of yarns; Fabric thickness, compressibility, stiffness, shear, drape, crease recovery, tear strength, bursting strength, pilling and abrasion resistance; Tensile testing of fabrics; Objective evaluation of low

stress mechanical characteristics (KES and FAST); Fabric hand and comfort; Air permeability; Wetting and wicking; Water-vapour transmission through fabrics; Thermal resistance of fabrics.

Unit 6. Textile chemical processing

Impurities in natural fibre and fabric; Organic textile and non-chemical treatment; Singeing; Chemistry and practice of preparatory processes (desizing, scouring, degumming, bleaching) for cotton, wool, silk, jute, flax and their blends with manmade fibres; Mercerization of cotton and woollenization of jute; Optical brightening agent.

Introduction to dyes and pigments; Concept of banned dyes; Classification of dyes; Dyeing of cotton, wool, silk, jute, flax, ramie, polyester, nylon, viscose, and acrylic with appropriate classes of dyes, such as direct, reactive, vat, natural, acid, basic, metal complex, etc.; Machinery used in desizing, scouring, bleaching, dyeing, mercerization, heat setting and drying.

Dyeing of blended textiles like polyester/cotton, polyester/wool, cotton/wool blends; Dyeing processes and machines for knitted fabrics; Dye-fibre interaction; Thermodynamics and kinetics of dyeing; Beer-Lambert's law; Kubelka-Munk theory and its application in colour measurement system; Methods for determination of wash, light, rubbing fastness.

Methods of printing such as roller printing and screen printing; Preparation of printing paste; Various types of thickeners; Printing auxiliaries; Direct styles of printing of (i) cotton with reactive dyes, (ii) wool, silk, nylon with acid and metal complex dyes, (iii) polyester with disperse dyes; Resist and discharge printing of cotton, silk and polyester; Pigment printing; Transfer printing of polyester; Inkjet printing; Digital printing; Printing faults.

Mechanical and chemical finishing of textiles; Stiff, soft, wrinkle resistant, water repellent, flame retardant, bio-polishing of cotton; Milling, rot resistance/moth proof/anti-microbial; soil burial test for textile bio-degradability; Decatizing and shrink resistant finishing of wool; Antistatic and soil release finishing; Formaldehyde-free finishes; Heat setting of synthetic fabrics; Green processing techniques. Pollution control and treatment of textile effluents; Recycling of textile materials and fabrics and By-product utilization.

Advanced textile wet processing and best available techniques (BAT):

Basics and consequences of conventional textile wet processing. Modern aspects for textile pretreatments: Biotechnology applications in textiles: its merits and demerits. Modern processing machines, their working principle and control techniques. Technology of advanced finishing: Nanotechnology in textile processing applications. Use of plasma technology in textile wet processing technology, Multi functional finishing

Unit 7. Garment manufacturing

Different methods and principles of developing basic patterns viz. Drafting, flat pattern method and draping. Traditional textiles and costumes of India and their influence on contemporary trends in fashion. Structural and applied designs in apparels. Figure irregularities and special

problems with reference to apparel designing. Sewing techniques and their applications in manufacturing of apparels/garments. Apparel standards, specification. Application of art principles in textile designs such as constructed and surface / applied. Green and Smart garmenting.

Functional clothing and clothing comfort and smart textiles:

Definition, classification and applications of functional and smart textiles; 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.

Unit 8 : Technical textiles :

Textile Filter media for dry and wet filtration. Types and application of geosynthetics, Fibres and fabric selection criteria for geotextile applications. Application of textiles in automobiles. Protective textiles, clothing requirements for thermal protection, ballistic protection. Material, method of production and areas of application of agrotextiles. Different types of fabrics used for packaging. Textiles used in health care applications, textile used for building and construction industry. Textile structural composites and applications.

Nano technology and applications in textile: Nano fibre, nano particle and nano tube, properties and applications. Principle of electrospinning.

Unit 9 : Concept of sustainability in textile :

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, reduction, recycling and disposal of waste. Hazards involved in chemical processing and laws related to environmental protection. Life cycle analysis, social accountability and ethical practices. Concept of eco-labels, ISO 14024:2018.