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| **Textile Engineering** |
| **Sr. No.** | **Core Areas** | **Percentage** |
| 1. | Textile Raw Materials | 20% |
| 2. | Yarn Manufacturing  | 10% |
| 3. | Fabric Manufacturing  | 10% |
| 4. | Textile Wet Processing | 10% |
| 5. | Garment Manufacturing  | 10% |
| 6. | Textile Testing and Quality Control | 10% |
| 7. | Textile engineering utilities and services | 10% |
| 8. | Technical Textiles | 05% |
| 9. | Environmental issues related to Textile Industry | 10% |
| 10. | Statistical methods in textile Engineering | 05% |
|  | **Total** | **100%** |

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| **Textile Engineering (Detailed)** |
| **Sr. No.** | **Core Areas** | **Percentage** |
| **1.** | **TEXTILE RAW MATERIALS:*** 1. **Textile Fibers\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_5%**
		1. Definition and classifications of textile fibers
		2. Vegetable Fibers:
		3. Cotton: introduction of cotton and its types, Cultivation, picking and ginning of cotton, Structure of cotton fiber, Physical, chemical properties and end users of cotton fiber, Varieties of Pakistani cotton, Cotton grading
		4. Bastfibres: Fibers such as jute, flax, ramie etc., Production and processing of bastfibres, Fiber properties and uses
		5. Leaf fibres: Fiber such as abaca and sisal etc., Production, processing, properties and uses of leaf fibers
		6. Animal Fibres:
		7. Hair fibers: Introduction, classification, structure, production, properties and uses of wool fibers, Grading of wool, Introduction of fibers such as Camel, Mohair, Cashmere, Alpaca and Angora
		8. Silk: Production, properties and uses of silk yarn
		9. Mineral Fibers:

Introduction, processing, properties and end uses of natural mineral fibers such as Asbestos* + 1. Regenerated Fibres:

Manufacturing methods of viscose, acetate, tencel and lyocelfibres, their properties and uses in textile industry* + 1. Synthetic Fibers:
		2. Manufacturing methods of polyester, polyamide and acrylic fibers, their properties and uses in textile industry
		3. Manufacturing methods of various elastanefibres, their properties and uses in textile industry
	1. **Structure of Fibres\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_5%**
		1. Crystalline and non-crystalline materials, structure of crystals, polymer crystals, X-ray diffraction and crystallinity, assessment of crystallinity, microstructure and macrostructure of natural fibers; cotton and other vegetable fibers, silk wool and other animal fibers, micro and macro structure of synthetic fibers; polymer crystallization from the melt solution, fiber formation, microstructure of manmade fibers
		2. Moisture Absorption and Swelling of Fibres

Equilibrium absorption of water, humidity and relative humidity, relation between regain and relative humidity, comparative curves for various fibres, heat of sorption, effect of evolution of heat swelling of fibres, axial swelling, transverse swelling, measurement of swelling, theories of sorption, effect of hydrophilic groups, absorption in crystalline and non crystalline regions, hysteresis – a molecular explanation, structural effects in rayon fibres, structural effects in other fibres, theories of time dependence* + 1. Dielectric Properties:

Definition of dielectric properties, effect of frequency, effect of moisture, effect of temperature, static electricity, influence of moisture on resistance, measurement of static charge, and static problems in textile* + 1. Optical Properties:
		2. Refractive index and birefringence, measurement of refractive indices
		3. Absorption and dichroism, reflection and luster
		4. Mechanical Properties:

Tensile properties; true stress, specific stress, tenacity, breaking length, elastic and plastic deformation, Hooke’s law, Poisson’s ratio, stress-strain curves, elastic recovery. Torsion of fibers, bending, compression. Strain rate and temperature dependence, creep and stress relaxation* + 1. Thermal Properties:
		2. Heat capacity, thermal conductivity, decomposition and degradation, coefficient of thermal expansion.
		3. Fiber friction, effect of fiber friction and lubrication
	1. **Introduction to Mechanics of Materials\_\_\_\_\_\_\_\_\_\_\_\_\_\_5%**
		1. Role of Mechanics of Materials in Engineering, Stresses and Deformations, True Stress and True Strain.
		2. Study of Stress and Strain:
		3. Stress - Strain Diagrams of Ductile and Brittle Materials,
		4. Isotropic and Anisotropic Materials
		5. Modulus of Elasticity
		6. Modulus of Rigidity
		7. Elastic and Plastic Behavior of Materials
		8. Non Linear Elasticity
		9. Linear Elasticity
		10. Stress and Strain in Changed Thermal Conditions.
		11. Repeated Loading
		12. Bending of Elasto-plastic Materials
		13. Analysis of Stresses and Deformations
		14. Tensile Behavior of Textile Fibers Tensile Recovery:
		15. Elastic Performance Coefficient in Tension
		16. Inter Fiber Stress and its Transmission
		17. Module 4: Stress Analysis of Yarn:
		18. Staple Fiber Yarn
		19. Continues Filament Yarn
		20. Influence of Twist on Modulus of Rigidity of Yarn
		21. Plasticity of Textile Fibers:

Effect of Load, Temperature Time etc.* + 1. Module 6: Mechanical Properties of Textile Materials:

Translation of Mechanical Properties of Fibers into Yarn, Yarn into Fabric* + 1. Mechanics of Yarns:
		2. Mechanics of Bent Yarns
		3. Flexural Rigidity.
		4. Fabric Wrinkling.
		5. Stiffness in Textile Fabrics.
		6. Creasing and Crease-proofing of Textiles
		7. Compression of Textile Materials:
		8. Study of Resilience.
		9. Friction between Single Fibers
		10. Friction in Plied Yarns
		11. Drape and Hand of Woven and Knitted Fabrics:
		12. Structural Geometry of Textile Fabrics
		13. Twisted Structure of Plied Yarn
	1. **High Performance Fibers\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_5%**
		1. Aramid Fibers:

 Manufacturing, structure, properties, end uses1.4.2 Polyethylene Fibers:Manufacturing, structure, properties, end uses* + 1. Carbon Fibers:

Manufacturing, structure, properties, end uses* + 1. Glass Fibers:

Manufacturing, structure, properties, end uses* + 1. Ceramic Fibers:

Manufacturing, structure, properties, end uses* + 1. Chemical Resistant Fibers:

Manufacturing, structure, properties, end uses* + 1. Thermally Resistant Fibers:

Manufacturing, structure, properties, end uses | **20%** |
| **2.** | **YARN MANUFACTURING:*** 1. **Spinning Processes:**
		1. Flow charts of spinning processes for filament and staple-spun yarns carded and combed yarns, jute, flax and spun silk yarn
	2. Input and output of each department
		1. Intermittent spinning and continuous spinning
		2. Different spinning techniques
	3. **Blow Room:**
		1. Objectives of blow room
		2. Working principles in blow room
		3. Study of bale breaker, porcupine opener, various beaters, cage condenser, scutcher and removal of wastes
	4. **Carding:**
		1. Objectives of carding
		2. Carding actions
		3. Working of card
		4. Role of different parts and their speeds
	5. **Drawing:**

2.4.1 Concept of drafting* + 1. Real and perfect drafting
		2. Draft calculation
		3. Drafting system
		4. Drafting and doubling
		5. Objects of drawing frame
		6. Working of drawing frame.
		7. Breaker, inter and finisher drawing frame
	1. **Combing:**
		1. Objectives of combing
		2. Noil %age
		3. Combing preparatory processes
		4. Study of comber
		5. Working of Rectilinear comber
	2. **Roving Formation:**
		1. Objectives of roving frame
		2. Winding principles
		3. Working of roving frame
		4. Why and how twist is imparted in roving
	3. **Spinning:**
		1. Objectives of ring spinning
		2. Principle and mechanism of twist insertion
		3. Working of ring frame
		4. Yarn counting and its systems
	4. **Woolen Industry:**
		1. Woolen and worsted yarn
		2. Flow charts for woolen and worsted spinning processes
		3. Wool classification and sorting
		4. Impurities in wool
		5. Raw material for woolen and worsted industry
		6. Wool scouring, carbonizing, drying and blending
		7. Woolen carding and woolen spinning
	5. **Worsted Industry:**
		1. Worsted carding, backwashing and gilling
		2. Combing, drawing and spinning
	6. **Winding and Yarn Packing:**
		1. Yarn package types
		2. Yarn clearers
		3. Removal of yarn faults
 | **10%** |
| **3.** | **FABRIC MANUFACTURING:*** 1. **Basics of weaving\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_05%**
		1. History and scope of weaving.
		2. Introduction to weaving technology-loom elements, yarn preparation , warping and its objectives, sizing and its objectives, primary motions of weaving, secondary and ancillary motions of weaving, different shedding systems-merits/demerits, shuttle and shuttle less weft insertion systems
		3. Merits/demerits of different weft insertion systems
		4. Beating-up and its types – Eccentricity (pros and cons)
		5. Fabric take-up and warp let – off
		6. Warp and weft stop motion warp protector motion, weave presentation, repeat, draft, peg plan and reed plan, plain weave and its derivatives, twill weave and its derivatives, construction of satin and sateen weaves
	2. **Basics of knitting\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_05%**
		1. History and scope of knitting.
		2. Introduction to knitting and its terminology, machine knitting elements, beard, latch and compound needles
		3. Classification of knitting machines, principles and mechanism of weft knitting
		4. Loop formation, usage of different knit loops, properties of plain and rib fabrics, properties of purl and interlock fabrics
		5. Introduction to warp knitting, mechanism of loop formation in warp knitting, Classification of warp knitting machines, basic warp knitted structures, stitch notation of warp weft knitted structure, End usage of warp knitted structures
 | **10%** |
| **4.** | **TEXTILE WET PROCESSING:*** 1. **Introduction:**
		1. Introduction to textile chemical processing.
		2. Chemical processing flow chart
	2. **Shearing & Singeing Fundamentals:**
		1. Shearing & Singeing processes
		2. Shearing Machine and its description
		3. Singeing Machine and its description
		4. Evaluation of singed fabric
	3. **Desizing& Scouring Fundamentals:**
		1. Analysis of sizing materials composition
		2. Desizing Techniques and Methods
		3. Scouring chemicals and Auxiliaries
		4. Saponification, Dispersion, Suspension and Emulsion
		5. Evaluation of desizing& scouring
	4. **Bleaching & Mercerizing Fundamentals:**
		1. Bleaching Chemicals and auxiliaries
		2. Bleaching chemistry and mechanisms
		3. Types of Mercerization and its effects
		4. Evaluation of Bleached & Mercerized fabrics
		5. Liquid ammonia treatment
	5. **Dyeing Fundamentals:**
		1. Introduction to colorants and auxiliaries
		2. Dyeing of natural and manmadetextile materials with direct, reactive, sulphur, vat, acid, and disperse dyes
		3. Dyeing of polyester, nylon, acrylic, wool and silk
		4. Evaluation and characterization of dyed textile materials
	6. **Color Science Fundamentals:**
		1. Introduction to color mixing, specification, measurement and quality control of color
	7. **Printing Fundamentals:**
		1. Design development& Engraving
		2. Techniques and styles of printing
	8. **Finishing Fundamentals:**
		1. Classification of finishes: chemical; mechanical

4.8.2 Application and evaluation methods of chemical and mechanical finishes | **10** |
| **5.** | **GARMENT MANUFACTURING:*** 1. **Garment Types and Categories**
	2. **Stitch Classification:**
		1. Stitch Definition, Properties and Classes
	3. **Seams:**
		1. Seam Definition, Dimensions, classes, appearance & Performance and Problems
	4. **Sewing Thread Functions and Characteristics**
	5. **Garment Preparatory:**
		1. Marker Making.
		2. Fabric Spreading.
		3. Fabric Cutting.
	6. **Sewing Machine Fundamentals:**
		1. Sewing Machine types and classifications
		2. Stitching Forming Mechanisms
		3. Stitch forming devices
			1. Thread Control devices
			2. Needles
			3. Bobbins, Cases and Hooks
			4. Loppers

SpreadersThroat Plates, Tongues and Chaining Devices* 1. **Sewing Process:**
		1. Material handling in sewing process
		2. Basic layouts of sewing room for different articles
		3. Work Aids in sewing process
		4. Special Operations in Sewing
	2. **Apparel Support Materials:**
		1. Trims
		2. Accessories
	3. **Garment Pressing:**
		1. Fundamentals of garment pressing
		2. Pressing equipment types
		3. Effect of different pressing techniques on different material types
	4. **Sewing Problems, Faults and their Remedies**
	5. **Garment Handling and Packaging Technology**
 | **10%** |

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| **6.** | **TEXTILE TESTING AND QUALITY CONTROL:*** 1. **Sampling:**
		1. Different methods and techniques
	2. **Textiles and Moisture:**
		1. Estimation of moisture in textile materials, standard atmospheric conditions for textile testing
	3. **Fibre testing:**
		1. Fibre fineness, maturity, length, strength, color and

trash* 1. **Yarn Testing:**
		1. Linear density, twist, strength, evenness, hairiness, friction
	2. **Fabric Testing:**
		1. Tensile testing, Tear strength testing, Bursting strength, Stretch and recovery. Testing for pilling, testing for abrasion resistance, crease recovery, Thickness, fabric friction, fabric construction, fabric handle, stiffness, drape, fastness properties, water repellency, air permeability, dimensional stability and water repellency. Fiber identification (Chemical/Flame), Fabric P.H
	3. **Quality Control:**
		1. Definitions of quality. Types of quality control. Quality assurance. Presentation of quality related data, Quality control charts, basis of control charts, control limits/action limits, specification limits. State of statistical control Types of variation of quality assessed from quality control charts, variation due to chance, and variations due to assignable causes. Advantages of using quality control charts, types of quality control charts, x-bar charts (day to day i.e. subgroup to subgroup variation), r-bar charts (within day i.e. within subgroup variation), p-bar charts (percent defective), how and when corrective action is taken by using Q.C. charts
 | **10%** |
| **7.** | **TEXTILE ENGINEERING UTILITIES AND SERVICES.****7.1 Boilers**7.1.1 Boiler Construction and its parts7.1.2 Types of Boilers and accessories**7.2 Application of steam**7.2.1Production of steam and its utilization**7.3 Humidity**7.3.1 Effect of humidity on production and quality, 7.3.2 humidity controls, types of humidifiers and their working**7.4 Ventilation**7.4.1 Types of ventilations**7.5 Air-conditioning**7.5.1 Principles, types**7.6 Compressors**7.6.1 Types, constructions and working **7.7 Fire safety** 7.7.1 Fire Hazards, Causes and prevention systems**7.8 Generators**7.8.1 Types, calculation of load for installation**7.9 Noise Control**7.9.1 Noise measurement, Industrial Noise reduction, Air bore and structural borne noise**7.10 Vibrations**7.10.1 Mechanical vibrations and impacts**7.11 Fuel and Energy**7.11.1Energy sources, Fuel Economy in textile mills**7.12 Utility equipment maintenance** | **10%** |
| **8.** | **NON-WOVEN AND TECHNICAL TEXTILES:*** 1. **Technical Textiles:**
		1. *Agrotech*
		2. *Buildtech*
		3. *Geotech*
		4. *Medtech*
		5. *Mobiltech*
		6. *Oekotech*
		7. *Packtech*
		8. *Protech*
		9. *Sporttech*
		10. *Hometech*
		11. *Indutech*
		12. *Clothtech*
		13. Characterization and testing, principles of design for performance
 | **05%** |
| **9.** | **ENVIRONMENTAL ISSUES RELATED TO TEXTILE INDUSTRY:*** 1. **Textile & Environment:**
		1. Air pollution
		2. Water pollution
		3. Noise pollution
		4. Effect of fibre production & manufacturing industry on environment
		5. Effect of yarn manufacturing industry on environment
		6. Effect of fabric manufacturing industry on environment
		7. Effect of textile processing industry on environment
		8. Effect of garment manufacturing industry on environment
	2. **Environmental Management Systems and Eco-labeling:**
		1. EMS models
		2. Key elements of an EMS
		3. Integration of existing environmental activities in textile to EMS
		4. EMS and compliance
		5. Introduction to ISO 14000, ISO 14001,ISO 18001, REACH,Oeko-tex 100, EU eco-label and development of standards
	3. **Cleaner Production Technologies Related to Textile Industry:**
		1. Sources, impact, monitoring, reduction and control of pollution in textile industry
	4. **Textile Effluents & Waste Management:**
		1. Environmental impact assessment
		2. Environmental audits
		3. National Environmental Quality Standards
		4. Textile effluent treatment methods: physical; chemical; biological
		5. Textile Solid waste management
 | **10%** |
| **10.** | **STATISTICAL METHODS IN TEXTILE ENGINEERING:*** 1. **Introduction to statistics & probability**
	2. **Acceptance sampling in textiles**
	3. **Measures of central tendency**
	4. **Measures of variation**
	5. **Analysis of variation (ANOVA)**
	6. **Correlation & regression**
	7. **Statistical process control**
	8. **Process control charts**
	9. **Pareto charts**
	10. **Process capability analysis**
	11. **Design & analysis of experiments**
 | **5%** |
|  | **Total** | **100%** |