

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY,  
UTTAR PRADESH, LUCKNOW**



**Syllabus**

**For**

**M.Tech. (Textile Chemistry)**

**(Effective from the Session: 2016-17)**

## Course Structure and Evaluation Scheme for M. Tech

### Textile Chemistry, effective from 2016-17

#### Semester I

S. No	Sub. Code	Name of the Project	Periods			Credit	Evaluation Scheme					Subject Total
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTTT011	Quality Evaluation of Textiles	3	0	0	3	20	10	70	-	-	100
2	MTTC103	Advances in Bleaching and Finishing	3	0	0	3	20	10	70	-	-	100
3	MTTT011 / MTTC013	Knitting and Nonwoven/ Environmental Practices in Textiles	3	0	0	3	20	10	70	--	--	100
4	MTTT021 / MTTT022	Technical Textiles/ High performance fibres & Composites	3	0	0	3	20	10	70	--	--	100
5	MTCC101	Research Process & Methodology	3	0	0	3	20	10	70	--	--	100
	MTTT151	Quality Evaluation of Textiles	0	0	3	2				20	30	50
	MTTC153	Advances in Bleaching and Finishing lab.	0	0	2	1				20	30	50
		<b>Total</b>				<b>18</b>						<b>600</b>

#### Semester II

S. No	Sub. Code	Name of the Project	Periods			Credit	Evaluation Scheme					Subject Total
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTTT201	Characterization of Polymers and Fibres	3	0	2	4	20	10	70	-	-	100
2	MTTC203	Theory of coloration in textiles	3	0	2	4	20	10	70	-	-	100
3	MTTC031 / MTTC033	Nano technology in textiles/ Enzyme Technology for textiles	3	0	0	3	20	10	70	--	--	100
4	MTTT041 / MTTT042	Functional Textiles / Textile Costing and Cost Control	3	0	0	3	20	10	70	--	--	100
5	MTTT051 / MTTT052	Instrumentation & Automatic Controls / Statistics & Controls for Textile Industry	3	0	0	3	20	10	70	--	--	100
	MTTT251	Characterization of Polymers and Fibres Lab	0	0	3	2				20	30	50
	MTTC253	Coloration in textiles Lab.	0	0	2	1				20	30	50
		<b>Total</b>				<b>18</b>						<b>600</b>

**Proposed Course Structure and Evaluation Scheme for M. Tech. Textile Chemistry  
To be effective from 2017-18**

**Semester III**

S. No	Subject Code	Name of the Project	Periods			Credit	Evaluation Scheme					Subject Total
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTTC351	Seminar	0	0	6	3	--	--	--	100	--	100
2	MTTC352	Dissertation	0	0	28	15	--	--	--	200	300	500
3		<b>Total</b>				<b>18</b>						<b>600</b>

**Semester IV**

S. No	Subject Code	Name of the Project	Periods			Credit	Evaluation Scheme					Subject Total
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTTC451	Dissertation (Final)	0	0	36	18	--	--	--	200	400	600
2		<b>Total</b>				<b>18</b>						<b>600</b>

# 1<sup>st</sup> Semester M. Tech. Textile Chemistry

## 1. MTTT 101 Textile Quality Evaluations

UNIT I: Fibre classification, properties and standards, methods of measuring fibre fineness, Methods of Measuring fibre length, HVI testing- the basics, Application of HVI, AFIS- the basics, Testing & data analysis, maturity and fineness testing, Application of NIR spectroscopy for textile measurement, properties.

Unit 2: MASS VARIATION OF TEXTILE STRANDS: Depiction of mass Variation of textile strands in time and frequency domain; interpretation and significance of U% and CV% for textile strands; classification and analysis of yarn faults created by mass variation, VARIANCE LENGTH CURVES AND SPECTROGRAM OF TEXTILE STRANDS: Effect of specimen length and total length on mass variation measurements of textile strands; theory of construction of VL curve; analysis of variance length curves to understand and avoid the introduction of mass variation during the spinning operation; determination of periodic mass variation in the form of spectrogram; determination of theoretical wave length from spectrum; comparison between normal and ideal spectrum; type of faults and their representation in spectrogram; interpretation of superimposed waves in spectrogram

UNIT II: Strength & Elongation tests:, definitions of different terms of tensile tests, factors affecting tensile testing, fibre strength, yarn strength & fabric strength test methods, Influence of testing factors on yarn tensile properties; measurement and application of yarn modulus; creep and stress relaxation of yarn; significance of estimating minimum yarn strength, seam strength.

UNIT IV: Hygral expansion, relaxation shrinkage, swelling shrinkage, methods of measuring dimensional stability, Snagging test, wrinkle recovery & pilling resistance, abrasion resistance test, factors affecting abrasion resistance,

UNIT V: Thermal comfort, air permeability, moisture transport, sensorial comfort, water absorption and water repellency tests, colour fastness testing, objective evaluation of fabric handle. Kawabata system, FAST: fabric assurance by Simple testing, FABRIC APPEARANCE AND OTHER PROPERTIES Study of fabric appearance in terms of drape, formability, crease recovery, evaluation of fabric properties like flammability, impact resistance, absorbency

## 2. MTTC 102 Advances in Bleaching & Finishing

Combined preparatory processes and energy conservation, Ammonia mercerization, low temperature scouring of cotton fabrics, solvent scouring, low temperature bleaching, cold and hot mercerization, Determination of efficiency & various preparatory process. Methods used for degradation of cotton during bleaching. Whiteness measurement.

Solvent finishing advances in chemical and other finishes for synthetic fabrics and their blends with natural fibres. Foam finishing, Energy requirement and conservation in finishing. Minimum application technique. Developments in textile finishing such as resin finishing, soil release flame proofing, antistatic, water proof and water repellent finishing of united fabrics. Finishing of micro denier fibre fabrics, antibacterial finishes use of bio technology in bleaching.

## 3. Departmental Elective 1

### 3.1 MTTT011: Knitting & Non-Woven ( L T P 3 0 0) Credits 3

Concepts of loop formation in weft and warp knitting. Different forces acting on the needle butt and mechanics of loop formation. Study of dynamics of knitting process. Study of different machines, process and yarn parameters affecting the yarn tension in knitting zone and loop length. Concept of 'Robbing Back' of yarn in loop. Study of design and performance of high speed knitting cam and increase in machine production. Yarn feeding devices on circular knitting machines. Geometry and properties of weft knitted fabrics – importance of Doyle's and Munden's research, k-values and Pierce's geometry. Outlines of process control in knitting. Use of electronics and computers and other developments in knitting. Features of warp knitted fabrics and their uses.

Classification and areas of application of nonwoven fabrics. Different methods of production of nonwoven fabrics. Effect of machines, fibre and process variables on properties of nonwoven fabrics. Failure mechanism of nonwoven fabrics. Prediction of needle punched nonwoven fabric behavior. Designing of nonwoven for engineering applications. Development in nonwoven machineries. Developments in various nonwoven manufacturing techniques.

### 3.2 MTTC013: Environmental practices in textiles ( L T P 3 0 0) Credits = 3

**STRUCTURE AND COMPOSITION OF ATMOSPHERE:** Environment - definition, scope and importance of environmental study - composition of atmosphere. Particles, ions and radicals in the atmosphere. Thermochemical and photochemical reactions in the atmosphere.

**ECOSYSTEM:** Structure and stability of the ecosystem. Health of our planet. Nature of textiles. Textile fibre production. Yarn production. Fabric production. Use of textiles. Garman ban on toxic dyes, chemicals and auxiliaries. Present status of textile industry.

**ENVIRONMENTAL POLLUTION:** Definition. Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution and thermal pollution in textile industry. Solid waste management - causes, effects and control measures. Role of an individual in prevention of pollution.

**EFFLUENT TREATMENT:** Introduction. Characteristics and treatment of Textiles processing effluents. Flow chart of effluent treatment processes. Primary, Secondary and Tertiary treatments. Evaporation and Reverse osmosis, ultra filtration, membrane filtration, advanced oxidation techniques.

**ECOFRIENDLY PROCESSING:** Brief note on dry processing techniques, low liquor applications, use of biodegradable auxiliaries, use of natural resources in textile preparatory, dyeing and finishing processes.

**SOCIAL ISSUES AND THE ENVIRONMENT:** Sustainable textiles, role of non-governmental organizations. Social complaints - Human rights, value education, women, child welfare and human health. Process of EIA - ISO 14000 - Environment protection act – Air (prevention and control of pollution) act, Water (prevention and control of pollution) act. SA8000 certification process

**TEXT BOOKS :**

1. Gilbert M Masters, "Introduction to Environmental Engineering and Science", Printice Hall, India, 2004.
2. Tobler-Rohr M I, Handbook of sustainable textile production, Woodhead Publishing Ltd, 2011.
3. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2010.
4. Keith Slater, "Environmental Impact of Textiles", Woodhead Pub. Ltd, Cambridge, 2003. ISBN:1-85573-541-5
5. Deswal, "An Introduction To Environmental Science", Dhanpat Rai & Co Pvt. Ltd, New Delhi, 2011.
6. Koteswara Rao M V R, "Energy Resources: Conventional & Non-Conventional ", BSP Publications, India, 2006.
7. Cunningham W P, Cunningham M A, "Environmental Science: A Global Concern", McGraw-Hill, Boston, 2008.
8. De A K, "Environmental Chemistry", New Age International P Ltd, New Delhi, 2006.

#### **4. Departmental Elective 2**

##### **4.1 MTTT021: Technical Textiles (L T P 3 0 0) Credits 3**

Composites: Basic concepts, classification, manufacturing techniques-from fibre to composite, textile composites, composite applications, reuse & recycling; geotextiles: basic classification, main functions of a geotextiles, applications; Architectural textiles, concepts of tensegrity structures.

Automotive Textiles: requirements on automotive textiles including tyre cords, air bags, seat belts and seat fabrics, carpets, trims.

Principles of filtration, industrial filtration in textile, chemical, food and metallurgical applications.

Medical textile materials and structures; application of compression bandage technology for medical care; integrating electronic sensors into medical textiles; knitted electro-textiles.

Protective Textiles: Bullet proof, stab proof vests. Impact protection: impact mechanism and cellular textile composites. Ballistics and body armour.

Technical clothing, sportswear, spacewear, sailing equipment.

Medical and Smart Textiles

Industrial Tapes :Slide fastener tapes - Insulating tapes – Book binder’s tapes - Labeling Tapes – Border Tapes – Elastic- Pleated lingerie ribbing. Non-pile carpet weaves and their looms. Pile surfaced carpet weaves and their looms. Needle felt floor coverings. Classification of braids – Trimmed braids – Flat braids – Circular Braids - Hollow braids. Production techniques. Properties and applications.

Definition of home textiles- requirements. Kitchen linen, Bedlinen, Furnishing ,Floor coverings, Wall coverings, Decoration fabrics.

##### **4.2 MTTT022: High Performance Fibres & Composites**

ARAMIDS & CO POLYESTERS: Fibres formation – Fibre & structure properties, performance and Application. CARBON AND GRAPHITE: Classification and Types, manufacturing Processes from Polyacrylonitrile (PAN) and Rayon structured pitch based fibres, properties. GLASS FIBRES: Types and Composition, Manufactures Processes, Fibre structures, Properties and Applications. POLY ETHELENE FIBRES: Types - UHMWPE, HDPE, Manufacturing process, properties and applications CERAMIC FIBRES: Classification and fibre formation, composition, structure, properties and application POLYURETHANE ELASTOMERIC FIBRES: Manufacturing Processes, Fibre Properties, Application and future trends METALLIC COMPOUND FIBRES: Aluminium Oxide fibres and lead oxide fibres – Preparation and processes, Fibre structure, properties and Application. OPTICAL FIBRES: Light Propagation. Silica Fibres- Fibre manufacture and Application

#### **5. MTCC101: Research Process & methodology: As per AKTU Syllabus**

**6. MTTT151: Quality Evaluation of textiles Lab (L T P 0 0 3) credits 2**

As per syllabus

**7. MTTC153: Advances in Bleaching & Finishing Lab:**

As per syllabus

## 2<sup>nd</sup> Semester M. Tech. Textile Chemistry

### 1. MTTT201: Characterization of Polymers and Fibres (L T P 3 0 0) Credits 3

FIBRE STUDY: Basic concept of crystalline regions, and orientation - their effects on fibre properties. Sources of elucidation of fibre structure.

MOISTURE PROPERTIES: Definitions, humidity, regain moisture content. Hygroscopic nature and moisture absorption behaviour of textile fibres, relation between regain and relative humidity, Quantitative theory of moisture absorption, effect of temperature, stresses and hydrophilic groups, crystalline and non-crystalline regions on moisture regain. Heats of sorption. - Definition of heat absorption and heat of wetting.

OPTICAL PROPERTIES: Refractive index and birefringence - absorption, dichroism, reflection and lustre of fibres. (8) MECHANICAL PROPERTIES: Expression of tensile test results - stress strain relations of fibres. Effect of moisture and temperature on stress, strain. Elasticity and elastic recovery properties of fibres. (6) TIME EFFECTS: Creep, stress relaxation phenomenon. Basic concepts in dynamic tension testing and visco elastic behaviour. Torsional and flexural rigidity of fibres.

ELECTRICAL PROPERTIES: Definition of mass specific resistance and the influence of moisture. Dielectric constant – factors influencing the dielectric properties of fibres.

STATIC ELECTRICITY: Problems and elimination in textile processes – electro static series.

CHARACTERIZATION OF CHEMICAL STRUCTURE: Principle of Spectroscopy, FTIR Spectroscopy, ATR-FTIR Spectroscopy, NMR Spectroscopy, UV-VIS Spectroscopy, Mass Spectroscopy, Raman Spectroscopy, AES/AAS Spectroscopy. (11) CHARACTERIZATION OF PHYSICAL AND MORPHOLOGICAL STRUCTURE: Optical microscopy, Scanning Electron Microscope, Atomic Force Microscope, Transmission Electron Microscope, Xray Diffractometer, Density Gradient Column. (11) THERMAL CHARACTERIZATION: Differential Scanning Calorimetry, Differential Thermal Analysis, Thermo Gravimetric Analysis, Dynamic Mechanical Analysis.

### 2. MTTC203: Theory of Coloration of Textiles (L T P 3 0 0) credits 3

Definition of terms and mathematical equation relevant to physio chemical aspect of dyeing such as diffusion coefficient standard affinity, heat of dyeing, entropy of dyeing, saturation value, adsorption on sites etc.

ii. Kinetics of Dyeing:

(a) Methods for measurement of diffusion coefficient and different equation used for calculation of diffusion coefficient.

(b) Significance of diffusion coefficient in relation of physical structure of fibre.

(c) Determination of diffusion coefficient of dyes suitable for natural and synthetic fibres.

iii. Thermodynamics of dyeing:

(a) Adsorption isotherms and experimental design their determination.

(b) Classification of adsorption isotherm and their applicability to different dye fibre systems.

(c) Standard affinity equation representing different adsorption isotherm.

(d) Dye fibre interactions and analytical methods for their investigations.

Technique of coloration and theories behind them. Recent developments in the mechanism of dyeing of different fibres by various classes of dyes. Quantitative treatment for kinetics as well as equilibrium dyeing state of dye in solution in fibre and dye fibre interactions. Physicochemical aspects of printing. Dye –polymer interaction and methods of investigation. Role of fibre structure and other characteristics in dyeing.

### 3. Departmental Elective 3:

#### 3.1 MTTT031: Nano Technology in Textiles (L T P 3 0 0) credits 3

Nanoscale – Definition, various methods of manufacturing nano materials and their characterization. Nanofibers - Manufacturing, properties and uses of nanofibre, Nanofinishes - Super hydrophobicity and lotus effect, self cleaning, UV protection, Antimicrobial finishes

**Application of Plasma in Textiles**



Concept, types of plasma and their generation, Plasma treatment of textile for water and oil repellency, Interfacial engineering of functional textiles for biomedical applications, plasma modification of wool, plasma modification of natural cellulosic fibers, characterization of plasma treated textiles.

#### **Development in Finishing**

Various Low liquor and minimum application techniques in textile finishing, their advantages and limitations, wrinkle free finishing – concept of wet and moist cross linking, various eco-friendly resin finishes, Bio-Finishing, Concept of UV-A and UV-B, factors affecting UV protection. Various UV- protection finishes and their evaluation, antimicrobial finishes – mode of action, factors affecting, various antimicrobial finishes. Developments in textile finishing such as soil release, flame retardant, antistatic, fluoro chemicals, silicone finishes.

#### **Wash down effects on denim**

Stone wash,, enzyme wash, combined stone and enzyme wash, acid wash, ball blast, whiskering, sand blast, ice wash.

Developments in finishing machineries.

Developments in stenters and physical finishing machines

#### **SUGGESTED READINGS:-**

1. Technology of finishing – J.T. Marsh, 1948
2. Technology of finishing – Vol. X – Dr. V.A. Shenai & Dr. Saraf 1990
3. Chemical processing of polyester/cellulosic blends – R.M. Mittal and S.S. Trivedi.
4. Silk dyeing, printing and finishing – Prof. M.L. Gulrajani.
5. Garment Finishing & Care Labelling by S.S. Satsangi, Usha Publishers, 53-B/AC-IV, Shalimar Bagh, New Delhi.
6. Plasma technologies for textiles – R. Shishoo
7. Nano fibres and Nano technology in textiles, Brown P.J, Woodhead Publishing 2007

### **3.2 MTTC033: Enzyme Technology for Textiles ( L T P 3 0 0) Credits 3**

#### **ENZYMES 12**

Nomenclature and classification of enzymes; characteristic features of enzymes; modifiers of enzyme activity - activators and inhibitors; specificity of enzyme action; extraction and purifications of enzymes.

#### **ENZYMES FOR COTTON FIBRE**

Chemistry and structure of cotton fibre; enzymes in pretreatment of cotton substrates – desizing, scouring, bleaching and bio finishes.

#### **ENZYMES FOR OTHER FIBERS**

Enzymes for processing and functionalizing protein fibres; enzymatic modification of polyester, polyamide, polyacrylonitrile and cellulose acetate fibres.

#### **ENZYMES IN EFFLUENT TREATMENT**

Enzyme technology and biological remediation, Enzyme decolourisation and decolouration by biosorption and enrichment cultures.

#### **REFERENCES**

1. Freifelder D., "Molecular Biology ", Jones and Bartlett Publishers Inc. 1987.
2. Nierstrasz V. and Cavaco-Paulo A., "Advances in textile biotechnology", Woodhead Publishing Ltd, Cambridge, UK, 2010.
3. Cavaco-Paulo A. and Gubitz G., "Textile processing with enzymes", Woodhead Publishing Ltd, Cambridge, UK, 2003.

### **4. Departmental Elective 4:**

#### **4.1 MTTT041: Functional Textiles ( L T P 3 0 0) Credits 3**

Chemical and mechanical finishing. The challenges and charm of Chemical finishing. Importance of chemical finishing. Application of chemical finishes.

**SOFTENING FINISHES:** Introduction. Mechanisms of the softening effect. Types of Softeners. Compatibility and combinability of softeners. Evaluation and testing methods. Troubleshooting for softening finishes.

**HAND BUILDING FINISHES:** Introduction. The hand building effect. Textiles with hand building finishes. Evaluation methods. Trouble shooting for hand building finishes.

**NON-SLIP FINISHES:** Introduction. Mechanisms of non-slip finishes. Application methods and combinability. Evaluation, Trouble shooting for non-slip finishes. **ELASTOMERIC FINISHES:** Introduction. Mechanism of elastomeric effect. Evaluation. Trouble shooting for elastomeric finishes.

**ULTRAVIOLET PROTECTION FINISHES:** Introduction. Mechanism of UV protection. Evaluation. Trouble shooting for UV protection finishes, EMI Shielding. **ANTIMICROBIAL FINISHES:** Introduction. Properties of an effective antimicrobial finish. Mechanisms of antimicrobial finishes. Evaluation. Trouble shooting for antimicrobial finishes.

**NOVEL FINISHES:** Introduction. Anti-odour and fragrance finishes. Mosquito repellent finish. Conductive finish. Fibre surface modifying finishes using plasma and radiation technologies. Fibre surface modification by sol-gel finishes with inorganic oxide films. Microencapsulation technique for finishing of Textiles. Smart textiles by chemical finishing.

#### **TEXT BOOKS:**

1. Schindler W D and Hauser P J, "Chemical Finishing of Textiles", The Textile Institute, Woodhead Publishing Ltd., Cambridge, 2004.
  2. Charles Tomasino, "Chemistry & Technology of Fabric Preparation & Finishing", Department of Textile Engineering, Chemistry and Science, College of Textiles, North Carolina State University, Raleigh, 1992.
  3. Perkins W S, "Textile Colouration and Finishing", Carolina Academic Press, U.K, 1996.
- Menachem L and Stephen B S, "Handbook of Fibre Science and Technology", Volume II, Part B, Marcel Dekker Inc., New York, 1983.

#### **4.2 MTTT042: Textile Costing & Cost Control (L T P 3 0 0) Credits 3**

**FUNDAMENTALS OF COSTING:** Cost concept. Classification of cost, elements of cost. Methods of costing. Unit and operating costing, preparation of cost sheet. Estimation of cost of production and component of total cost. Profit planning, job order, batch process, conversion cost. Inventory costing.

**COSTING IN SPINNING INDUSTRY:** Elements of cost – Ascertainment of Clean Cotton Cost –Cost Statements Quantity and value of total cotton/ Man-made fiber issued input, wastage and output in each processing cost center up to yarn stage- Net Mixing Cost- Waste multipliers for each cost center mixing wise Cost Centrewise conversion cost, Selling price of various wastes. Power cost estimation, Yarn realisation statement, Decision making using Contribution per frame shift among various counts of yarn production.

**COSTING IN WEAVING INDUSTRY:**–Elements of cost Calculation of Yarn requirements for weaving –computation of value loss and net realization, Cost Statements– Cost centre wise conversion cost from winding to weaving, Sort wise cost of production of Grey Cloth sort wise stock accounting of Grey cloth, Cost of Sizing material, Cost of sales of cloth sold in grey stage and sales realization

**COSTING IN KNITTING AND GARMENT INDUSTRY:**– Elements of cost –Calculation of garment weight of different sizes, Dia determination, Setting the knitting program, Dyeing program,Consumption of fabric per garment. Estimating of cost of process loss in Compacting, Bleaching, Raising, Shearing, Printing and Dyeing. Estimating the Knitting rates, Calculation of CMT charges. Cost sheet with Profit margins and foreign quotes.

**COST CONTROL AND COST REDUCTION:** Introduction, Process of Cost Control and Cost Reduction, Cost Reduction Programme and its implementation, Methods and Techniques-Value analysis and Value Engineering, Just -In-Time (JIT), Activity Based Costing(ABC).

#### **TEXT BOOKS:**

- Bhave P V and Srinivasan V,"Cost accounting in textile mills",ATIRA monograph, Ahmedabad,India, 1974 2.
- Varma H K,"Costing in Textile Industry", Dhanpat Rai publications, New Delhi, 1965 3.
- Shinn William,"Elements of Textile Costing" School of Textiles,North Corolina state,1965
- Jain IC,"Cost accounting-An introduction", Prentice hall, NewDelhi, 2001
- Ratnam T V,"Cost control and costing in spinning mills", Seshan printers, Coimbatore, India, 1992

## **5. Departmental Elective 5**

### **5.1 MTTT051: Instrumentation & Automatic Controls (L T P 3 0 0) credits 3**

#### **Significance of Measurement and Instrumentation**

##### **Introduction**

Generalized configuration and functional stages of measuring systems.

Measurement of Force, Torque, Velocity, Acceleration, Pressure, Temperature, Flow, Level, Viscosity, Humidity & Moisture (Qualitative Treatment Only).

##### **Review of Industrial Instrumentation**

The transducer and its environment; an overview;

Sensing process and physical laws.

Transducer classification and their modeling; information, energy and incremental models;

Developments in sensors, detectors and transducer technology; displacement transducers;

force, torque and motion sensors; piezoelectric transducers; capacity type transducers; Strain gage transducers; accelerometers, pressure transducers based on elastic effect of volume and connecting tubing.

##### **Instruments and Control Systems Concepts**

Characteristics of instruments,

Design and selection of components of a measuring system.

Dynamic Response of Instruments:

Mathematical model of a measuring system,

response of general form of instruments to various test inputs;

Time domain and frequency domain analysis.

Elementary transfer functions and Bode plots of general transfer functions.

Nyquist, Nichols Plot.

Stability by graphical and analytical Methods,

Design of Stabilizing Networks,

Minor loop correction

Characteristics of control loop elements.

##### **Errors in Measurement**

Errors in Measurement and Its Analysis:

Causes and types of experimental errors;

Systematic and random errors. Uncertainty analysis;

Computation of overall uncertainty;

Estimation for design and selection for alternative test methods.

### **5.2 MTTT052: Statistics & Controls for Textile Industry (L T P 3 0 0) Credits 3**

**STANDARD PROBABILITY DISTRIBUTIONS:** Mean and variance of Probability distribution, Geometric distribution, Binomial distribution, Poisson distribution, Normal approximation to Binomial and Poisson. (10)

**STANDARD SIGNIFICANCE TESTS:** Hypothesis, significance level, interpretation of significance test, single and double tail tests. Errors and choice of sample size. Test for single mean, two means – test for single variance, two variances and single proportion. Rejection of outliers.

**ANALYSIS OF VARIANCE:** ANOVA for different models, test of significance – comparison with a control, global comparisons. Rank test. (10)

**DESIGN OF EXPERIMENTS:** Introduction. Random variation in experiments – randomization, 2n full-factorial designs – Yate's algorithm, fractional replication. Optimization techniques using composite designs.

**LINEAR REGRESSION:** Introduction. Method of least squares – linear regression equation – correlation coefficient. Regression through origin – multiple regression. Confidence limits. (10)

**CONTROL CHARTS:** General principle of control charts – action and warning limits – interpretation of control charts. Control charts for defectives, defects, averages, ranges. Cusum charts. Process capability analysis.

**Total L: 60**

**REFERENCES:**

1. Leaf G A V, “Practical Statistics for the Textile Industry”, The Textile Institute, Manchester, 1984.
2. Leaf G A V, “Practical Statistics for the Textile Industry”, The Textile Institute, Manchester, 1987.
3. J. R. Nagla, “Statistics for Textile Engineers”, Woodhead Publishing India Pvt. Ltd., 2014
4. Meloun M and Militky J, “Statistical Data Analysis: A Practical Guide”, Woodhead Publishing Ltd. UK, 2011.
5. Hayavadana J, “Statistics for Textile and Apparel Management”, Woodhead Publishing Ltd., UK, 2012.
6. Montgomery D C, “Design and Analysis of Experiments”, John Wiley & Sons, New York, 1997.
7. Ronald D moen, Thomas W Nolan and Lloyd P Provost, “Quality Improvement Through Planned Experimentation”, McGraw Hill, 1998.

**6. MTTT251: Characterization of polymers & Fibres Lab ( L T P 0 0 3) credits 2**

As per syllabus

**7. MTTC253: Coloration of Textile Lab (L T P 0 0 2) Credits 1**

As per Syllabus