

**AFFILIATED INSTITUTIONS**  
**REGULATIONS - 2013**  
**CURRICULUM I TO IV SEMESTERS (FULL TIME)**  
**M.TECH. TEXTILE TECHNOLOGY**

**SEMESTER I**

<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>THEORY</b>					
<b>TX7101</b>	Theory of short staple yarn spinning	4	0	0	4
<b>TX7102</b>	Process Control and Fabric Engineering	4	0	0	4
<b>TX7103</b>	Textile Quality Evaluation	4	0	0	4
<b>TX7104</b>	Fibre Physics	4	0	0	4
<b>TX7105</b>	Functional Finishes	4	0	0	4
<b>TOTAL</b>		<b>20</b>	<b>0</b>	<b>0</b>	<b>20</b>

**SEMESTER II**

<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>THEORY</b>					
<b>TX7201</b>	Statistics for Textile Engineering	3	1	0	4
<b>TX7202</b>	Clothing Science	4	0	0	4
	Elective I	4	0	0	4
	Elective II	4	0	0	4
	Elective III	4	0	0	4
<b>TOTAL</b>		<b>19</b>	<b>1</b>	<b>0</b>	<b>20</b>

**SEMESTER III**

<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>THEORY</b>					
	Elective IV	4	0	0	4
	Elective V	4	0	0	4
<b>PRACTICAL</b>					
<b>TX7311</b>	Project Work (Phase I)	0	0	12	6
<b>TOTAL</b>		<b>8</b>	<b>0</b>	<b>12</b>	<b>14</b>

**SEMESTER IV**

<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>THEORY</b>					
<b>TX7411</b>	Project Work (Phase II)	0	0	24	12
<b>TOTAL</b>		<b>0</b>	<b>0</b>	<b>24</b>	<b>12</b>

**TOTAL NUMBER OF CREDITS : 66**

**LIST OF ELECTIVES**  
**M.TECH. TEXTILE TECHNOLOGY**

**SEMESTER – II**

<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>TX7001</b>	Theory of Yarn Structures	4	0	0	4
<b>TX7002</b>	Structure and Properties of Fabrics	4	0	0	4
<b>TX7003</b>	Management of Research and Development	4	0	0	4
<b>TX7004</b>	Enzyme Technology for Textile Processing	4	0	0	4
<b>TX7005</b>	Management of Textile Effluents	4	0	0	4
<b>TX7006</b>	Textile Polymer Rheology	4	0	0	4
<b>TX7007</b>	Textile Structural Composites	4	0	0	4

**SEMESTER - III**

<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>TX7008</b>	Alternative Spinning Systems	4	0	0	4
<b>TX7009</b>	Design and Analysis of Textile Experiments	4	0	0	4
<b>TX7010</b>	Colour Science and its Applications	4	0	0	4
<b>TX7011</b>	Characterization of Textile Polymers	4	0	0	4
<b>TX7012</b>	Textiles in Civil Construction and Transportation	4	0	0	4
<b>TX7013</b>	Medical Textiles	4	0	0	4

**OBJECTIVES**

To enable the students to learn the theory of various operations carried out at different stages of yarn spinning, which would be helpful them in understanding the influence of various parameters on quality and productivity of short staple yarn.

**OUTCOME**

Upon completion of this course, the student shall be able apply the knowledge gained for

- Selecting suitable machine and process variables at different processes of yarn spinning to produce better quality yarn with maximum productivity and
- Designing processes for producing yarn of required parameters and
- Innovating design and process modification.

**UNIT I FIBRE DISPERSION AND CLEANING 18**

Necessity of fibre-individualization; fibre opening and cleaning in blow-room machinery; forces acting on the fibre during carding operation; the mechanism of fibre dispersion, fibre transfer, short fibre removal and trash removal; entanglement and disentanglement of fibres; theory of hook formation; the new approaches to improve fibre-dispersion in carding operation; mechanism of removal of short fibre, neps and trash in comber.

**UNIT II ATTENUATION AND FIBRE STRAIGHTENING 18**

Principle of roller drafting and its application in yarn production; ideal drafting; factors affecting drafting force, fibre dynamics during drafting, drafting irregularities and their causes and remedies; amount of draft and draft distribution on strand irregularity; the function of aprons in roller drafting; limitation of apron-drafting and the scope for improvement; mechanism of wire- point drafting and its application in yarn production; merits and demerits of wire-point drafting; comparison of wire-point drafting with roller drafting; influence of fibre- extent on yarn quality; improvement of fibre- extent by carding, drafting and combing actions.

**UNIT III TWISTING 12**

Twisted yarn geometry, forces acting on fibre and yarn during twisting, effect of fibre helix angle on strength, parameters affecting optimum twist level; balloon and spinning triangle formation and their effects on yarn quality and productivity; fundamental requirement to create real twist in a strand, mechanism of twisting principles in ring spinning; separation of twisting and winding actions of yarn; modified twisting principles - open end twisting, false twisting, air-jet twisting, air-vortex twisting, up-twisting, two-for-one twisting, hollow-spindle twisting; merits and demerits of modern twisting system.

**UNIT IV FIBRE BLENDING AND LEVELLING 12**

Importance of achieving homogeneous blending in fibre-mix; types of mixing during spinning preparatory process; lateral and longitudinal fibre blending; analysis of fibre blend index values; process parameters of spinning machinery for processing blended material; influence of intermediate product uniformity on yarn uniformity; different methods of levelling adopted during spinning processes.

**TOTAL : 60 PERIODS**

**REFERENCES**

1. Oxtoby E., "Spun Yam Technology", Butterworths, London, 1987
2. Klein W., "The Technology of Short-staple Spinning", The Textile Institute, Manchester, 1998. ISBN: 1870812980.
3. Klein W., "A Practical Guide to Opening and Carding", The Textile Institute, Manchester, 1999. ISBN: 1870812999.
4. Klein W., "A Practical Guide to Combing, Drawing and the Roving Frame", The Textile Institute, Manchester, 1999. ISBN: 1870372287.
5. Klein W., "A Practical Guide to Ring Spinning", The Textile Institute, Manchester, 1999. ISBN: 1870372298.
6. Lord P.R., "Yarn Production: Science, Technology and Economics", The Textile Institute, Manchester, 1999. ISBN: 1870372174.

7. Salhotra K.R. and Chattopadhyay R., "Book of papers on Blow room, Card", Indian Institute of Technology, Delhi, 1998.
8. Shaw J., "Short-staple Ring Spinning", Textile Progress, The Textile Institute, Manchester, 1982
9. Doraiswamy I., Chellamani P., and PavendhanA., "Cotton Ginning", Textile Progress, Vol. 24, No.2, The Textile Institute, Manchester1993. ISBN: 1870812484.
10. Grosberg P. and Iype C, "Yarn Production: Theoretical Aspects", Textile Institute, 1999, ISBN: 1870372034.
11. Carl A. Lawrence "Fundamentals of Spun Yarn Technology", CRC Press, 2003, ISBN: 978-1-56676-821-4.

**TX7102**

**PROCESS CONTROL AND FABRIC ENGINEERING**

**L T P C**

**4 0 0 4**

### **OBJECTIVES**

To enable the students to learn the

- Theory of preparation of yarn for fabric formation and different types of fabric formation techniques and
- Selection and control of process variables during preparatory and fabric formation.

### **OUTCOME**

Upon completion of this course, the student shall be able to select and control the process variables at preparatory and fabric formation to achieve the fabric with required qualities.

### **UNIT I WEAVING PREPARATION**

**12**

Yarn quality requirements - weaving and knitting; winding - yarn faults, quality of splice/knot, knot factor and clearing efficiency, Optimum clearing of yarn; wound yarn package requirements for different weft insertion system and high speed knitting warping; control of ends break in warping, warp beam quality requirements; quality control in size recipe, size pick-up control, yarn stretch control, quality requirements of sized beam – defects and their causes and remedies. Control of productivity in winding, warping and sizing; Waste control in winding, warping and sizing.

### **UNIT II WEAVING**

**12**

Loom accessories – quality requirements and its effects on loom performance; control of cross ends and missing ends. Loom shed productivity control – loom speed, loom efficiency, loom stops. Fabric quality control – fabric defects and their causes and remedies; process control for weaving filament, blend yarn and dyed yarn.

### **UNIT III KNITTING**

**12**

Types of stitches and their influence on knit fabric properties; weft knitting – method of setting the machine, factors affecting the formation of loops in weft knitting, performance of different yarns, Fabric defects- causes and remedies.

### **UNIT IV NON-WOVEN**

**12**

Quality control in web preparation; Influence of material and process parameters on fabric quality and performance.

### **UNIT V UNCONVENTIONAL FABRIC FORMATION**

**12**

3D Fabrics – Structure, Comparison of 2D and 3D fabrics, classifications; Multilayer fabrics – theory, weaving process, fabric properties, applications; 3 D orthogonal weaving – weaving principles, properties and applications; 3D Braiding – 2D braiding, 3 D braiding, multilayer interlock braiding, properties and applications of braided fabric ; concept of 3D multi axial warp knitting.

**TOTAL : 60 PERIODS**

## TEXT BOOKS

1. Russel S.J., "Hand book of nonwovens", Wood head Publishers, Cambridge, England, 2007.
2. Albrecht W., Fuchs K. and Kittleman W., "Nonwoen fabrics", Wiley Vch, 2003, ISBN :3-527-30406-1
3. Anadur S., "Handbook of weaving", CRC Press, London, 2001.
4. Paliwal M.C. and Kimothi P.D., Process control in weaving, ATIRA Publications.
5. Lord P.R. and Mohamed M.H., "Weaving: Conversion of yarn to fabric", Merrow, 1992, ISBN: 090409538X
6. Booth J.E., "Textile Mathematics-Volume 3", The Textile Institute, Manchester, 1977, ISBN: 090073924X.
7. Talukdar M.K., Sriramulu P.K. and Ajgaonkar D.B., "Weaving: Machines, Mechanisms, Management", Mahajan Publishers, Ahmedabad, 1998, ISBN: 81-85401-16-0
8. Ajgaonkar D.B., "Knitting technology", Universal Publishing Corporation, Mumbai, 1998, ISBN: 81-85027-34-X.
9. Chandrasekhar Iyer, Bernd Mammel and Wolfgang Schach., "Circular knitting", Meisenbach GmbH, Bamberg, 1995, ISBN: 3-87525-066-4.
10. Spencer D.J., "Knitting Technology", III Ed., Textile Institute, Manchester, 2001, ISBN:185573 333 1.
11. Samuel Raz., "Warp knitting production", Melliland Textilberichte, GmbH, Rohrbacher, 1987, ISBN: 3-87529-022-4.
12. Lunenschloss J., Albrecht W. and David Sharp, "Non-woven Bonded Fabrics", Ellis Harwood Ltd., New York, 1985, ISBN: 0-85312-636-4.
13. Hu J., "3-D fibrous assemblies: Properties, applications and modelling of three-dimensional textile structures", Woodhead Publishing Ltd., ISBN 1 84569 377 9.

**TX7103**

**TEXTILE QUALITY EVALUATION**

**L T P C  
4 0 0 4**

## OBJECTIVES

To make the students to

- Understand different characteristics of yarns and fabrics
- Understand the effects of fabric characteristics on its end uses
- Analyze the various reports generated during quality evaluation of yarns and fabrics and
- Interpret the results obtained through these reports for process and quality control.

## OUTCOME

Upon completion of this course, the student shall be able to apply the knowledge gained to

- Analyze and interpret the results obtained from quality evaluating systems of yarns and fabrics and
- Design fabrics with appropriate characteristics for the required end uses.

## UNIT I

### MASS VARIATION OF TEXTILE STRANDS

**5**

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

## UNIT II

### VARIANCE LENGTH CURVES AND SPECTROGRAM OF TEXTILE STRANDS

**13**

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 III TENSILE PROPERTIES OF YARN 5**

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

**MECHANISM OF FABRIC FAILURE 4**

Mode of fabric failure – tensile, tear, abrasion, slippage, bursting and fatigue; influence of fibre, yarn characteristics and fabric structure on fabric failure

**UNIT IV COMFORT AND LOW STRESS MECHANICAL PROPERTIES 9**

Role of transmission properties on thermal properties and thermal comfort viz., air permeability, water vapour permeability, resistance to penetration of liquid water, resistance to flow of heat and electrical conductivity; low stress mechanical properties during tensile, compression, bending, shear and buckling deformation; influence of low stress mechanical properties of fabrics on fabric handle, tailorability and sewability

**UNIT V FABRIC APPEARANCE AND OTHER PROPERTIES 9**

Study of fabric appearance in terms of drape, formability, crease recovery, wrinkle recovery and pilling resistance; influence of fibre, yarn characteristics and fabric structure on the fabric appearance; evaluation of fabric properties like dimensional stability, flammability, impact resistance, absorbency

**PRACTICALS 30**

1. Measurement of U% of sliver, roving and yarn
2. Measurement of imperfections and hairiness of yarn
3. Analysis of variance-length curve
4. Analysis of spectrogram
5. Measurement and analysis of single yarn tensile properties
6. Study of creep behaviour of yarn
7. Measurement and analysis of yarn faults
8. Measurement and analysis of surface and compression property of fabric

**TOTAL : 75 PERIODS**

**REFERENCES:**

1. Furter R., "Evenness testing in yarn production: Part I", The Textile Institute, Manchester, 1982.
2. Furter R., "Evenness testing in yarn production: Part II", The Textile Institute, Manchester, 1982.
3. Furter R., "Strength and elongation testing of single and ply yarns", The Textile Institute, Manchester, 1985.
4. Steadman R.G., "Cotton testing", Textile Progress, Vol. 27, No.1.Text.Inst, 1997, ISBN:1870812859.
5. Lord P.R. and Grover G., "Roller drafting", Textile Progress, Vol. 23 No.4, Textile Institute, 1993, ISBN:1870812468.
6. "Instrumentation in the textile industry", Vol. 1; 1996, Instrument Society of America, 1997, ISBN:1556175973.
7. Kothari V.K., "Progress in Textiles: Science & Technology Vol. 1, Testing and Quality Management", IAFL Publications, New Delhi, 1999, ISBN: 81-s901033-0-X.
8. Slater K., Charles C., Thomas Springfield I.L., "Human Comfort", 1985.
9. Bishop D.L., "Fabrics: Sensory and Mechanical Properties", Textile Progress Vol. 26/3, 1994. ISBN: 1870812751.
10. Ukponmwan J., Mukhopadhuau A. and Chatterjee K., "Pilling", Textile Progress, Vol. 28/3, 1996. ISBN: 1870372153.
11. Li, "The Science of Clothing Comfort", Textile Progress, Vol., 29/3, 1997, ISBN: 1870372247.
12. Seyam, "Structural Design of Woven Fabric: Theory and Practice", Textile Progress, Vol., 31/3, 1999.
13. Laing and Sleivert, "Clothing Textiles and Human Performance", Textile Progress, Vol. 32/4, 2000.
14. Ponmwan, J.O, "The Thermal Insulation Properties on fabrics", Textile Progress, Vol. 24, No.4, Textile Institute, 1993, ISBN: 1870812654.

**OBJECTIVES**

To enable the students to learn about the

- fibre forming polymer characteristics and their related models and
- models describing fibre structure.

**OUTCOME:**

Upon completion of this course, the student shall be able to correlate the physical properties of polymer to its microstructure.

**UNIT I****12**

Synthetic fibre forming polymers, definition, terms and fundamental concepts of polymerization; molecular architecture in polymers-configuration and conformation, random chain model and rms end-to-end distance of polymeric chain

**UNIT II****12**

Glass transition temperature (T<sub>g</sub>), Factors affecting T<sub>g</sub>, WLF equation; Rubber Elasticity; Melting and Crystallization, polymer solutions- solubility parameter and its significance to fibre spinning.

**UNIT III****12**

Newton's law of viscosity, velocity distribution in flow systems Newtonian and non-newtonian fluids; mass transfer operations: Fick's law of diffusion, solid-liquid extraction and drying operations with application to polymer chips.

**UNIT IV****12**

Deformation of elastic solid, viscoelasticity and its measurement, non-linear viscoelasticity, yield behavior of solids and breaking phenomena

**UNIT V****12**

Models describing fibre structure, Fringed fibrillar and fringed micellar model, One phase model.

**TOTAL : 60 PERIODS****REFERENCES**

1. Billmeyer, "Textbooks of Polymer Science", 3<sup>rd</sup> ed., Wiley, 1984.
2. Sperling, "Introduction to Physical Polymer Science", Wiley, 1986.
3. Odian, "Principle of Polymerization", 3<sup>rd</sup> ed., Wiley, 1991.
4. Gordon, "High Polymers", Addison-Wesley, 1963.
5. Gupta.V.B. and Kothari V.K., "Man Made Fibre Production", Chapman and Hall, 1985
6. Kothari V.K., "Textile Fibres: Developments and innovations", IAFL Publication, 2000
7. Hongu T. and Philips G., "New Fibres", Wood Head Publishing Ltd, 1997

**OBJECTIVES**

To Enable the students to learn various finishes applied on the textile fabrics for different applications.

**OUTCOME**

Upon completion of this course, the student shall be able to state the

- Need for functional finishes and
- Methods of application of finishes and its evaluation.

<b>UNIT I</b>	<b>REPELLENCY FINISH</b>	<b>12</b>
Wetting and Wicking; surface energy – concept, measurement and relevance to repellency; repellents applied to textile substrates; repellency tests; application of repellents by impregnation, coating and surface modification techniques.		
<b>UNIT II</b>	<b>SOIL RELEASE AND ANTISTATIC FINISHING</b>	<b>12</b>
Detergency and soil release concepts; soil release agents; applications of soil- release finishes and testing; antistatic finishes- measurement, mechanism and antistatic agents applied on substrates.		
<b>UNIT III</b>	<b>FLAME PROOFING</b>	<b>12</b>
Terminology related to flammability; flame retardant mechanisms; flame retarding chemicals for textile materials and testing of flame retardant finishes.		
<b>UNIT IV</b>	<b>UV PROTECTION</b>	<b>12</b>
UV radiation; factors affecting UV protection; UV protection finishes; measurement of UV protection.		
<b>UNIT V</b>	<b>ANTIMICROBIAL FINISH</b>	<b>12</b>
Basic of microbiology; classification; chemistry and application of antimicrobial finishes; evaluation of antimicrobial finishes.		

**TOTAL : 60 PERIODS**

**REFERENCES**

1. Nierstrasz V. and Cavaco-Paulo A., “Advances in textile biotechnology”, Woodhead Publishing Ltd, Cambridge, UK, 2010.
2. Schindler W. D. and P J Hauser P. J., “Chemical finishing of textiles” Woodhead Publishing Ltd, Cambridge, UK, 2004.
3. Cavaco-Paulo A. and Gubitz G., “Textile processing with enzymes”, Woodhead Publishing Ltd, Cambridge, UK, 2003.
4. Heywood D., “Textile finishing ”, Woodhead Publishing Ltd, Cambridge, UK, 2003.
5. Rouette H. K., “Encyclopedia of textile finishing: English Version, Vol. 3 ”, Woodhead Publishing Ltd, Cambridge, UK, 2001.

<b>TX7201</b>	<b>STATISTICS FOR TEXTILE ENGINEERING</b>	<b>L T P C</b>
		<b>3 1 0 4</b>

**OBJECTIVES**

To make the students to learn about the

- Probability distributions, sampling and testing of hypothesis
- Process control using charts and process capability
- Design of experiments for textile applications and
- Modeling the probabilistic phenomena.

**OUTCOME**

Upon completion of this course, the student shall be able to

- Design the experiment, conduct statistical tests and analyse the results to arrive at the conclusions
- Study the capability of process and control the process based on data available and
- Make decisions with minimum error from available data.

<b>UNIT I</b>	<b>PROBABILITY DISTRIBUTION AND ESTIMATIONS</b>	<b>6</b>
Applications of Binomial, Poisson, normal, t, exponential, chi-square, F and Weibull distributions in textile engineering; point estimates and interval estimations of the parameters of the distribution functions		





**UNIT III WICKING AND WETTING 12**

Definitions; wetting – adhesive forces and interactions across interfaces; Surface tension; curvature; roughness and their effects on wetting phenomena. Wicking phenomena in fibrous materials – Capillarity; Hysteresis effects; Instability of liquid flow; Liquid spreading, absorbency in fibrous assemblies.

**UNIT IV HEAT AND MOISTURE INTERACTIONS 12**

Principles of Moisture diffusion; Thermal conduction and moisture diffusion in fibrous materials – Thermal conduction analysis; Effective thermal conductivity (ETC) for fibrous materials; Prediction of ETC by thermal resistance networks, volume averaging method and homogenization method; Structure of plain weave woven fabric composites and the corresponding unit cell

**UNIT V PHYSIOLOGICAL COMFORT 12**

Neuro physiological comfort – basis of Sensory Perceptions, measurement techniques – Mechanical Stimuli and thermal stimuli. Fabric tactile and mechanical properties – fabric prickliness, itchiness, stiffness, softness, smoothness, roughness, and scratchiness. Predictability of clothing comfort performance.

**TOTAL : 60 PERIODS**

**REFERENCES**

1. Hassan M. Behery, "Effect of Mechanical and Physical Properties on Fabric Hand", Wood head Publishing Ltd., ISBN 0-8493-3479-9.
2. Li Y., "The Science of Clothing Comfort", Textile Progress 31:1
3. Laing, R.M. and Sleivert G.G., "Clothing, Textile and Human Performance, Textile Progress, 32:2
4. Pan N. and Gibson P., Thermal and moisture transport in fibrous materials Wood head Publishing Limited ISBN-10: 1-84569-226-8.

**TX7001 THEORY OF YARN STRUCTURES L T P C  
4 0 0 4**

**OBJECTIVES**

To enable the students to learn about the structure of ideal and real yarn, migration of fibres in the yarn, breakage mechanism of yarn, mechanics of blended yarns and relationship between structure and property of yarns produced by different spinning systems.

**OUTCOME**

Upon completion of this course, the student shall be able to apply the knowledge gained to

- Estimate the parameters related by structure of yarn and
- Engineer the structure of yarn with required properties and end uses.

**UNIT I YARN GEOMETRY 18**

Elements of yarn geometry; geometry of helix and its application to yarn structures; yarn diameter, packing of fibres in yarn; estimation of packing density and radial packing density of yarn; geometry of folded yarns

**UNIT II FIBRE MIGRATION 6**

Migration characteristics in continuous filament and spun yarns; effect of various parameters on migration; measurement of fibre migration in yarn; effect of migration on tensile behaviors and hairiness of the yarn

**UNIT III YARN MECHANICS 12**

Analysis of tensile behavior, prediction of breakage - continuous filament yarn and spun yarn; effect of fibre properties and geometrical configuration of yarn on the tensile and bending properties of yarn; design of yarn structures for certain functional uses



3. Hu W., "Structure and mechanics of woven fabrics", Woodhead Publishing Limited, Cambridge, England, ISBN: 1-85573 904 – 6.
4. Dubruvski D., "Woven fabric Engineering", 2010, Sciyo, ISBN :978-953-307-194-7.
5. Dabiyan H., "Analysis of warp knitted structure, Part I, II, III & IV", Journal of The Textile Institute, 2012 Vol 102.

**TX7003**

**MANAGEMENT OF RESEARCH AND DEVELOPMENT**

**L T P C  
4 0 0 4**

**OBJECTIVES**

To enable the students to learn about the

- Management of Research and Development activity in industry
- Regulations governing R&D activities.

**OUTCOME**

Upon completion of this course, the student shall be able to manage R & D activities in organizations

**UNIT I**

**6**

Technological Innovation- types, nature, processes, need and importance; R&D - in world economic development, Indian economic development; R&D - corporate function and for strategic partnership in industries; innovation and creativity

**UNIT II**

**12**

Innovation focus in textiles organisations; HRM issues in textile innovations, leadership and innovation management in textile industries; organizational design and structure in textile innovation management; measurement, evaluation and assessment of R&D

**UNIT III**

**12**

Indian R&D infrastructure and Institutional framework; R&D promotion, incentives and support, cooperation between industry, institution and government Departments; commercialization of R &D; financing of R&D projects

**UNIT IV**

**12**

Concept of intellectual property, different types of IP, rationale behind intellectual property, balancing the rights of the owner of IP and society, enforcement of IPR; IP and constitution of India, world intellectual property organization (WIPO), WTO/TRIPS agreement, India and the TRIPS agreement; Patent law in India, interpretations and implementations, transitional period.

**UNIT V**

**18**

International patent laws, the patent cooperation treaty; Madrid system of international registration of trade marks, Hague system of international protection of industrial designs, The Lisbon agreement of protection of appellations of origin; Indian patent system, patentable inventions, difference between patentable and non patentable inventions; procedure for obtaining patent, consequences of grant of patent, rights of a patentee, limitations on patentee's rights, revocation of patent for non-working; transfer of patent, licence, transmission of right by operation of law, infringement of patent; Case studies relevant to textile patents

**TOTAL : 60 PERIODS**

**REFERENCES**

1. Alexander Stack, "International Patent Law", Edward Elgar Publishing Limited, 2011, ISBN: 9781849802581.
2. Allan Afuah, "Innovation Management, 2/e", Oxford University press India, 2009, ISBN:9780198064169.

3. Joe Tidd and John Bessant, "Managing Innovation: Integrating Technological, Marketing and Organizational Change", IV Edition, John Wiley India Pvt. Ltd New Delhi, 2011, ISBN 13:9788126534050.
4. Rao M.B. and Manjula Guru " Patent Law in India", Wolters Kluwer Law and Business, 2010, ISBN 13: 9789041132604
5. "Managing Innovation in Textiles 2011-International conference", Textile Institute, Manchester, UK, 2011, ISBN:9780956641922

**TX7004 ENZYME TECHNOLOGY FOR TEXTILE PROCESSING**

**L T P C  
4 0 0 4**

### **OBJECTIVES**

To enable the students to learn about

- Enzymes, types and kinetics of enzyme reaction on textile fibres
- Application of enzymes on different fibres and
- Treatment of enzyme effluents.

### **OUTCOME**

Upon completion of this course, the student shall be able to

- Give the rationale for selecting enzymes for particular processing and
- Appreciate limitations of existing processing operations using chemicals.

### **UNIT I 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.

### **UNIT II ENZYME KINETICS 12**

Kinetics of single-substrate enzyme-catalysed reactions; Basics of kinetics of multi-substrate enzyme-catalysed reactions.

### **UNIT III ENZYMES FOR COTTON FIBRE 12**

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

### **UNIT IV ENZYMES FOR OTHER FIBERS 12**

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

### **UNIT V ENZYMES IN EFFLUENT TREATMENT 12**

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

**TOTAL : 60 PERIODS**

### **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 Gubitx G., "Textile processing with enzymes", Woodhead Publishing Ltd, Cambridge, UK, 2003.

**OBJECTIVES**

To enable the students to learn about

- Pollutants from textile chemical processing industry, treatment and Government regulations.

**OUTCOME**

Upon completion of this course, the student shall know

- The hazards due to pollutants from textile chemical processing industry
- Method of treatment of pollutants
- Managing pollutants as per Government regulations and
- Methods of green processing.

**UNIT I****12**

Industrial policy of India; pollution monitoring and control; functions and activities of Ministry of environment; Central and State pollution control boards; environmental clearance and guidelines for industries; environment impact assessment; fiscal incentives for environmental protection; environmental auditing.

**UNIT II****12**

Wastewater characteristics; wastewater treatment - objectives, methods and implementation considerations; recycling of effluents.

**UNIT III****12**

Identification and reduction of pollution sources in textile wet processing; pollution control in man - made fibre industry; analysis of textile processing effluents – colour, odour, pH, total solids, suspended solids, total dissolved solids, BOD, COD, total alkalinity, chloride, sulphates, calcium and chromium; tolerance limits for effluents; bio - degradability of textile chemicals and auxiliaries.

**UNIT IV****12**

Technical regulations on safety and health aspects of textile materials – banned dyes and chemicals; eco labeling, eco friendly textile processes - machines and specialty chemicals; natural dyes and environmental considerations.

**UNIT V****12**

Need for solid and hazardous waste management in textile industry, types and sources of solid and hazardous wastes, storage, collection and transport of wastes, waste processing technologies, waste disposal

**TOTAL : 60 PERIODS****REFERENCES**

1. Trivedi R.K., "Handbook of Environmental laws, Acts, Guidelines, Compliances and Standards", Vol. 1, Enviro Media, India, 1996.
2. George Thobanoglous and Franklin L. Burton., "Waste Water Engineering and Treatment, Disposal, Reuse (Metcalf & Eddy Inc., California)", Tata McGraw-Hill Publishing co Ltd, New Delhi, 1995.
3. Manivasakam N., "Treatment of Textile Processing Effluents (including analysis)", Sakhi Publications, Coimbatore, 1995.
4. "Eco-Textiles: Regulations, Labels, Processing and Testing, A Special Report", The Bombay Textile Research Association, Mumbai, 1996.
5. "Symposium Proceedings on Eco - Friendly Textile Processing", Department of textile Technology, Indian Institute of Textile Technology, New Delhi, 1995.
6. Skelly J. K., "Water Recycling in Textile wet Processing", Woodhead Publishing Ltd, 2003.
7. Cooper P., " Colour in Dyehouse Effluent", Woodhead Publishing Ltd, 1995.
8. Slater K., "Environmental impact of textiles: Production Processes and Protection", Woodhead Publishing Ltd, 2003.
9. Chrutie R., "Environmental aspects of textile dyeing", Woodhead Publishing Ltd, 2007.

**OBJECTIVES**

To enable the students to learn about fluid flow and its related aspects with respect to melt and solution spinning.

**OUTCOME**

Upon completion of this course, the student shall be able to

- Characterize rheological behaviour of fluids and
- Analyse the effect of molecular parameters on the fluid flow.

**UNIT I****18**

Basic modes of deformation, Startup deformation, Step strain, Oscillatory shear; Linear responses-Elastic Hookean solids, Viscous Newtonian liquids and non Newtonian fluids; Viscoelastic responses - Boltzmann superposition principle, Maxwell model ; Classical rubber elasticity.

**UNIT II****12**

Viscosity-Effect of Pressure, temperature, activation energy, molecular weight and molecular weight distribution on viscosity, crosslinking, crystallinity branching, copolymerization, fillers, plasticizers and shear rate dependence of viscosity

**UNIT III****12**

Laminar flow through various profiles, flow analysis - power law, turbulent flow analysis, turbulence dumping.; rheological models for extensional viscosity; Flow in conical-cylindrical dies – pressure drop due to shear, extensional flow and pressure drop at die entry, flow in wedge shaped die; Swelling due to shear stresses and swelling due to tensile stresses.

**UNIT IV****12**

Shear rheometry- Linear displacement, Sliding plate rheometer, Co-cylinder axial sliding rheometer; Rotational motion - Parallel disks, Cone-plate and. Cone-partitioned plate; Rheo-optical methods- Flow birefringence, Scattering (X-ray, light, neutron), Spectroscopy (NMR, fluorescence, IR, Raman, dielectric)

**UNIT V****6**

Rheological behaviour of important thermoplastics, Applications of rheology to polymer processing.

**TOTAL : 60 PERIODS****REFERENCES**

1. Brydson J.A., "Flow properties of polymer melts", life books, London, 1978.
  2. Richard C. Progelhof and James L. Throne, "Polymer Engineering Principles", Hanser Publishers, New York, 1993.
  3. John M. Dealy and Kurt F. Wissburn, "Melt rheology and its role in plastics Processing", Chapman, London, 1995.
  4. Lenk R.S., "Polymer Rheology", Applied Science, London, 1978.
  5. Crawford R.J., "Plastics Engineering", Butterworth – Heinemann, Oxford, 1998
  6. Ferry J.D., "Viscoelastic Properties of Polymers", John Wiley & Sons, New York, 1986.
- Chang Dae Han, "Rheology in Polymer Processing", Academic Press, New York, 1976

**OBJECTIVES**

To enable the students to learn about

- Reinforcements, matrices used for the composites
- Manufacture and testing of composites and
- Mechanics of failure of composites.

## OUTCOME

Upon completion of this course, the student shall be able to

- Select different types of textile reinforcements and matrices used for the manufacture of composites and their behaviours and
- Evaluate the characteristics of composites.

### UNIT I REINFORCEMENTS 12

Manufacturing, properties and applications of Glass, Quartz, Boron, Silicon carbide, Carbon, HPPE and Aramid fibers.

### UNIT II MATRICES 12

Preparation, Chemistry, Properties and applications of thermoplastic and thermoset resins- Unsaturated Polyester, Vinyl Ester, Epoxy, Phenolics, polyimides, polyurethanes, polyamides, Polypropylene, PEEK and Polycarbonate

### UNIT III COMPOSITE MANUFACTURING 12

Composites manufacturing for both thermoplastics and thermosets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and Composite design requirements

### UNIT IV TESTING 12

Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, interlaminar shear stress and fatigue properties of thermoset and thermoplastic composites

### UNIT V MECHANICS 12

Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory, failure theories and interlaminar stresses.

**TOTAL : 60 PERIODS**

## REFERENCES

1. Mel. M. Schwartz, "Composite Materials", Vol. 1 & 2, Prentice - Hall PTR, New Jersey, 1997.
2. Bor Z.Jang, "Advanced Polymer composites", ASM International, USA, 1994.
3. Carlsson L.A. and Pipes R.B., "Experimental Characterization of advanced composite Materials", Second Edition, CRC Press, New Jersey, 1996.
4. George Lubin and Stanley T. Peters, "Handbook of Composites", Springer Publications, 1998.
5. Richard M. Christensen, "Mechanics of composite materials", Dover Publications, 2005.
6. Sanjay K. Mazumdar, "Composites Manufacturing: Materials, Product, and Process Engineering", CRC Press, 2001.

**TX7008**

**ALTERNATIVE SPINNING SYSTEMS**

**L T P C  
4 0 0 4**

## OBJECTIVES

To enable the students to learn the

- Theory of yarn formation by rotor spinning, friction spinning, air-jet spinning and other spinning systems and
- Effect of process parameters used in the spinning system on yarn quality.

## OUTCOME

Upon completion of this course, the student shall be able to select

- Process parameters for producing better quality yarn and
- Spinning system to be used (a) for raw materials of different qualities and types and (b) to produce yarn for specific end use.



**UNIT I ROTOR SPINNING 24**

Principle of open end spinning; description of the working of the rotor spinning; requirements of the raw materials; preparation of the sliver for rotor spinning; yarn formation and its structure; yarn withdrawal and winding; design of rotor, opening roller, transport tube, navel and their implications on production and yarn quality; developments in rotor spinning machine; production limits; process control; techno economic comparison with ring spinning.

**UNIT II FRICTION SPINNING 12**

Principle of yarn formation - DREF-2, DREF-3 spinning systems; developments in friction spinning systems; raw material requirement; effect of process variables on yarn quality; application of these machines for different end products; the economics; technological limitations.

**UNIT III AIR-JET SPINNING 12**

Description of the yarn production in air jet spinning machine; feasibility of higher draft applied in this machine; structure and quality of the air-jet spun yarn; raw materials requirement; process variables; production of by Airvortex system.

**UNIT IV OTHER SPINNING TECHNOLOGIES 12**

Production of yarn in PLYfil, self twist, electrostatic, Bobtex spinning systems; working details of the production of double-rove yarns, wrap yarns and core spun yarns; use of raw materials; economics of these methods of yarn production; yarn characteristics and their applications.

**TOTAL : 60 PERIODS**

**REFERENCES**

1. Oxtoby E., "Spun Yarn Technology", Butterworths, London, 1987.
2. Klein W., "New Spinning Methods ", The Textile Institute, Manchester, 1993.
3. Dyson E., "Rotor Spinning, Technical and Economics Aspects ", Textile Trade Press, New Mills, Stock Port, 1975.
4. Salhotra K.R. and Ishtiaque S.M., " Rotor Spinning; its advantages ", Limitations and Prospects in India, ATIRA, Ahmedabad, 1995.
5. Lord P.R, " Yarn Production; Science, Technology and Economics ", The Textile Institute, Manchester, 1999.
6. Trommer G., "Rotor Spinning", Meliand Textilebenchte GmbH, Rohrbacher, 1995.
7. Lawrence C.A and Chen K.Z., "Rotor Spinning ", Textile Progress, The Textile Institute, Manchester, 1984.
8. Lawrence C. A., "Advances in yarn spinning technology" Wood head publishing, 2010, ISBN-13: 978 1 84569 444 9.

**TX7009 DESIGN AND ANALYSIS OF TEXTILE EXPERIMENTS L T P C  
4 0 0 4**

**OBJECTIVES**

To make the students to learn about the

- Fundamentals of experimental design and
- Selection of suitable design and analysis of the results.

**OUTCOME**

Upon completion of this course, the student shall be able to

- Design the experiment suitable for a given study and
- Conduct statistical tests and analyze the results to arrive at the conclusions.

**UNIT I EXPERIMENTAL DESIGN FUNDAMENTALS 12**

Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression model.

**UNIT II SINGLE FACTOR EXPERIMENTS 12**

Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests, in respect of textile process, machine and quality parameters.

**UNIT III MULTIFACTOR EXPERIMENTS 12**

Two and three factor full factorial experiments,  $2^k$  factorial Experiments, Confounding and Blocking designs; application in textile experiments.

**UNIT IV SPECIAL EXPERIMENTAL DESIGNS 12**

Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methodology, Experiments with random factors, rules for expected mean squares, approximate F- tests for textile applications.

**UNIT V TAGUCHI METHODS 12**

Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design-control and noise factors, S/N ratios, parameter design, case studies related to textile engineering.

**TOTAL : 60 PERIODS**

**REFERENCES**

1. Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, 2003.
2. Nicolo Belavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.
3. Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996.
4. Leaf G.A.V., "Practical Statistics for the Textile Industry, Part I and II", The Textile Institute, Manchester, 1984, ISBN:0900739517.

**TX7010 COLOUR SCIENCE AND ITS APPLICATIONS LT P C  
4 0 0 4**

**OBJECTIVES**

To enable the students to learn about colour description and colour measurement.

**OUTCOME**

Upon completion of this course, the student shall become knowledgeable about Fundamentals of colour measurement and Prediction of recipe for colour matching.

**UNIT I COLOUR AND COLOUR VISION 12**

Definition of colour and its classification; Structure and function of the eye — Detail and study about eye and brain system; colour consistency tests for defective colour vision.

**UNIT II COLOUR DESCRIPTION 12**

Arrangement of colour; visual attribution of colour; Beer-Lambert's law; colour primaries and colour mixing; additive and subtractive colour mixing; colour specification; colour order systems – Munsel, Ostwald and CIE colour order systems.

**UNIT III COLOUR MEASUREMENT 12**

Principles of colour measurement; Tristimulus values; CIE diagram; standard Illuminant; standard observer; spectral reflectance; graphical and numeric representations.

**UNIT IV COLOUR MATCHING 12**

Definition; Manual colour matching; single constant Kubelka – Munk theory, spectral and tristimulus match; Metamerism; Concept of computer colour matching system. Application of CCM system to Textile processing; Advantages and Limitations of CCM system.

**UNIT V COLOUR DIFFERENCE AND COLOUR PREDICTION 12**

Colour difference - Perceptibility and acceptability; methods of assessment of colour difference formula; Measurement of fluorescence – Visual, photoelectric colourimeter and Spectro photometric; Characterisation of colour displays; colour mapping for two-dimensional texture image; texture effect on visual colour difference evaluation; colour synthesis for three-dimensional objects.

**TOTAL : 60 PERIODS****REFERENCES**

1. Shah H. S. and Gandhi R. S., "Instrumental colour measurement and computer aided colour matching for textiles", Mahajan Book Publication, 1990.
2. Park J., "Instrumental Colour formulation: A Practical guide", Woodhead Publishing, 1993, ISBN 0 901956 54 6.
3. Choudhury A. K. R., "Modern concepts of colour and appearance", Oxford and IBH Publishing Ltd, 2000.
4. Sule A. D., "Computer colour analysis", New Age International Publishers, 2002.
5. Mc Laren K., "The color science of Dyes & Pigments", Adam Hilger Ltd., 1983, ISBN 0-85274-426-9.

**TX7011 CHARACTERIZATION OF TEXTILE POLYMERS L T P C  
4 0 0 4****OBJECTIVE**

To enable the students to learn about different characteristics and their evaluation of polymers used in the production of textile fibres.

**OUTCOME**

Upon completion of this course, the student shall be able to interpret data obtained from various analytical instruments.

**UNIT I MOLECULAR WEIGHT 12**

Polymer solution thermo dynamics; molecular weight and molecular dimensions by end group analysis, osmometry, light scattering, viscometry, gel permeation chromatography, high performance liquid chromatography.

**UNIT II MOLECULAR STRUCTURE CHARACTERISATION 18**

Infrared, NMR, UV-visible, Raman spectroscopy, mass spectroscopy

**UNIT III THERMAL PROPERTIES 12**

Thermal properties by differential scanning calorimetry, differential thermal analysis, thermo gravimetry, thermo-mechanical analyzer, dynamic mechanical and dielectric analysis

**UNIT IV OTHERS 18**

Optical and electron microscopy; TEM, SEM, AFM, X-ray scattering from polymers, birefringence, crystallinity by density measurements, Surface area, pore volume measurements by B.E.T. method, porosimetry, surface energy measurements and particle size measurement.

**TOTAL : 60 PERIODS****REFERENCES**

1. Gupta V.B. and Kothari V.K., "Man Made Fibre production," Chapman and Hall, 1985.
2. Bill mayer, "Textbooks of Polymer Science," 3<sup>rd</sup> ed., Wiley, 1984.
3. Sperling, "Introduction to Physical Polymer Science," Wiley, 1986.
4. Campell D. and White J.R., "Polymer characterization, Physical Techniques", McGraw – Hill, New York, 1969.
5. Stamm M., "Polymer surfaces and Interfaces", Springer1<sup>st</sup> ed., 2008.



**OBJECTIVES**

To enable the students to learn about

- Different types of biomaterials and
- Biomedical application of textile structures.

**OUTCOME**

Upon completion of this course, the student shall know the

- Types of materials available for biomedical applications
- Functional requirements of textile structures for specific end uses and
- Selection and characterization of textile materials used for biomedical applications.

**UNIT I****12**

Biomaterials—introduction, types; natural, polymeric and biological biomaterials

**UNIT II****12**

Textile based healthcare and hygiene products; application of nano technology in medical hygiene textiles; advanced textile materials in healthcare; infection control and barrier materials; plasma treated barrier materials.

**UNIT III****6**

Bandages and pressure garments - elastic and non elastic compression bandages, support and retention bandages; bandaging textiles; evaluation of bandages; bandages for various end uses.

**UNIT IV****12**

Wound – types, healing process; requirements of wound dressing; wound care materials – types, advantages and limitations; Testing of wound dressings; advanced wound dressings

**UNIT V****18**

Implantable products; sutures – requirements, classifications, specifications, materials and their applications; vascular grafts, artificial ligaments, artificial tendons; scaffolds for tissue engineering; intelligent textiles for medical applications

**TOTAL :60 PERIODS****REFERENCES**

1. Allison Mathews and Martin Hardingham ., “Medical and Hygiene Textile Production - A hand book”, Intermediate Technology Publications, 1994.
2. Anand S.C., Kennedy J.F. Miraftab M. and Rajendran S., “Medical Textiles and Biomaterials for Health care”, Wood head Publishing Ltd. 2006.
3. Joon B. Park. and Joseph D. Bronzino., “Biomaterials – Principles and Applications”,CRC Press Boca Raton London, NewYork, Washington , D.C. 2002
4. Anand S., “ Medical Textiles”, Textile Institute, 1996, ISBN: 185573317X
5. Horrocks A.R. and Anand S.C, “Technical Textiles”, Textile Institute,1999, ISBN: 185573317X.
6. Adanur S., “ Wellington Sears Handbook of Industrial Textiles” Technomic Publishing Co., Inc., Lancaster Pennsylvania 1995, ISBN 1-56676-340-1.
7. Michael Szycher and Steven James Lee, “Modern Wound Dressing: A Systematic Approach to Wound Healing”, Journal of Biomaterials Applications, 1992
8. Rajendran S., “Advanced Textiles for Wound Care”, Woodhead Publishing Ltd., 2009, ISBN 1 84569 271 3.