UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY, CHENNAI

M.TECH. TEXTILE TECHNOLOGY (Regulations 2015)

UNIVERSITY DEPARTMENTS

Programme Objectives:

To enable to graduate students of Textile Technology to

1. Enhance their knowledge related to the theory textile processes and advances in processes
2. Design, conduct and interpret the results of the experiments, Design new process and product for textile industry
3. Manage research and development activities in textile industry, research organizations and
4. Enhance their skills for managing textile industry

Programme Outcomes:

Upon completion of the programme, the student shall be

a. Qualified to effectively teach the students at the undergraduate level
b. Able to develop new process or product at the textile industry or textile research organizations and
c. Qualified to effectively carryout fundamental and applied research.
d. Able to manage textile industry

	1	2	3	4
a	✓			
b	✓	✓	✓	
c	✓	✓	✓	
d	✓			✓

S.No.	Course Code	Course Title	Programme Outcomes			
Theory – Professional Core			a	b	c	d
1.		Colouration and Functional Finishes	✓	✓	✓	✓
2.		Polymer Physics	✓	✓	✓	
3.		Process Control and Fabric Engineering	✓	✓	✓	✓
4.		Theory of Short Staple Yarn Spinning	✓	✓	✓	✓
5.		Clothing Science	✓	✓	✓	
6.		Statistics in Textile Engineering	✓		✓	✓
7.		Textile Quality Evaluation	✓		✓	✓
Theory – Professional Electives						
8.		Alternative Spinning Systems	✓	✓	✓	✓
9.		Characterization of Textile Polymers	✓	✓	✓	
10.		Colour Science and its Applications	✓	✓	✓	
11.		Enzyme Technology for Textile Processing	✓	✓	✓	✓
12.		Management of Research and Development		✓	✓	
13.		Management of Textile Effluents	✓			✓
14.		Medical Textiles	✓	✓	✓	
15.		Structure and Properties of Fabrics	✓	✓	✓	
16.		Textile Polymer Rheology	✓	✓	✓	
17.		Textile Reinforced Composites	✓	✓	✓	
18.		Textiles in Civil Construction and Transportation	✓	✓	✓	
19.		Theory of Yarn Structures	✓	✓	✓	
20.		High Performance Fibres	✓	✓	✓	
21.		Financial Management	✓			✓
22.		Operation Research	✓			✓
23.		Total Quality Management in Textile Industry	✓			✓
24.		Protective Clothing	✓	✓	✓	
25.		Process Control and Optimization of Yarn Spinning	✓			✓
26.		Shuttleless Weaving Technology	✓	✓		✓
Practicals - Employability Enhancement Courses						
27.		Technical Seminar	✓			
28.		Project Work (Phase I)	✓	✓	✓	✓
29.		Industrial Training	✓			✓
30.		Project Work (Phase II)	✓	✓	✓	✓

UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY:: CHENNAI 600 025

REGULATIONS - 2015

I TO IV SEMESTERS CURRICULUM AND SYLLABUS (FULL TIME)

M. TECH. TEXTILE TECHNOLOGY

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	TX7101	Colouration and Functional Finishes	PC	4	4	0	0	4
2.	TX7102	Polymer Physics	PC	5	3	0	2	4
3.	TX7103	Process Control and Fabric Engineering	PC	4	4	0	0	4
4.	TX7104	Theory of Short Staple Yarn Spinning	PC	4	4	0	0	4
5.		Elective I	PE	3	3	0	0	3
			TOTAL	**20**	**18**	**0**	**2**	**19**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	TX7201	Clothing Science	PC	4	4	0	0	4
2.	TX7202	Statistics in Textile Engineering	PC	4	4	0	0	4
3.	TX7203	Textile Quality Evaluation	PC	5	3	0	2	4
4.		Elective II	PE	3	3	0	0	3
5.		Elective III	PE	3	3	0	0	3
Practicals								
6.	TX7211	Technical Seminar	EEC	2	0	0	2	1
			TOTAL	**21**	**17**	**0**	**4**	**19**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Elective IV	PE	3	3	0	0	3
2.		Elective V	PE	3	3	0	0	3
3.		Elective VI	PE	3	3	0	0	3
Practicals								
4.	TX7311	Industrial Training	EEC	0	0	0	0	1
5.	TX7312	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**16**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
Practicals								
1.	TX7411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL CREDITS : 66

Professional Core (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Colouration and Functional Finishes	PC	4	4	0	0	4
2.		Polymer Physics	PC	5	3	0	2	4
3.		Process Control and Fabric Engineering	PC	4	4	0	0	4
4.		Theory of Short Staple Yarn Spinning	PC	4	4	0	0	4
5.		Clothing Science	PC	4	4	0	0	4
6.		Statistics in Textile Engineering	PC	4	4	0	0	4
7.		Textile Quality Evaluation	PC	5	3	0	2	4

Professional Electives (PE)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	TX7001	Alternative Spinning Systems	PE	3	3	0	0	3
2.	TX7002	Characterization of Textile Polymers	PE	3	3	0	0	3
3.	TX7003	Colour Science and its Applications	PE	3	3	0	0	3
4.	TX7004	Enzyme Technology for Textile Processing	PE	3	3	0	0	3

5.	TX7007	Management of Research and Development	PE	3	3	0	0	3
6.	TX7008	Management of Textile Effluents	PE	3	3	0	0	3
7.	TX7009	Medical Textiles	PE	3	3	0	0	3
8.	TX7014	Structure and Properties of Fabrics	PE	3	3	0	0	3
9.	TX7015	Textile Polymer Rheology	PE	3	3	0	0	3
10.	TX7016	Textile Reinforced Composites	PE	3	3	0	0	3
11.	TX7017	Textiles in Civil Construction and Transportation	PE	3	3	0	0	3
12.	TX7018	Theory of Yarn Structures	PE	3	3	0	0	3
13.	TX7006	High Performance Fibres	PE	3	3	0	0	3
14.	TX7005	Financial Management	PE	3	3	0	0	3
15.	TX7010	Operation Research	PE	3	3	0	0	3
16.	TX7019	Total Quality Management in Textile Industry	PE	3	3	0	0	3
17.	TX7012	Protective Clothing	PE	3	3	0	0	3
18.	TX7011	Process Control and Optimization of Yarn Spinning	PE	3	3	0	0	3
19.	TX7013	Shuttleless Weaving Technology	PE	3	3	0	0	3

Employability Enhancement Courses (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Technical Seminar	EEC	2	0	0	2	1
2.		Project Work (Phase I)	EEC	12	0	0	12	6
3.		Industrial Training	EEC	0	0	0	0	1
4.		Project Work (Phase II)	EEC	24	0	0	24	12

TX7101 COLORATION AND FUNCTIONAL FINISHES L T P C

4 0 0 4

OBJECTIVES

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

UNIT I INKJET PRINTING 12

Concept and, methods of inkjet printing; colour separation; selection of dyes and developments in inks; techno-economical features.

UNIT II ENZYMES IN PROCESSING 12

Enzymes; Enzymes Kinetics; Enzymes in Chemical processing

UNIT III COATING 12

Coating polymers and auxillaries; Coating techniques and Coated fabric assessment.

UNIT IV SOIL RELEASE AND ANTISTATIC FINISHING 12

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.

UNIT V UV PROTECTION AND APPLICATIONS OF NANOTECHNOLOGY 12

UV radiation; factors affecting UV protection; UV protection finishes; measurement of UV protection. Synthesis of Nanomaterials used in Textiles; Nanocoating methods on textile substrates.

TOTAL : 60 PERIODS

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

REFERENCES

1. Park J., “Instumental Colour formulation: A Practical guide”, Woodhead Publishing, 1993, ISBN 0 901956 54 6.
2. Choudhury A. K. R., “Modern concepts of colour and appearance”, Oxford and IBH Publishing Ltd, 2000.
3. Sule A. D., “Computer colour analysis”, New Age International Publishers, 2002.
4. Mc Laren K., “The color science of Dyes & Pigments”, Adam Hilger Ltd., 1983, ISBN 0-85274-426-9.
5. Freifelder D., "Molecular Biology ", Jones andBartlett Publishers Inc. 1987.
6. Nierstrasz V. and Cavaco- Paulo A., “Advances in textile biotechnology”, Woodhead Publishing Ltd, Cambridge, UK, 2010.
7. Cavaco -Paulo A. and Gubitz G., “Textile processing with enzymes”,Woodhead Publishing Ltd, Cambridge, UK, 2003.
8. Ujiie H.,”Digital Printing of Textiles”, Woodhead Publishing Ltd, Cambridge, UK, 2006.

TX7102 **POLYMER PHYSICS** **L T P C**
3 0 2 4

OBJECTIVES

To enable the students to learn about

- Fibre forming polymer characteristics and their related models and models describing fibre structure.
- Conducting of experiments to characterize the polymers and fibres

UNIT I **9**

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 **9**

Glass transition temperature (Tg), Factors affecting Tg, WLF equation; Rubber Elasticity; Melting and Crystallization, polymer solutions- solubility parameter and its significance to fibre spinning.

UNIT III **9**

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 **9**

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

UNIT V **9**

Mechanical properties of natural and synthetic fibres, moisture sorption behaviour of natural and synthetic fibres. Models describing fibre structure, Fringed fibrillar and fringed micellar model, One phase model.

PRACTICALS: **30**

1. Analysis of fibres using FTIR
2. Analysis of fibres using TGA
3. XRD graph analysis of various fibres
4. Crystallinity determination using FTIR and XRD
5. Wettabilty analysis of various fibres assemblies

TOTAL: 75 PERIODS

OUTCOMES

Upon completion of this course, the student shall be

- able to correlate the physical properties of polymer to its microstructure
- able to characterize polymers and fibres

REFERENCES

1. Billmeyer, "Textbooks of Polymer Science",3rd ed., Wiley, 1984.
2. Sperling, "Introduction to Physical Polymer Science", Wiley, 1986.
3. Odian, "Principle of Polymerizatin", 3rd ed., Wiley, 1991.
4. Gordon,"High Polymers", Addision-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

TX7103 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.

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

OUTCOMES

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.

REFERENCES

1. Russel S.J., "Hand book of nonwovens", Wood head Publishers, Cambridge, England, 2007.
2. Albrecht W., Fuchs K. and Kitteleman 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", Melliand 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.

TX7104 THEORY OF SHORT STAPLE YARN SPINNING L T P C

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.

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; ply twisting, twist balance; 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

OUTCOMES

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.

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 Pavendhan A., "Cotton Ginning", Textile Progress, Vol. 24, No.2, The Textile Institute, Manchester 1993. 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.
12. Klein W., “Rieter Manual of spinning”, Rieter Machine Works, Winterthur, 2014

TX7201 CLOTHING SCIENCE L T P C
4 0 0 4

OBJECTIVES

To enable the students to learn about

- Important characteristics of the fabric responsible for its comfort properties and
- Different phenomena which take place in the fabric related to the comfort properties of the fabric.

UNIT I FABRIC HAND 12

Definition and concept of fabric hand; Elements relating to fabric hand; Development of fabric hand evaluation - Subjective evaluation of fabric hand; Objective evaluation of fabric hand - The El Mogahzy–Kilinc hand method. Effects of fibre and yarn properties on fabric hand.

UNIT II CHARACTERISTICS OF POROUS MATERIALS 12

Geometrical characterization of single fibres; Structural analysis of fibrous materials with fibre orientations; Determination of the fibre orientation; Characterization of porous fibrous materials; Pore distribution in a fibrous material; Methods of Measurement of moisture vapour transfer.

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

OUTCOMES

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

- Understand different phenomena such as wetting, wicking and, heat and moisture interaction and
- Correlate the property of the fabric with comfort to the wearer.

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.

TX7202 STATISTICS IN TEXTILE ENGINEERING L T P C
4 0 0 4

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.

UNIT I PROBABILITY DISTRIBUTION AND ESTIMATIONS 6

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 II HYPOTHESIS TESTING 18

Sampling distribution; significance tests applicable to textile parameters – normal test, t-test, chi-square test and F-test; p-Values; selection of sample size and significance levels with relevance to textile applications; acceptance sampling

UNIT III ANALYSIS OF VARIANCE AND NON-PARAMETRIC TESTS 12

Analysis of variance for different models; non-parametric tests - sign test, rank test, concordance test

UNIT IV PROCESS CONTROL AND CAPABILITY ANALYSIS 12

Control charts for variables and attributes - basis, development, interpretation, sensitizing rules, average run length; process capability analysis

UNIT V DESIGN AND ANALYSIS OF EXPERIMENTS 12

2^k full-factorial designs; composite designs; robust designs; development of regression models, regression coefficients; adequacy test; process optimizations.

TOTAL : 60 PERIODS

OUTCOMES

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.

REFERENCES

1. Montgomery D.C., “Introduction to Statistical Quality Control”, John Wiley and Sons, Inc., Singapore, 2002, ISBN: 997151351X.
2. Leaf G.A.V., “Practical Statistics for the Textile Industry, Part I and II”, The Textile Institute, Manchester, 1984, ISBN:0900739517.
3. Douglas C. Montgomery, “Design and analysis of experiments”, John Wiley & Sons, Inc, Singapore, 2000, ISBN 9971 51 329 3
4. Ronald D. Moen, Thomas W. Nolan, Lloyd P. Provost, “Quality improvement through planned experimentation’, McGraw-Hill, 1998, ISBN 0-07-913781-4

TX7203 TEXTILE QUALITY EVALUATION L T P C
3 0 2 4

OBJECTIVES

To make the students to

- Understand different characteristics of yarns and fabrics
- Understand the effects of fabric characteristics on its end uses
- Test the yarn and fabric samples
- 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.

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

VARIANCE LENGTH CURVES AND SPECTGROGRAM 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 II 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

UNIT III 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
6. Measurement and analysis of single yarn tensile properties

7. Study of creep and stress relaxation behaviour of yarn
8. Measurement and analysis of yarn faults
9. Measurement and analysis of surface and compression property of fabric

TOTAL : 75 PERIODS

OUTCOMES

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.

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.
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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.
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TX7001 ALTERNATIVE SPINNING SYSTEMS L T P C

3 0 0 3

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.

UNIT I ROTOR SPINNING 18

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 9

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 9

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 9

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 : 45 PERIODS

OUTCOMES

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.

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. Lawerence 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.
9. Klein W., “Rieter Manual of spinning”, Vol.5&6, Rieter Machine Works, Winterthur, 2014.

TX7002 CHARACTERIZATION OF TEXTILE POLYMERS L T P C
3 0 0 3

OBJECTIVES

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

UNIT I MOLECULAR WEIGHT 9

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 13

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

UNIT III THERMAL PROPERTIES 9

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

UNIT IV OTHER PROPERTIES 14

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

TOTAL : 45 PERIODS

OUTCOMES

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

REFERENCES

1. Gupta V.B. and Kothari V.K., “Man Made Fibre production,” Chapman and Hall, 1985.
2. Bill mayer, “Textbooks of Polymer Science,” 3rd 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”, Springer1st ed., 2008.

TX7003 COLOUR SCIENCE AND ITS APPLICATIONS L T P C
3 0 0 3

OBJECTIVES

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

UNIT I COLOUR AND COLOUR VISION 9

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; properties of light.

UNIT II COLOUR DESCRIPTION 9

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 9

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

UNIT IV COLOUR MATCHING 9

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 9

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 : 45 PERIODS

OUTCOMES

Upon completion of this course, the student shall become knowledgeable about

- Fundaments of colour measurement and
- Prediction of recipe for colour matching.

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., “Instumental 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.

TX7004 ENZYME TECHNOLOGY FOR TEXTILE PROCESSING L T P C

3 0 0 3

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.

UNIT I ENZYMES 9

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 9

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

UNIT III ENZYMES FOR COTTON FIBRE 9

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

UNIT IV ENZYMES FOR OTHER FIBERS 9

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

UNIT V ENZYMES IN EFFLUENT TREATMENT 9

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

TOTAL : 45 PERIODS

OUTCOMES

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.

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.

TX7007 MANAGEMENT OF RESEARCH AND DEVELOPMENT L T P C

3 0 0 3

OBJECTIVES

To enable the students to learn about the

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

UNIT I 9

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 9

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 9

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 9

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 **9**

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 : 45 PERIODS

OUTCOMES

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

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

TX7008 MANAGEMENT OF TEXTILE EFFLUENTS L T P C

3 0 0 3

OBJECTIVES

To enable the students to learn about

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

UNIT I 9

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 9

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

UNIT III **9**

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 **9**

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 **9**

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 : 45 PERIODS

OUTCOMES

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.

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. Chritie R., "Environmental aspects of textile dyeing", Woodhead Publishing Ltd, 2007.

TX7009 **MEDICAL TEXTILES** **L T P C**

3 0 0 3

OBJECTIVES

To enable the students to learn about

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

UNIT I **9**

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

UNIT II **9**

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 **9**

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 **9**

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

UNIT V **9**

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: 45 PERIODS

OUTCOMES

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.

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 Pennylvania 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 2713.

TX7014 **STRUCTURE AND PROPERTIES OF FABRICS** **L T P C**

3 0 0 3

OBJECTIVES

To enable the students to learn about the

- Geometrical properties of woven fabrics and its relationship with the mechanical properties of fabric
- Structure-property relationship of knitted and bonded fabrics
- Theory and evaluation of fabric hand.

UNIT I GEOMETRICAL PROPERTIES OF FABRICS 14

Plain Fabric- theories, crimp ratio and thread spacing, jammed condition; geometry of non-plain fabric; Knitting- geometry of plain, complex knitted structures.

UNIT II MECHANICAL PROPERTIES OF WOVEN FABRICS 13

Tensile- geometrical changes during extension, load-extension modulus of fabrics; Buckling – buckling of elastic materials, complex forms of buckling; Shear and drape – complex fabric deformation, nature of shear, shear properties, drape of fabrics.

UNIT III MECHANICS OF KNITTED AND BONDED FABRICS 9

Stress-strain behavior of plain knit fabric and warp knit fabrics, Mechanical properties of bonded fabrics. Structure property relationship in bonded fabrics.

UNIT IV THEORY AND EVALUATION OF FABRIC HAND 9

Definition and concept of fabric hand, Fabric hand attributes and quality descriptors, Subjective evaluation of fabric hand, Objective evaluation of fabric hand, Effect of fibre yarn and fabric factors on fabric hand, Effect of processing on fabric hand, different hand evaluation methods.

TOTAL : 45 PERIODS

OUTCOMES

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

- Determine the geometrical parameters of woven, knitted and bonded fabrics
- Correlate the geometry of fabric with the mechanical properties of fabrics and
- Evaluate the hand of fabric.

REFERENCES

1. Hearle J.W.S., Grosberg P. and Baker S., “Structural mechanics of Fibres yarn and Fabrics”, Vol .1, Wiley-Intersciences, New York, 1969.
2. Hassan M. Behery, “Effect of mechanical and physical properties on fabric hand”, Woodhead Publishing Limited, Cambridge, England, ISBN 13: 978-1-85573-918-5.
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.

TX7015 TEXTILE POLYMER RHEOLOGY L T P C

3 0 0 3

OBJECTIVES

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

UNIT I 13

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 rubberelasticity.

UNIT II **9**

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 **9**

Laminar flow through various profiles, flow analysis - power law, turbulent flow analysis, turbulence dumpling.; rheological models for extensional viscosity; Flow in coni-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 **9**

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 **5**

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

TOTAL: 45 PERIODS

OUTCOMES

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.

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
3. Publishers, New York, 1993.
4. John M. Dealy and Kurt F. Wissburn, “Melt rheology and its role in plastics Processing”, Chapman, London, 1995.
5. Lenk R.S., “Polymer Rheology”, Applied Science, London, 1978.
6. Crawford R.J., “Plastics Engineering”, Butterworth – Heinemann, Oxford, 1998
7. Ferry J.D., “Viscoelastic Properties of Polymers”, John Wiley & Sons, New York, 1986.
8. Chang Dae Han, “Rheology in Polymer Processing”, Academic Press, New York, 1976

TX7016 TEXTILE REINFORCED COMPOSITES **L T P C**
3 0 0 3

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

UNIT I REINFORCEMENTS **9**

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

UNIT II MATRICES 9

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

UNIT III COMPOSITE MANUFACTURING 9

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

UNIT IV TESTING 9

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 9

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

TOTAL : 45 PERIODS

OUTCOMES

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

- Select different types of textile reinforcements and matrices for the manufacture of composites for getting different characteristics and
- Evaluate the characteristics of composites

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.

TX7017 TEXTILES IN CIVIL CONSTRUCTION AND TRANSPORTATION L T P C

3 0 0 3

OBJECTIVES

To enable the students to learn about

- Textiles used for civil construction and transportation applications and their functional requirements and
- Evaluation of textile materials used for civil construction and transportation applications.

UNIT I GEO TEXTILES 14

Geo textile – definition, types, functions; types of fibers and fabrics used in geo textiles; applications of natural fibers in geo-textiles; joining of geo- textiles; multi functional uses of

geo synthetics in civil engineering; usage of geo-synthetic in civil engineering applications as filters, reinforcement, separation and drainage medium; material specifications and design criteria of geo-synthetics for specific applications.

UNIT II ARCHITECTURE TEXTILES 13

Fiber and fabric property requirements for architecture textiles; Coated textiles; Tents, Awnings and Canopies; Inflatable structures – high pressure and low pressure inflatable structures; Textile for roofing applications; Acoustic and heat insulation textiles; Floor and wall covering, scaffolding nets.

UNIT III TRANSPORTATION TEXTILES 9

Quality and design of textile materials used in automobiles – tire cord, filter, air bag, belt, seat cover, noise insulation; Design and development of textile reinforced composites in automobile and aeronautic industry.

UNIT IV EVALUATION 9

Evaluation of textile material used in civil construction and transportation industry in terms of performance, construction surviability and durability.

TOTAL : 45 PERIODS

OUTCOMES

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

- Understand the requirements of textiles used for civil construction and transportation applications and
- Design the textile materials for the above applications.

REFERENCES

1. Horrocks A.R. and Anand S.C., “Handbook of Technical Textiles”, The Textile Institute, Manchester, 2000, ISBN: 1855733854.
2. R. W. Sarsby, “Geo Synthetics in Civil Engineering”, Woodhead Publishing, ISBN-13: 978-1-85573-607-8
3. Mukhopadhyay S.K. and Partridge J.F., “Automotive Textiles”, Textile Progress, Vol.29, No1/2, 1999, ISBN:1870372212.
4. Adanur S., “Wellington sears handbook of Industrial textiles”, Technomic publishing co inc., 1995, ISBN : 1–56676–340–1.
5. Eugeniooñate and Bern kröplin “Textile Composites and Inflatable Structures”, Springer Dordrecht, Berlin, Heidelberg, New York, ISBN-10 1-4020-3316-8

TX7018 THEORY OF YARN STRUCTURES L T P C

3 0 0 3

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.

UNIT I YARN GEOMETRY 13

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 5

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 9

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

UNIT IV BLENDED YARN MECHANICS 9

Blend irregularity; measurement of blending irregularity; concept of elongation balance; effect of properties of constituent fibres and blend composition on behavior of blended yarns

UNIT V STRUCTURE - PROPERTIES RELATIONSHIP 9

Structure - property relationship in yarns produce from different spinning systems.

TOTAL :45 PERIODS

REFERENCES

1. Hearle J.W.S., Grosberg P. and Baker S., "Structural Mechanics of fibres, yarns and fabrics", Wiley Interscience, New York, 1969.
2. Goswami B.C., Martindale J.G. and Scardino F.L., "Textile Yarns: Technology, Structure and Applications", Wiley Interscience, New York, 1985.
3. Hearle J.W.S., Thwaitesand J.J. and Amikrbayhat A., "Mechanics of Flexible Fibre Assemblies", Maryland, 1980.
4. Postle P., Dejong S.and Carnaby G.A., "The Mechanics of Wool Structure", Ellis Horwood, London, 1988.
5. Grosberg P. and Iype C., "Yarn production: Theoretical aspects", Textile Institute publication, 1999, ISBN-13: 978 1 87037 203 9.

TX7006 HIGH PERFORMANCE FIBRES L T P C
3 0 0 3

OBJECTIVES

To enable the students to learn about

- Advanced spinning technology for manufacturing high performance fibres, their properties and applications

UNIT I ADVANCED SPINNING TECHNOLOGY 9

Advances in conventional fibre forming process; gel spinning; liquid crystal spinning; electro-spinning

UNIT II HIGH PERFORMANCE FIBRES FOR INDUSTRIAL APPLICATIONS 9

Manufacturing, properties and applications of glass fibres, basalt fibres; carbon fibres, high performance polyethylene fibres; ceramic fibres

UNIT III HIGH PERFORMANCE FIBRES FOR MEDICAL APPLICATIONS 13

Manufacturing, properties and applications of alginate fibres; chitosan fibres; regenerated silk and wool protein fibres; synthetic biodegradable fibres

UNIT IV SPECIALITY FIBRES 14

Hollow and profile fibres; blended and bi-component fibres; film fibres and functionalized fibres for specific applications; manufacturing, properties and applications of chemical and thermal resistant fibres

TOTAL: 45 PERIODS

OUTCOMES

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

- Understand the method of producing high performance fibres
- Select a high performance fibres for right type of end uses

REFERENCES

1. Hearle J. W. S., "High Performance Fibres", Woodhead Publishing Ltd., Cambridge, England, 2001.
2. Hongu T. and Phillips G.O., "New Fibres", Woodhead Publishing Ltd., England, 1997.
3. Kothari V. K., "Textile Fibres: Development and Innovations", Vol. 2, Progress in Textiles, IAFL Publications, 2000.
4. Peebles L.H., "Carbon Fibres", CRC Press, London, 1995.

TX7005 FINANCIAL MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

To enable the students to learn about

- Costing of textile products
- Different sources of finance, cost of capital and investment appraisal techniques
- Financial statements

UNIT I **14**

Goals and functions of finance; types of costs; costing – concepts, classification; preparation of cost sheet; costing of yarn, fabric and garments; breakeven analysis

UNIT II **9**

Investment appraisal; Payback period method, Accounting Rate of Return; DCF methods - IRR, NPV, PI; depreciation - concept, methods

UNIT III **9**

Capital structure; sources of finance-debt, equity; cost of capital; working capital management; estimation of working capital

UNIT IV **13**

Tools of financial analysis and control – profit and loss account, balance sheet; financial ratio analysis; analysis of operating and financial leverage; dividend policy; illustrations for spinning mill, composite mill and garment industry

TOTAL: 45 PERIODS

OUTCOMES

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

- Calculate the cost of yarn, fabric and garment
- Identify the sources for capital and calculate cost of capital
- Calculate depreciation and carryout investment appraisal
- Interpret and analyze financial statements

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TX7010 OPERATION RESEARCH L T P C
3 0 0 3

OBJECTIVES:

To enable the students to learn about

- Operations research (OR) methods that can be applied in the textile industry
- Formulating and solving OR problem related to textile industry

UNIT I LINEAR PROGRAMMING TECHNIQUES 9

Linear programming – formulation, solution by graphical and simplex methods; dual simplex method

UNIT II TRANSPORTATION AND ASSIGNMENT MODELS 13

Transportation problem – North / West corner Solution, least cost method, Vogel’s approximate method, optimality check - Modi method, stepping stone method; solution to assignment problem- Hungarian method; unbalanced, infeasible assignment problems; maximisation in assignment problems; transhipment problems

UNIT III INTEGER LINEAR PROGRAMMING, GAME THEORY 9

Solution to integer programming problem - Branch and bound algorithm, cutting plane algorithm; Game theory: Two person – zero sum games: saddle point, dominance rule, graphical method

UNIT IV PROJECT SCHEDULING 9

CPM and PERT networks for project scheduling- finding critical path, probability and cost consideration in the project scheduling; crashing; resource planning, levelling

UNIT V DECISION MAKING THEORY, QUEING MODELS 5

Decision making under risk: decision trees, decision making under uncertainty; Queuing theory – single and multi-channel models – infinite number of customers and infinite calling source

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Design operations research problems that can be applied to textile industry.
- Solve the OR problems

REFERENCES:

1. Panneerselvam R., "Operations Research", Prentice Hall of India, 2002.
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TX7019 TOTAL QUALITY MANAGEMENT IN TEXTILE INDUSTRY L T P C
3 0 0 3

OBJECTIVES:

To enable the students to understand about

- Total quality management concepts
- Different TQM tools and techniques and
- Quality standards

UNIT I INTRODUCTION TO QUALITY MANAGEMENT 9

Definitions of quality, quality philosophies of Deming, Crossby and Miller; customer focus; leadership – concepts; quality planning; quality costs; vision, mission statements and Quality Policy.

UNIT II PRINCIPLES OF TOTAL QUALITY MANAGEMENT 9

Evolution of TQM, TQM models; continuous process improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen; supplier performance measures; Deming wheel; internal external customer concept; customer satisfaction index, customer retention; team work and team building, empowerment

UNIT III QUALITY MANAGEMENT TOOLS 18

Principles and applications of Quality Function Deployment, Failure Mode and Effect Analysis, Seven old QC tools, Seven New Management tools, Statistical Quality Control techniques, Mistake proofing, Benchmarking, JIT, and Kanban; Taguchi Quality Loss Function, Total Productive Maintenance (TPM), Process Capability analysis

UNIT IV QUALITY SYSTEMS 9

ISO 9000 and other quality system – elements, implementation of quality system in spinning, weaving and garment industry; TQM implementation strategies

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Understand the concept of TQM, different TQM tools and techniques
- Develop innovative tools to implement TQM in the textile industry

REFERENCES:

1. Dale H. Besterfiled. et al., "Total Quality Management", Pearson Education Asia, 1999.(Indian reprint 2002).
2. Rose J.E., "Total Quality Management", Kogan Page India Pvt., Ltd., 1993.
3. William J. Kolarik., "Creating Quality", McGraw-Hill, Inc., NY, 1995.
4. Jill A. Swift., Joel E. Ross and Vincent K. Omachonu, "Principles of Total Quality", St. Lucie Press, US, 1998.
5. Samuel K. Ho, "TQM, An Integrated approach", Kogan Page India Pvt Ltd, 2002.
6. Dale H. Besterfield et al, "Total Quality Management", Pearson Education Asia, 2001.
7. P.L.Jain, "Quality Control and Total Quality Management", Tata McGraw - Hill, 2001.
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TX7012 PROTECTIVE CLOTHING L T PC
3 0 0 3

OBJECTIVES:

To enable the students to understand about

- Functional requirements of protective clothing
- Selection of fibre, yarn and fabric for developing protective clothing
- Evaluation of protective clothing

UNIT I FIBRE REQUIREMENTS 9

Suitability and properties of high performance fibres for various protective clothing – chemical composition and physical structure

UNIT II YARN AND FABRIC REQUIREMENTS 9

Types of yarns; woven, knitted and non - woven fabric structures, methods of production, effect of structure on their performance

UNIT III CLOTHING CONSTRUCTION 9

Method of construction of garments according to various protective end uses like protection against cold, ballistic protection, use of different fabric type (knitted, woven, and Non-woven), coated / laminated in different places; use of inter lining and composites; 3D structures; high tech textiles – variable electronics; protective garments for industrial and apparel end uses

UNIT IV FINISHING OF PROTECTIVE CLOTHING 9

Types of finishes - fire retardant finishes, water repellent finishes, anti - microbial finishes; chemical finishes against radiation and chemicals; method of application of finishes; protective finishes for health care garments

UNIT V QUALITY EVALUATION 9

Evaluation of protective fabrics; desirable properties of protective textiles, method of testing for thermal protective performance, abrasion and wear resistance, evaluation of resistance to mildew, ageing, sunlight, chemical, electrostatic and electrical resistivity, impact properties; ASTM standards for protective garments .

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Select fibre, yarn and fabric for developing protective clothing for different applications
- Understand different types of finishes given to develop protective clothing
- Understand the evaluation of protective clothing

REFERENCES:

1. Adanur S., "Wellington sears handbook of Industrial textiles" Technomic publishing co. inc., 1995, ISBN : 1 – 56676 – 340 – 1
2. Pushpa Bajaj and Sengupta A.K, "Protective clothing", the Textile Institute, 1992, ISBN 1-870812 – 44-1
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TX7011 PROCESS CONTROL AND OPTIMIZATION IN YARN SPINNING L T P C
3 0 0 3

OBJECTIVES:

To enable the students to understand

- The process control at different stages of spinning preparatory and ring spinning process to achieve yarn of required quality

UNIT I BLOWROOM PROCESS 9

Opening and cleaning efficiency-assessment and control; optimization of trash removal, control of lint in waste; causes for neps generation, control; role of blowroom accessories; assessment and control of blowroom output quality, its influence on yarn quality; process changes for processing manmade fibres

UNIT II CARDING PROCESS 9

Optimization of trash removal – its influence on quality, control of lint in waste; neps removal efficiency, cleaning efficiency – factors, control; hooks formation; levelling – optimization; assessment and control of card sliver quality, it influence on yarn quality; process changes for processing manmade fibres

UNIT III DRAWFRAME PROCESS AND COMBING PROCESS 9

Levelling in drawframe-optimization; blended yarn production- blending irregularity assessment and control; hooks straightening in roller drafting arrangement; quality of drawframe sliver-assessment and control, its influence on yarn quality; quality of comber lap - control of comber preparatory process; noil%, combing efficiency and neps removal efficiency of comber – assessment and control; hooks removal

UNIT IV ROVING AND YARN PRODUCTION PROCESSES 9

Roving quality-assessment and control, its influence on yarn quality; ring spinning- control of end breakage rate; quality of yarn-assessment and control; changes for processing manmade fibres; classification of yarn defect, control of yarn defects

UNIT V PRODUCTION CONTROL 9

Factors affecting the production limits of the spinning machinery; new concepts in achieving higher production in the spinning machinery; role of humidity and machinery maintenance-production and quality; computation of the labour and machine productivity indices

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Understand the process variables and their control at different stages of ring yarn production
- Analyse the test results and hence control the process
- Compute different indices of machine and labour productivity

REFERENCES

1. Garde A.R. and Subramaniam T.A., “Process Control in Spinning”, ATIRA Publicaitons, Ahmedabad, 1989
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TX7013 SHUTTLE LESS WEAVING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

To enable the students to understand

- Different mechanisms of weft insertion, their advantages and limitations

UNIT I INTRODUCTION 5

Introduction to shuttleless weaving; advantages of shuttleless weaving, comparison with shuttle weaving; features of unconventional weaving; different Selvedges: tucked-in, leno, fused, stitched, their mechanism of formation, their characteristics and uses; weft accumulator.

UNIT II PROJECTILE WEAVING MACHINE 9

Basic principle of projectile weaving; feeding of yarn to projectile; sequence of weft insertion; cam driven shedding; dwelling Sley beat-up; torsion bar picking; energy utilization during picking.

UNIT III RAPIER WEAVING MACHINE 9

Classification based on type of rapier; system of weft insertion and number of rapiers; Sequence of weft insertion for Gabler and Dewas systems, their comparison; driving of flexible and rigid rapiers; asynchronized rapier timing; rapier buckling.

UNIT IV AIR-JET AND WATER-JET WEAVING MACHINE 13

Principle of weft insertion in air-jet weaving, air requirements; path of the yarn on loom; sequence of weft insertion; control of air stream by relay nozzle, confuser profile reed and suction; design of air jet nozzle, air drag force, factors affecting drag force

Principle of weft insertion in water-jet weaving machine, path of the yarn on loom; quality of water required; sequence of weft insertion; water jet nozzle, merits and demerits of water jet weaving; fabric drying on loom

UNIT V MULTIPHASE WEAVING 9

Technological developments – models & features; functional description of multi-linear shed weaving – shed formation, filling insertion, beat-up, let-off, take-up and selvedge motion; characteristics of multi-linear shed weaving machine; circular and narrow weaving

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students will be able to understand

- mechanisms of picking in rapier, airjet, waterjet and projectile looms
- accessories required in the shuttleless weaving machines
- Principle of fabric formation in multiphase weaving machine

REFERENCES:

1. Weaving Technology and Operations, Allaan Ormerod and Walter S. Sondhelm, The Textile Institute, 1995, ISBN 1 870812 76 X
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