

KUMARAGURU COLLEGE OF TECHNOLOGY, COIMBATORE-641 049
DEPARTMENT OF TEXTILE TECHNOLOGY

Choice Based Credit System (Regulations 2013)

M. Tech. TEXTILE TECHNOLOGY

SEMESTER I

Code No.	Courses	Hours / Week			Credits
		L	T	P	C
THEORY					
P13TXT101	Fibre Science	3	0	0	3
P13TXT102	Theory of Yarn Formation	3	0	0	3
P13TXT103	Structural Mechanics of Fabrics	3	0	0	3
P13TXT104	Advances in Chemical Processing	3	0	0	3
P13TXT105	Statistical Application in Textile Engineering	3	1	0	4
P13TXTE01	Elective 1	3	0	0	3
PRACTICAL					
P13TXP101	Advanced Textile Testing Lab	0	0	3	1
P13TXP102	Statistical Analysis Laboratory	0	0	3	1

Total Credit: 21

SEMESTER II

Code No.	Courses	Hours / Week			Credits
		L	T	P	C
THEORY					
P13TXT201	Yarn Quality Analysis	3	0	0	3
P13TXT202	Fabric Quality Analysis	3	0	0	3
P13TXT203	Technical Textiles	3	0	0	3
P13TXT204	Clothing Comfort	3	0	0	3
P13TXTE02	Elective 2	3	0	0	3
P13TXTE03	Elective 3	3	0	0	3
PRACTICAL					
P13TXP201	Product Engineering Lab	0	0	3	1
P13TXP202	Independent study	0	0	2	1

Total Credit: 20

SEMESTER III

Code No.	Courses	Hours / Week			Credits
		L	T	P	C
THEORY					
P13TX7301	Research Methodology	3	0	0	3
P13TX7E04	Elective 4	3	0	0	3
P13TX7E05	Elective 5	3	0	0	3
PRACTICAL					
P13TXP301	Project Work Phase I	0	0	12	6
P13TXP302	Entrepreneurial skills development	0	0	2	1

Total Credit: 16**SEMESTER IV**

Code No.	Courses	Hours / Week			Credits
		L	T	P	C
PRACTICAL					
P13TXP401	Project Work Phase II	0	0	24	12

Total Credit: 12

Semester	Credits
I	21
II	20
III	16
IV	12
TOTAL CREDITS	69

ELECTIVES

Code No.	Courses	Hours / Week			Credits
		L	T	P	C
P13TX7E001	Worsted and Bast fibre Spinning	3	0	0	3
P13TX7E002	Advances Textile Finishing	3	0	0	3
P13TX7E003	Enzyme Application in Textiles	3	0	0	3
P13TX7E004	Nanotechnology in Textiles	3	0	0	3
P13TX7E005	Textile Composites	3	0	0	3
P13TX7E006	Management of Textile Production	3	0	0	3
P13TX7E007	Protective Clothing For Hazardous Environment	3	0	0	3
P13TX7E008	Theory of Coloration	3	0	0	3
P13TX7E009	Advanced Computer Concepts in Textile Process Engineering	3	0	0	3
P13TX7E010	Advancements in Medical Textiles	3	0	0	3
P13TX7E011	Textile costing & Optimization	3	0	0	3
P13TX7E012	Apparel Production Management	3	0	0	3
P13TX7E013	Apparel Quality Control and Standards	3	0	0	3
P13TX7E014	Apparel Marketing & Merchandising	3	0	0	3
P13TX7E015	Nonwovens	3	0	0	3

INTER-DISCIPLINARY ELECTIVES

Code No.	Courses	Hours / Week			Credits
		L	T	P	C
P13TX7E016	Control systems and Automation in Textile Engineering	3	0	0	3
P13TX7E017	Energy Management in Textile Industry	3	0	0	3
P13TX7E018	Geo Textiles	3	0	0	3
P13TX7E019	Textile Effluents Management	3	0	0	3
P13MATE17	Mathematical Modeling and Simulation	3	0	0	3
P13MAE204	Operations Research	3	0	0	3

Objectives:

- To impart the knowledge about fibre structure and physical characterisation methods.
- To educate in interpreting fibre properties such as moisture, mechanical, optical, frictional, electrical and thermal properties in terms of structure of the fibres.

UNIT I FIBRE STRUCTURE**9**

Fibre Structure: Parameters of fine and morphological structures. Structural models: Fringed fibriller, fringed micelle, order and orientation. Structure Study Techniques: Optical and electron microscope – SEM, TEM, Nuclear Magnetic Resonance, The scanning Tunneling microscope (STM), The Atomic Force Microscope (AFM). X-ray diffraction, IR spectroscopy.

UNIT II MOISTURE PROPERTIES**9**

Theoretical explanation of moisture and related properties - Conditioning - Mechanism of conditioning, factors influencing rate of conditioning - Effect of conditioning on fibre properties. Swelling - Types and measurement– Surface adsorption - Heats of sorption - Differential and integral heat of sorption - measurement of sorption - Diffusion of moisture, Interaction of moisture and heat changes.

UNIT III MECHANICAL PROPERTIES**9**

Tensile properties of fibres – Effects of variability – Elastic recovery –Time effects – fibre stress and deformation other than tensile – Bending and bending fatigue – shear properties – loop strength and knot strength – Torsional properties, Model theory of visco elasticity, rubber elasticity. Theories of mechanical properties – variety of approaches – structural effect in various fibres – Theories of time dependence, Thermo dynamic effects.

UNIT IV ELECTRICAL & THERMAL PROPERTIES**9**

Dielectric properties – Measurement – effect. Electrical resistance of fibres, Static electricity - measurements of static electricity – Problems and elimination. Thermal conductivity – specific heat - Various thermal parameters of fibres – structural changes. Thermal transitions – Secondary - Second order and first order transitions, multiple transitions. Nature and mechanism of Heat setting of fibres – physics of heat setting – Heat setting and structural parameters – Mechanism of heat setting – Thermodynamic Argument of heat setting – multiple sequence – structural model, Thermo gravimetric analysis and interpretation of results.

UNIT V OPTICAL & FRICTIONAL PROPERTIES**9**

Refractive index of fibres - Birefringence and optical orientation factor. Absorption and Dichroism. Comparison of optical orientation factor with X- ray orientation and FTIR orientation

factors - Reflection of light, Luster index, factors influencing luster. Fibre friction – measurement and empirical results of fibre – directional friction effects of wool.

TOTAL HOURS:

45

TEXT BOOKS:

1. Morton W E and Hearle J W S, “Physical properties of Textile fibres”, Textile Institute, UK, 1993.
2. Mukhopadhyay S K, “Advances in Fibre Science”, Textile Institute, UK, 2000.

REFERENCES:

1. Carty P, “Fibre Properties”, Pentaxion Publishers, 1996, ISBN: 9781874430889
2. Gupta V.B., Kothari V.K. Textile Fibres: Developments and Innovations. Vol. 2, Progress in Textiles: Science & Technology. IAFL Publications, 2000.
3. Warner S, “Fiber Science”, Prentice Hall, 1995, ISBN: 9780024245410.
4. Gupta V P and Kothari V K, “Manufactured Fibre Technology”, Chapman & Hall Publishers, 1997.
5. Mishra S P, “Textbook of Fibre Science and Technology”, New age publications, 2000.

Objectives:

- To teach the underlying theoretical principles of various processes that take place during spinning
- To educate to think technically on the yarn geometry, fibre blending and leveling.

UNIT-I FIBRE DISPERSION AND CLEANING**9**

Mechanism of ginning of cotton, factors affecting ginning; the necessity 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; theory of hook formation; mechanism of removal of short fibre, neps and trash in comber.

UNIT-II ATTENUATION AND FIBRE STRAIGHTENING**9**

Principle of roller drafting and its application in yarn production; ideal drafting; factors affecting drafting force, 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

UNIT-III TWISTING**9**

mechanism of twisting principles in ring spinning- balloon and spinning triangle formation and their effects on yarn quality and productivity; 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. Adhesive process: Bobtex and Twistless spinning

UNIT-IV YARN GEOMETRY**9**

Basic Yarn Geometry - Packing of fibres in yarn; Fibre arrangement in twisted yarn; Mechanism of fibre migration; effect of various parameters on migration. relationship of ring, rotor, air-jet and friction spun yarns.

UNIT-V FIBRE BLENDING AND LEVELLING**9**

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; different methods of levelling adopted during spinning processes.

TOTAL HOURS:

45

TEXT BOOKS:

1. Klein W , “New Spinning Process”, The Textile Institute, Manchester, Vol.5,UK, 2010.
2. Lord P R, “Handbook of Yarn Production: Technology, Science and Economics”, Woodhead Publishing Limited, ISBN: 978 1 85573 696 2, 2003.

REFERENCES:

1. Lawrence C A, “Fundamentals of Spun Yarn Technology”, Woodhead Publishing Limited, ISBN: 978 1 56676 821 4, 2003.
2. Hearle J W S and Grosberg P, Backer S, “Structural Mechanics of fibres, yarns, fabrics”, Wiley Inter Science Publications, 1969.
3. Chattopadhyay R. (Ed), Advances in Technology of Yarn Production, NCUTE, IIT Delhi,2002.
4. Gowda R.V.M., "New Spinning Systems", NCUTE, IIT Delhi, 2003.
5. W.Klein, “The Technology of short staple spinning Vol I-IV-The Textile institute,2010

Objectives:

- To understand the concepts of fabric structure and its mechanics
- To impart the knowledge on mechanical parameters with respect to fabric structure

UNIT-I FABRIC MECHANICS**9**

Fabric Mechanics: Fabric Specifications and cover factor. Plain cloth geometry - crimp ratio and thread spacing - setting theory and maximum set. Pierce's flexible and elastic thread model - Oloffson's general model. Crimp interchange in woven fabrics - crimp balance -geometrical structure of twill and mat weaves.

UNIT-II TENSILE PROPERTIES OF WOVEN FABRICS**9**

Tensile properties of woven fabrics :stress-strain curve .Modelling of tensile behavior.anisotropy of woven fabric. geometrical changes during the extension of cloth - load extension modulus. Application of force, energy and finite element methods in fabric tensile behavior analysis.

UNIT-III THEORIES ON FABRIC BENDING**9**

Theories on Fabric Bending: Moment-curvature curve of bending, bending stiffness, bending hysteresis modeling of bending behavior, polar diagrams of the bending model.

UNIT-IV FABRIC SHEAR AND COMPLEX DEFORMATION**9**

Shear stress –strain curves ,relationship between shear and bending deformation, Modelling of shear behavior, Buckling , Drape- two and three dimensional drape ,fabric drape and mechanical properties, modeling of drape.

UNIT-V KNITTING DYNAMICS**9**

Knitting Dynamics: Yarn tension and knitting forces - effect of cam shape, increase in number of feeders and increase in linear speed. Fabric Geometry and Properties: Tightness factor - Dimensional properties - Spirality - Relaxation - shrinkage

TOTAL HOURS: 45**TEXT BOOKS:**

1. J Hu, "Structure and mechanics of Woven fabrics", Hong Kong Polytechnic University, Wood Head Publishing Ltd, 2004.

2. Hearle J W S, Grosberg P and Backer S, "Structural mechanics of fibres, yarn and fabrics", Wiley Interscience Publishing limited, 1969.

REFERENCES:

1. Seyam A M, "Structural Design of Woven fabrics", Textile progress Vol.31, No: 3. Wood Head Publishing Ltd, 2002
2. Hassan M.Behery Effect of mechanical and physical properties on fabric hand" wood head publishing., ltd, 2005
3. Progress in Textiles: Science & Technology Vol. 1, Testing and Quality Management, V.K. Kothari, IAFL Publications, New Delhi, ISBN: 81- 901033-0-X, 1999.
4. Ukponmwan, J, Mukhopadhyay, A, Chatterjee, K, "Pilling", Textile Progress, Vol. 28/3, ISBN: 1870372153, 1996.
5. Laing & Sleivert, "Clothing Textiles and Human Performance", Textile Progress, Vol. 32/4, 2000.

Objectives:

- To acquire a detailed knowledge about pretreatment and chemistry of dyeing
- To educate technically the various methods and process of dyeing, printing and finishing.

UNIT-1 GREY PREPARATION**9**

Single stage grey preparation. Degradation of fibres associated with chemical pretreatment process – degradation of cotton during desizing, scouring, bleaching. Damage of wool, silk, polyester during pretreatment process. Recent developments in pretreatments.

UNIT-2 PHYSICAL CHEMISTRY OF DYEING**9**

Kinetic and Equilibrium of dyeing. Adsorption isotherms- Langmuir, Freundlich and ‘C’ isotherms. Determination of dye affinity. State of dye in solutions. Aggregation number-its determination and effect on dyeing. Use of solubility parameter concept in dyeing.

UNIT-3 DYEING**9**

Natural dyes & their dyeing. Antimicrobial dyes, Water repellent dyes and other fluorine containing functional dyes. Biodegradable dyes. Florescent dyes and phosphorescent colorants. Super critical fluid and CO₂ dyeing, IR dyes, Ultrasonic, magnetic dyeing. Redox and low temperature processes. Microencapsulation technology in dyeing.

UNIT-4 PRINTING**9**

Pigment printing-optical effect pigment, substrate based effect. Digital carpet printing. Sublimation. Thermal inkjet printing- Ink systems, Fabric pretreatments and post treatment, Jet printing machines, Limitations. Transfer printing, Garment printing-chest printing. Evolution of textile printing workflow, New design styles. Steamer.

UNIT-5 FINISHING**9**

Use of enzymes in textile finishing - Enzymatic processing of natural fibres - Surface modification and functionalization of synthetic fibres. Comfort and health issues related to functional finishes. Super-hydrophobic nano finishes - Photocatalytic self-cleaning nano finishes - Antimicrobial nano finishes. Coating and Lamination methods.

TOTAL HOURS: 45**TEXT BOOK**

1. M Gulrajani, "Advances in the dyeing and finishing of technical textiles", The Textile Institute, woodhead publishing, 2013.
2. A.A. Vaidya, "Chemical Processing of Man-made Fibres and Blends", John Wiley and Sons, New York, 1984.

REFERENCES

1. Johnson.A., "The Theory of Colouration of Textiles", SDC, Second edition, ISBN: 0901956481, 1989.
2. Chakraborty J N, "Fundamentals and practices in colouration of textiles", The Textile Institute, woodhead publishing, 2009.
3. Venkataraman, "Chemistry of Synthetic Dyes", Academic Press, London, 1970.
4. H Ujiie, "Digital Printing of Textiles", The Textile Institute, woodhead publishing, 2006.
5. Dcerrek Hey Wood, 'Textile Finishing', Society of Dyers and Colorist, 2003.

Objectives:

- To develop interpretation skill
- Application of statistical methods in textile manufacturing
- To gain knowledge in process control
- To develop knowledge in design of experiments

UNIT I PROBABILITY DISTRIBUTION AND ESTIMATIONS 12

Applications of Binomial, Poisson, normal, student's, t, 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 12

Sampling distribution; significance tests applicable to textile quality parameters – normal test, t-test, chi-square test and F-test; 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.

UNIT IV PROCESS CONTROL AND CAPABILITY ANALYSIS 12

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

UNIT V DESIGN AND ANALYSIS OF EXPERIMENTS 12

Limitations of experimental design; Latin square design, Randomized block design-2k full-factorial designs; development of regression models, calculation of regression coefficients; adequacy test for regression equations; process optimizations, multivariate analysis

TOTAL HOURS: 60

TEXT BOOKS

1. Montgomery D.C., "Introduction to Statistical Quality Control", John Wiley and Sons, Inc., Singapore, ISBN: 997151351X, 2002.
2. Leaf G.A.V., "Practical Statistics for the Textile Industry, Part I and II", The Textile Institute, Manchester, ISBN: 0900739517, 1984.

REFERENCES:

1. Douglas C. Montgomery, "Design and analysis of experiments", John Wiley & Sons, Inc, Singapore, ISBN 9971 51 329 3, 2000.

2. Ronald D. Moen, Thomas W. Nolan, Lloyd P. Provost, "Quality improvement through planned experimentation", McGraw-Hill, ISBN 0-07-913781-4, 1998.
3. Hayavadana. J, "Statistics for textile and apparel management" wood head publishing India (P) Ltd, 2012, ISBN – 8789380308-04-3
4. J.R.Nagla, "Statistics for textile engineers" woodhead publishing India (P) Ltd, 2013, ISBN: 1782420673
5. Meloun, Miliky, "Statistical data analysis a practical guide" wood head publishing,, 2011, ISBN: 0857091093

Objectives:

- To impart the skills in fibre testing and analysis
 - To demonstrate various advanced yarn and fabric testing methods
1. Identification of fibre from various methods
 2. Determination of percentage of spin finish present in the fibre
 3. Determination of fibre density
 4. Evaluation and analysis of MVI data for differently graded cotton material.
 5. Evaluation of tensile characteristics of different woven and nonwoven fabrics.
 6. Evaluation of compressional characteristics of different woven and nonwoven fabrics.
 7. Evaluation of bending characteristics of different woven and nonwoven fabrics.
 8. Determination of wicking behavior properties of given sportswear.
 9. Calculation of seam strength and seam strength efficiency with given stitches and stitch density
 10. Study and assessment of seam puckering.
 11. Determination of button impact strength
 12. Determination of compressive strength in various composite material

TOTAL HOURS: 45

Objectives:

- To impart the skills on statistical analysis in textile industry using softwares
- To understand the statistical approach for quality control in textile engineering

LIST OF EXPERIMENTS

1. Analysis of given data and construction of frequency distribution.
2. Measure of central tendency and dispersion for the given data
3. Finding the correlation coefficient and analyzing its significance for the given data.
4. Finding the regression equation, fitting a straight line, confidence limit, extrapolation, significance and goodness of fit for the given data.
5. Construction of control charts for attributes and variables, interpretation of control charts for the given data
6. Analysis of variance, calculation of variance ratio and interpretation of F value, test of significance (One-way ANOVA) for the given data.
7. Analysis of variance, calculation of variance ratio and interpretation of F value, test of significance (Two-way ANOVA) for the given data.
8. Finding the significance of the given data about mean using t-test (one tail) at given confidence level and finding the tolerance limits
9. Finding the significance of the given data about mean using t-test (two tail) at given confidence level and finding the tolerance limits
10. Finding the significance of the given data using χ^2 test at given confidence level and finding the tolerance limits
11. Estimating the proportion % value using normal distribution and finding SD, Mean, for the given data.
12. Optimization of process parameters using 2^k factorial design concepts for the given data.

TOTAL HOURS: 45

Objectives:

- To impart technical knowledge on yarn evenness and fibre length
- To educate the influence of various yarn parameters on tensile characteristic and its Quality

UNIT-I MASS VARIATION OF TEXTILE STRANDS**9**

Mass Variation: Determination of mass variation of textile strands in time and frequency domains- Interpretation and significance of U% and CV% for textile strands- Classification and analysis of yarn faults created by mass variations- Theoretical limit for strand regularity and index of irregularity.

UNIT-II VARIANCE LENGTH CURVES OF TEXTILE STRANDS**9**

Variance – Length Curves: Introduction to variance-length curves – within length and between length variance curves- Effect of specimen length and total length on mass variation measurements of textile strands; Analysis of variance-length curves to understand and avoid the introduction of mass variation during the spinning operations.

UNIT-III SPECTROGRAM OF TEXTILE STRANDS**9**

Spectrogram: Determination of periodic mass variations of textile strands in the form of spectrogram - Comparison between normal spectrum and ideal spectrum- Type of faults and their representation in spectrogram- Interpretation of superimposed waves in spectrogram- Wavelength range for each machine in a spinning mill.

UNIT-IV TENSILE PROPERTIES OF YARN**9**

Tensile Properties: Influence of specimen length on yarn tensile properties- Measurement and application of yarn modulus, creep and stress relaxation- Effect of testing speed on yarn tensile properties- Significance of estimating minimum yarn strength.

UNIT-V INFLUENCE OF YARN QUALITY**9**

Effect of yarn properties like evenness, strength, elongation, modulus, hairiness, abrasion resistance, fibre and yarn mix-up and yarn tension history on the performance of yarn during winding, warping, weaving and knitting- Effect of yarn quality on fabric wear, appearance and comfort properties.

TOTAL HOURS: 45

TEXT BOOKS:

1. P Grosberg and C Iype ‘Yarn production: Theoretical aspects’, Woodhead Publishing Limited, January 1999.
2. R.Furter, “Evenness testing in yarn production: Part I &II”, The Textile Institute,Manchester, 1982.

REFERENCES:

1. R.Furter, “Strength and Elongation Testing of Single and Ply Yarns”, The Textile Institute, Manchester, 1985.
2. Steadman, R.G, “Cotton Testing”, Textile Progress, Vol. 27, No.1.Text.Inst, ISBN: 1870812859, 1997.
3. Kothari V.K., “Progress in Textiles: Science & Technology Vol. 1, Testing and Quality Management”, IAFL Publications, New Delhi, ISBN: 81-s901033-0-X, 1999.
4. Barella.A and Manich.A.M, “Yarn Hairiness: A Further update, Textile Progress, Vol 31 No.4, 2000.
5. Lord P.R. and Grover G., “Roller drafting”, Textile Progress, Vol. 23 No.4, Textile Institute, ISBN:1870812468, 1993.

Objectives:

- To elucidate the technical knowledge on smart properties of fabrics
- To educate the concepts of low stress mechanical properties & other properties

UNIT I MECHANISM OF FABRIC FAILURE**9**

Mode of fabric failure – tensile, tear, abrasion, bursting and fatigue. Influence of fibre, yarn characteristics and fabric structure on the fabric failure.

UNIT II COMFORT PROPERTIES OF FABRICS**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.

UNIT III FABRIC APPEARANCE**9**

Study of fabric appearance in terms of Drape, Crease Recovery, Wrinkle Recovery and Pilling Resistance. Influence of fibre, yarn characteristics and fabric structure on the fabric appearance.

UNIT IV LOW STRESS MECHANICAL PROPERTIES**9**

Study of 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 OTHER PROPERTIES**9**

Evaluation of fabric properties like Dimensional Stability, Flammability, Impact Resistance, Absorbency. Evaluation of technical textile fabrics for various applications.

TOTAL HOURS: 45**TEXT BOOKS**

1. AR.Bunsell “Handbook of tensile properties of textile and technical fibres” wood head publishing ltd., 2009.
2. J.Fan and L.Hunter, “engineering apparel fabrics and garments” wood head publishing ltd, ISBN: 978-1-84569-134-9 (2009)

3. D.L.Bishop, "Fabrics: Sensory and Mechanical Properties", Textile Progress Vol. 26/3, ISBN: 1870812751, 1994.
4. Li, "The Science of Clothing Comfort", Textile Progress, Vol., 29/3, ISBN: 1870372247, 1997.

REFERENCES

1. Progress in Textiles: Science & Technology Vol. 1, Testing and Quality Management, V.K. Kothari, IAFL Publications, New Delhi, ISBN: 81- 901033-0-X, 1999.
2. Ukponmwan, J, Mukhopadhyay, A, Chatterjee, K, "Pilling", Textile Progress, Vol. 28/3, ISBN: 1870372153, 1996.
3. Seyam, "Structural Design of Woven Fabric: Theory and Practice", Textile Progress, Vol., 31/3, 1999.
4. Laing & Sleivert, "Clothing Textiles and Human Performance", Textile Progress, Vol. 32/4, 2000.
5. Hassan M.Behery Effect of mechanical and physical properties on fabric hand" wood head publishing., ltd, 2005
6. Mohsen Miratbab "Fatigue failure of textile fibres, wood head publishing, ltd 2009.

Objectives:

- To acquire technical knowledge in high performance & high tech fibres
- To obtain product development skills in technical textiles

UNIT -I HIGH PERFORMANCE FIBRES**9**

Requirements of high performance fibres. Aramid: Kevlar fibre – structure – properties and application. Nomex fibre: structure – properties and application. Polyphenylene Sulphide (PPS) fibre: properties – applications. Carbon fibres: classification - properties and applications. Glass fibres: Types and composition - properties - applications.

UNIT-II**HIGH****TECH****FIBRES****9**

Ceramic fibres: classification – composition – structure - properties and applications. Elastomeric (Polyurethane) fibre: properties - applications. HDPE fibres: properties - applications. Polybenzimidazole (PBI): structure - properties and applications. Polystyrene based fibres - properties – applications. Micro fibres: properties - applications; Poly Lactic Acid (PLA): properties – applications. Ultra-fine fibres and Hollow fibres: applications.

UNIT-III MILITARY TEXTILES**9**

Current and Future Requirements of Soldier – Protective materials, devices and end-use requirements – role of comfort in military clothing – sweat management for military textiles – Cold weather clothing: physiological response to cold –clothing design principles – estimation of insulation – evaluation systems - selection of clothing. Designing Military clothing with high-tech materials: design process – features of military clothing - physiological monitoring - thermal management - signature management - chemical and biological defense management -flame resistance - environmental defense - body armor.

UNIT-IV FILTRATION**TEXTILES****9**

Filtration: Introduction - definition – filtration mechanisms – classification of filter media – properties of filter media – fibres for high temperature filtration. Woven fabric media: Introduction - properties of yarns – effect of type of yarn & yarn structure on filter fabric performance – Effect of fabric weave pattern on filter fabric performance – filter fabric finishing processes – properties of woven fabric filters. Nonwoven fabric media: Introduction – Types – needle felts – electrostatic effects on nonwoven filters – bonded media: resin bonded – thermal

bonded. Dry-laid spun filter media: spun bonded filter and melt blown filter. Composite nonwovens filter.

UNIT-V AUTOMOTIVE TEXTILES

9

Introduction - global scenario – Seat Belt: classification – global scenario – forces acting on passenger with and without seat belt – critical characteristics – fibres & fabric structure – manufacturing methods – performance testing. Air bags: principle of working – laws of motion – air bag inflation – types of air bags – raw materials and manufacturing methods. Filters: carburetor filter – engine oil filter – fuel tank filter - cabin filters – other filters. Tyre cord: functions – types of tyres – reinforcement materials – properties of tyre cords – manufacturing and finishing of tyre cords. Seating fabrics: property requirements - seat comfort – materials. Other minor components: headliners – hoses and belts – bonnet liners - door trims - roof trims - floor coverings – parcel shelves – trunk liners – dash board – sun visors – battery separators.

TOTAL HOURS: 45

TEXT BOOKS:

1. Mukhopadyay S.K., “High Performance Fibres”, Textile Progress, Textile Institute, Manchester, Vol. 25, 1993.
2. S.C.Anand & A.R.Horrocks, “Hand Book of Technical Textiles”, Wood head publications Ltd., ISBN 1 85573 385 4, 2000.

REFERENCES:

1. Derek B. Purchas, K. Sutherland (Editor) “Hand Book of Filter media”, Elsevier Science & Technology Books, ISBN: 1856173755, November 2002.
2. Eugene Wilusz “Military Textiles”, Wood head publications Ltd., ISBN 978-1-84569-206-3, 2008.
3. R.Senthil Kumar “Seat Belt” – A review article, Asian textile Journal, July2010.
4. W Fung, Collins and Aikman Automotive Fabrics and J M Hardcastle, Consultant, UK “Textiles in automotive engineering” Woodhead Publishing, ISBN 1855734931, November 2000.
5. R Shishoo, Shishoo Consulting AB, Sweden “Textile advances in the automotive industry” Woodhead Publishing, ISBN-13: 9781845693312, October 2008.

Objectives:

- To understand the inter relationship between the clothing & human comfort
- To learn about science & technology of clothing that deals with the comfort

UNIT – I CONCEPT OF CLOTHING**9**

Need and selection of clothing - definition of comfort - components of clothing comfort - Subjective perception of comfort: Psycho-Physiological factors of clothing - Aesthetic concepts of clothing - Various aspects of clothing comfort: thermal comfort - sensorial comfort - body movement comfort. Comfort variables: Thermal and non-thermal comfort variables

UNIT – II THERMAL MANAGEMENT IN CLOTHING**9**

Human-clothing-environment system - Thermo-regulation in human body - Heat balance - Heat loss - Thermoregulation through clothing system: Heat exchange through clothing. Thermal comfort of clothing - Measurement of thermal transmission characteristics - Parameters for expressing thermal characteristics - Effect of body motion and wind.

UNIT - III MOISTURE MANAGEMENT IN CLOTHING**9**

Moisture transport - Liquid water transfer: wicking and water absorption - Principles of moisture vapour transfer - Evaluation of moisture vapour transmission - Factors affecting heat and mass transfer through fabrics- Parameters expressing heat and mass transmission- Air permeability and measurement.

UNIT - IV COMFORT PROPERTIES OF FIBERS, YARNS AND FABRICS**9**

Comfort properties of fibers: Physical modification of fibers - Comfort properties of yarns: Effect of yarn structure characteristics, effect of spinning technique, texturizing - Comfort properties of fabric structures: Fabric constructional parameters, finishing.

UNIT - V COMFORT PROPERTY OF CLOTHING**9**

Physical Properties of Clothing and Comfort: Thermal resistance – Water vapour diffusion resistance – Water holding property – Effect of fabric properties – Radiation exchange – Flammability – Clothing with internal spaces.

TOTAL HOURS: 45**TEXT BOOKS:**

1. A Das, R.Alagirusamy, "Science in clothing comfort", Woodhead publishing, India ISBN: 978184596789, Jan 2010.
2. G.song, "Improving comfort in clothing", woodhead publishing services in textiles No: 106, ISBN: 184569 539, Jan 2011

REFERENCES:

1. Buchanan D.R, "The Science of Clothing Comfort", Textile Progress, Vol.31, No.1/2, ISBN-13: 9781870372244, 2001.
2. Fourt L.and Hollies N.R.S., "Clothing – Comfort and Function", Marcel Decker, New York, 1970.
3. Laing R.M., and Sleivert G.G., "Clothing, Textiles and Human Performance", Textile Progress, Vol.32, No.2, 2002.
4. Ukponmwan J.O., "The Thermal Insulation Properties of Fabrics", Textile Progress, Vol.24, No.4, 1992.
5. Slater K, "Comfort Properties of Textiles", Textile Progress, Vol.9, No.4, 1977.

Objectives:

- To study the influence of process variables on ring and rotor spun yarn quality
- To develop various yarns by using different methods of spinning
- To study the influence of finishes on the fabric quality

LIST OF EXPERIMENTS

1. Studies on influence of process variables on ring-spun yarn quality
2. Studies on influence of process variables on rotor-spun yarn quality
3. Development and Analysis of siro-spun and siro-fil yarns
4. Development and Analysis of mélange yarns
5. Development and Analysis of core-spun yarns
6. Investigating the influence of process variables on air-jet-spun yarn quality
7. Investigating the influence of process variables on friction-spun yarn quality
8. Development of special fabrics – denim, canvas, spacer, etc.
9. Development of technical textiles
10. Studies on the constituents of Textile effluents
11. Investigation of influence of enzymes on textile chemical processing
12. Studies on garment washing process
13. Studies on effect of aesthetic and functional finishes on fabrics

TOTAL HOURS: 30

Objectives:

- To equip the students to make an independent analysis useful for research
- To make use of analytical outcomes in the application of textile problems.

Student should undertake in depth study of a subject of outside the regular courses offered in the programme. The study should be carried out under the guidance of a faculty member. The Subject area chosen by the student should be sufficiently different from the area of project to be pursued by the student in the succeeding semesters. Student must submit the detailed plan of work to the **Independent Study coordinator** before one week from the last instruction day of previous semester. The evaluation will be based on the seminars (3 nos.) presented before **review committee and its coordinator** during the semester and report submitted as well as viva-voce presented at the end of the Semester before **internal & external valuers**. The valuation pattern is as follows.

Particulars	Maximum Marks		Minimum Marks
CAM		50	25
Average of 3 seminars presentations	45		
Attendance	5		
End Semester Valuation (Project Report & Viva Voce)		50	25
Total		100	50

TOTAL HOURS: 15

Objectives:

- To gain knowledge about research objectives and defining the research problem
- To learn about research design and various data collection methods
- To know about data interpretation and report writing

UNIT I RESEARCH OBJECTIVES AND DEFINING THE RESEARCH PROBLEM**9**

Literature review-identification and selection of problem – Formulation. Research methodology - definition, mathematical tools for analysis, types of research, exploratory research, conclusive research, modeling research, algorithmic research, research process – steps.

UNIT II RESEARCH DESIGN AND EXPERIMENTAL DESIGN**9**

Meaning, purpose and principles of research design – Design criteria- Different types of research and experimental design.

UNIT III METHODS OF DATE COLLECTION, MEASUREMENT AND SCALING TECHNIQUES**9**

Sources of data –data collection methods - primary data – observation method – personal interview – telephonic interview – mall survey – questionnaire design. Observation, questionnaire and interviews. Measurement scales – scaling techniques – scale constitution techniques – contact analysis.

UNIT IV PROCESSING AND ANALYSIS OF DATA**9**

Processing operation-problems in processing-types of analysis-hypothesis testing - testing of hypotheses concerning means (one mean and difference between two means – one tail and two tails tests)

UNIT V INTERPRETATION AND REPORT WRITING**9**

Meaning and Techniques of interpretation – Types of report – guidelines to review report – typing instructions – oral presentation - Significance of report writing – Case studies.

TOTAL HOURS: 45**TEXT BOOKS:**

1. Kothari C.R., "Research Methodology, Methods and Techniques", Wiley Eastern, New Delhi, 1990.
2. Panneer selvam.R, "Research Methodology", Printice Hall of India, New Delhi, 2004.

REFERENCES:

1. Sedhu. A.M. and Singh A., "Research Methodology in Social Sciences", Himalaya Publishing House, Mumbai, 1980.
2. Bailey, Kenneth D., "Methods of social research", New York, 1978.
3. Best, John W., and Kahn, James V., "Research in education", 5th Ed., New Delhi: Prentice-Hall of India Pvt. Ltd., 1986.
4. Emory, C.William, "Businees Research Methods", Illinois: Richard D.Irwin, Inc. Homewood, 1976.
5. Ullman, Neil R., "Elementary statistics", New York: MCGraw-Hill, 1970.

1**OBJECTIVES:**

- Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits.

UNIT I ENTREPRENEURSHIP AND PROJECT IDENTIFICATION**5**

Entrepreneur : Types, role and qualities- entrepreneurship in economic growth- factors affecting entrepreneurial growth. Project Identification And Selection (PIS):Meaning of Project, Project Identification, Project Selection Project Formulation – Steps involved in setting up a Business, Market Survey and Research, Techno Economic Feasibility Assessment – Project Reports – Sources of Information.

UNIT II BUSINESS**5**

Small Enterprises: Definition, Characteristics, Relationship between Small and Large Units, Rationale, Objectives, Scope, Opportunities for an Entrepreneurial Career, Role of small Enterprise in Economic development, Problems of SSIs.

UNIT III FINANCING, ACCOUNTING & SUPPORT TO ENTREPRENEURS**5**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Break Even Analysis – Taxation – Income Tax, Excise Duty – Sales Tax. Sickness in small Business: Causes and Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion & Diversification.

PART B FIELD WORK**15**

1. Preparation of detailed report in new spinning/ weaving projects.
2. Marketing survey of a new developed textile product.
3. Customer survey of existing textile product.
4. Analysis on selection criteria of financial institution.
5. New product developments compare to existing textile products.
6. Techno commercial Survey

TOTAL HOURS: 30

TEXT BOOKS:

1. S.S.Khanka, “Entrepreneurial Development”, S.Chand & Co. Ltd., 2001.
2. Donald F.Kuratko, “Entrepreneurship – Theory, Process and Practices”, Cengage learning, 9th edition, 2012.
3. Robert Hisrich, “Entrepreneurship”, Tata McGraw-Hill, 6th Edition, 2008.

REFERENCES:

1. Thomas Zimmerer, Norman M.S.Dough Wilson, “Essentials of Entrepreneurships and Small Business Management”, Pearson/Prentice Hall, 5th Edition, 2008.
2. Mathew J Manimala, “Entrepreneurship Theory at Cross Roads: Paradigms and Praxis”, Dream tech, Press, 2nd Edition, 2005.
3. Rabindra N. Kanungo “Entrepreneurship and Innovation”, Sage Publications, 1998.
4. EDII “ Faulty and External Experts – A Hand Book for New Entrepreneurs”, Entrepreneurship Development” Institute of India, 1986.
5. E. Gordon & K.Natarajan, “Entrepreneurship Development”, Himalaya, 2008.
6. Vidya Hattangad, Entrepreneurship, Himalaya, 2007.
7. Vasant Desai, Small Scale Industries and Entrepreneurship Himalaya, 2008.
8. V. B. Angadi, H. S. Cheema & M. R. Das, “Entrepreneurship, Growth, and Economic Integration- A linkage”, Himalaya, 2009.

Objectives:

- To impart technical knowledge on the properties of long staple fibres
- To educate the students on the constructional and operational features of long staple processing machinery

UNIT-I OPENING AND CLEANING**9**

Opening and Cleaning: Removal of raw wool impurities- methods of raw flax and jute processing-blending of fibers. Carding: Functions of a carding machine- operating principle of woolen, worsted, flax and jute carding machines.

UNIT-II COMBING**9**

Combing: Objectives of wool combing; working details of comber preparatory processes and combing machine- worsted top finishing.

UNIT-III DRAWING**9**

Drawing: Theory of long fiber drafting- study of drafting irregularities- doubling and autolevelling during drafting- detailed study of worsted, semi-worsted, jute, and flax drawing.

UNIT-IV ROVING & YARN FORMATION**9**

Operating details of roving production. Spinning Process: Detailed study of long- staple ring spinning machine - drafting, twisting, and balloon theory. Ring and travelers.

UNIT-V OTHER SPINNING**9**

Open end spinning machines for long staple fibers- principles and working details of rotor and friction spinning machines - comparison of long staple yarn production with short staple spinning process. Working principle of mule spinning machine- study of condensed spinning, cap spinning and self-twist spinning.

TOTAL HOURS: 45**TEXT BOOKS:**

1. Oxtoby E “Spun Yarn Technology” butter worth’s, London, New Edition 2002.
2. Lord P R, “Handbook of Yarn Production, Technology, Science and Economics”, Woodhead Publishing Limited, ISBN: 978 1 85573 696 2, 2003.

REFERENCES:

1. Lawrence C A, "Fundamentals of Spun Yarn Technology", Woodhead Publishing Limited, ISBN: 978 1 56676 821 4, 2003.
2. Happey F, "Contemporary Textile Engineering", Academic Press, London, 1982.
3. Gowda R.V.M., "New Spinning Systems", NCUTE, IIT Delhi, 2003
4. Woollen and Worsted Spinning, Abishek Publications, Chandigarh, 2002.
5. W.S.Simpson and G H Crawshaw Wool: Science and Technology, Woodhead Publishing Ltd, 2002.

P13TX7E002

ADVANCES IN TEXTILE FINISHING

3 0 0

3

Objectives:

- To educate on the commercial importance of finishing and concepts of finishing
- To understand the mechanism of functional and mechanical finishing of textile material

UNIT I EASY-CARE AND DURABLE PRESS FINISHES

9

Commercial importance of finishing and its classification. Concepts of antcrease finish, Esterification and etherification, Mechanisms and chemistry of easy-care and durable press finishes- Formaldehyde and non-formaldehyde containing product, cross linking agent and catalyst, problem of formaldehyde release. Developments in resins, Application methods, Compatibility with other finishes, Evaluation methods. Trouble shooting and practical problems.

UNIT II SOFTNERS AND SURFACTANT IN FINISHING

9

Methods of softening, Chemistry of softeners, Application of softening techniques to technical textiles, Effect of softeners on textile properties, Environmental impact of softeners, Measurement of fabric softness. Raw materials for surfactants, Cationic and non ionic surfactants, Novel surfactants, Applications of surfactants

UNIT III FLAME RETARDANT AND WATER REPELLENT FINISHES

9

Burning behaviour of polymers and ways to affect flame retardancy, Condensed phase and gas phase mechanisms of FR. Classification, application and developments in flame redardants. Test methods for fire resistance. Mechanisms of water repellency, Repellent chemistry, Evaluation of textile treated with repellent finishes, Troubleshooting repellent finishes and particularities.

UNIT IV FUNCTIONAL FINISHES

9

Soil release finish-mechanisms of soil release, Soil release chemistry, Evaluation of soil release. Anti-microbial finish- mechanism and chemistry, evaluation methods. Anti-static finish-mechanism & chemistry, conductive fibres, evaluation methods. Anti-pilling finish- mechanism and chemistry, evaluation methods. UV finish- mechanism and chemistry, evaluation methods.

UNIT V SPECIALITY POLYMERS IN FINISHING

9

Speciality polymer- Temperature responsive breathable coating. Bioactive finishes for protection against biological attack and other medical applications. Finishes for conductive textiles. Advances in application of speciality finishes/ coatings. Foam Finishing- Detailed study of various techniques of foam application. Drawbacks of foam finishing.

TOTAL HOURS:

45

TEXT BOOKS:

1. Gulrajani M L, "Advances in the dyeing and finishing of technical textiles" Woodhead Publishing Limited, 2013.
2. Schindler W D and Hauser P J, "Chemical finishing of Textiles" Woodhead Publishing Limited, 2004.

REFERENCES:

1. Lewin & Sello, Functional finishes, Part A & Part B; CRC Press, ISBN: 0824771184, 1994.
2. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001
3. Marsh, J.T., "An Introduction to Textile Finishing", Chapman and Hall Ltd., London, 1979.
4. From waste to Profits, Technical Manual Series III, National Productivity Council, New Delhi, 1998.
5. Heywood, "Textile Finishing", Woodhead Publishing Limited, 2003.

Objectives:

- To gain the knowledge about functions and applications of enzymes.
- To understand various effluent treatment methods

UNIT-I ENZYMES**9**

Introduction-classification and nomenclature of enzymes-protein structure: primary, secondary, tertiary, quaternary – protein properties – enzymatic catalysis.

UNIT – II FUNCTIONS OF ENZYMES**9**

Function of textile processing enzymes-amylases, celluloses, pectinolytic enzymes, esterase, proteases, nitrile- hydrolysing enzymes catalases, peroxidases, and laccases-wet processing of various textiles materials with enzymes.

UNIT-III APPLICATION OF ENZYMES**9**

Application of enzymes in processing-desizing finishing scowling-mass transfer of enzyme in textile materials.

UNIT-IV ACTIVITY OF ENZYMES**9**

Stabilization of enzymatic activity-handling of enzymes in batch, continuous equipment and practical issues-health and safety issues.

UNIT-V EFFLUENT TREATMENTS METHODS**9**

Membrane technologies, chemical treatment, biological treatment-Decolouration of enzymes, fungi and by biosorption and enrichment culture.

TOTAL HOURS: 45**TEXT BOOKS:**

1. Cavaco-Paulo & G.M. Gubitz “Textile Processing with Enzymes”. Textile Institute, 2003.
2. Wiseman, Alan. Hand book of Enzyme Biotechnology, 3rd ed., Ellis Harwood 1995.

REFERENCES:

1. Nierstrasz, Cavaco-Paulo, "Advances in textile bio technology," The Textile Institute, Wood head publishing, 2010.
2. Blanch, H.W., Clark, D.S. Biochemical Engineering, Marcel Dekker, 1997
3. Lee, James M. Biochemical Engineering, PHI, USA.
4. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill, 1986
5. Trevor Palmer, "Enzymes: Biochemistry, Biotechnology and Clinical Chemistry", 1st Edition, Affiliated East West Press, 2004

P13TX7E004

NANO TECHNOLOGY IN TEXTILES

3 0 0 3

Objectives:

- To understand the concepts of nanotechnology.
- To know the applications of nanotechnology in textiles.
- To gain knowledge on the characterization of nano textiles.

UNIT- I INTRODUCTION

9

Nano Technology: definition and basic concepts, particle size, nano particles; Different types of process: Top down approach, bottom up approach; Synthesis of nano materials used in textiles.

UNIT- II NANO FIBRES AND NANO PARTICLES

9

Nano fibres: Definition, properties and applications such as filtration, tissue engineering; Electro spinning of nano fibres: capillary method, charge injection method; Production of non-continuous or short yarns: Rotating collector method, Gap alignment method; carbon nano fibres, metal and metal oxide nano particles such as nano silver, nano silica, nano titanium, nano zinc oxide, nano magnesium oxide.

UNIT-III APPLICATIONS AND NANO FINISHING

9

Applications of nano technology in textile materials and polymers; Nano finishing through water and oil repellent, self cleaning, anti microbial, UV protective, nano architecture, nanopel, nano care, nano touch, nano feel, lotus effect.

UNIT-IV CHARACTERIZATION OF NANO TEXTILES

9

Characterization methods: Optical microscopy, Scanning Electron Microscopy, Transmission electron microscopy, Atomic force microscopy, Energy dispersion X-ray and raman spectroscopy. Testing of nano functional Textiles: Anti-microbial testing, UV protection testing and self cleaning testing.

UNIT- V CNT, NANOCOMPOSITES AND NANO COATING

9

Synthesis of carbon nanotubes: principle methods, arc discharge, laser ablation, chemical vapour deposition (CVD); Polymeric Nano Composites: definition, types, characterization, applications; Nanotechnologies for coating and structuring of textiles: Anti-adhesive nano coating of fibres and textiles, water and oil repellent coatings by plasma treatment, self cleaning super hydrophobic surfaces, layer by layer self assembly, sol-gel coating.

TOTAL HOURS: 45

TEXT BOOKS:

1. Ashutosh Sharma, Jayesh Bellare and Archana Sharma, “Advances in Nanosciences and Nanotechnology”, NISCAIR, First Edition, 2004.
2. Brown P and Stevens K., “Nano fibres and Nanotechnology in Textiles”, Woodhead Publishing Limited, 2007.

REFERENCES:

1. Jurgen Schulte, “Nanotechnology: Global strategies, industry trends and applications”, Wiley Publications, 2005.
2. Bhushan Bharat, “Springer Handbook of Nanotechnology”, Springer, 2007.
3. Brown P and Stevens K, “Nano fibres and Nanotechnology in Textiles”, Woodhead Publishing Limited, 2007.
4. “Industry insight Indian nanotechnology”, Cygnus Business Consulting and Research, 2006.
5. Lynn E.Foster, “Nanotechnology: Science, Innovation and Opportunity”, Prentice Hall Professional Technical Reference, 2005.
6. Mark Ratner & Daniel Ratner, “Nanotechnology: A Gentle Introduction to Next Big Idea”, Prentice Hall Professional Technical Reference, 2002.

Objectives:

- To acquire knowledge on constituents of composite materials
- To get exposure to various composite manufacturing technologies and testing of composites

UNIT-1 COMPOSITES REINFORCEMENT AND MATRICES 9

Composites: introduction – definition – classification based on reinforcement and matrix - constituents. Matrix: thermoplastic and thermosetting matrices – properties – limitations – comparison - applications. Reinforcement Types – MMC, CMC, PMC – properties – limitations- applications. Textile Reinforcement Forms – fibre, roving, fabric, mat, braid, etc. - properties – applications. High performance fibres: aramid- glass – boron – carbon. Prepregs and Preforms: properties – manufacturing. Testing of Reinforcement and Matrices.

UNIT-2 COMPOSITES MANUFACTURING TECHNOLOGIES 9

Lay-up & Automatic lay-up: working principle – advantages – limitations – applications. Resin Transfer Moulding: principle of operation – resin system & injection – mold materials - resin flow strategies - advantages – limitations – applications. Filament winding: principle of working – geometry of winding – types of winding – mandrels - advantages – limitations – applications. Pultrusion: process equipments - principle of operation – pull forming - advantages – limitations – applications. Consolidation techniques: Vacuum bagging – Pressure bagging.

UNIT - 3 DESIGN OF STRUCTURE WITH COMPOSITES 9

Interface: definition – conditions for good interfacial reactions - interface mechanisms - surface treatments. Design of Composites: material selection - configuration selection – design requirements – design load definitions – optimization concepts - laminate design.

UNIT-4 MECHANICS AND TESTING OF COMPOSITES 9

Geometric and Physical definitions. Lamina and Laminate: definition - angle of orientation mass density and ply thickness, fibre volume fraction (FVF) - critical fibre length - rule of mixture. Fibre Composites: strength and failure – fracture toughness – fatigue – impact – delamination – moisture expansion – conductivity – damage and failure modes. Testing of Composites: Destructive testing: tensile - compression – bending - shear – impact – ignition loss & matrix digestion – accelerated weathering test.

UNIT-5: APPLICATIONS OF COMPOSITES 9

Land Transport Applications: Automotive applications – rail road applications – mass transit applications – military applications. Marine Applications: boats – large power yachts – sail boats

– pressure hulls – sonar domes – fairings – control surfaces – decking – pipes. Industrial Applications: antennas – bridges – cable cars – electrical and electronics. Composite Biomaterials: orthopaedic implants – femoral components for total hip arthroplasty – bone cement, articulation components. Construction applications: rebars – prestressing – rehabilitation – platforms – pedestrian bridges – cooling towers. Other applications: aircrafts, sports goods and aerospace.

TOTAL HOURS: 45

TEXT BOOKS:

1. S.T. Peters, Chapman & Hall, “Hand Book of Composites”, Second Edition, ISBN 0 412 54020 7, 1998.
2. Robert M.Jones, Taylor & Francis, “Mechanics of Composite Materials”, Second Edition, 1999.

REFERENCES:

1. Güneri Akovali, “Hand book of Composite Fabrication” Rapra technology Ltd., UK, ISBN: 1-85957-263-4, 2001.
2. Isaac M.Daniel, Ori Ishai, “Engineering mechanics of Composite Materials”, Oxford University Press, UK, 1994.
3. A. Brent Strong, “Fundamentals of Composites Manufacturing” Society of Manufacturing Engineers, 2008.
4. Mel M. Schwartz, “Composite materials handbook” McGraw-Hill, 1992.
5. Stuart M. Lee, “International encyclopedia of composites” VCH, 1999.

Objectives:

- To gain knowledge about the production planning
- To know about the maintenance management concepts
- To understand the enterprise resource planning

UNIT I INTRODUCTION**9**

Indian Textile Industry: Structure, production and exports. Textile Policy. Sickness of Textile Industry- Analysis and options. Essentials of production management, production systems, classification. Material management: Role of material management techniques, purchase management, acceptance sampling and inspection, vendor rating system, inventory management.

UNIT II PRODUCTION PLANNING & CONTROL**9**

Production, planning and control: types of production systems and problems of planning and control, product section design, process planning, forecasting, planning of batch, mass and job shop system. Machine balancing. Layout and material handling. Machine assignment and allocation of jobs.

UNIT III MAINTENANCE & QUALITY MANAGEMENT**9**

Maintenance management: maintenance concepts, maintenance strategies, maintenance planning. Productivity and improvement techniques. Quality management: Introduction to TQM, concepts of value and quality assurance, total quality control, quality circles, ISO 9000.

UNIT IV MARKETING MANAGEMENT**9**

Marketing management: fundamental of industrial marketing, industrial buyer behaviour model. Marketing: systems selling, role of service, marketing planning and marketing strategies. Purchasing; Objectives, value engineering, vendor relations, selection of vendors. Material Requirement Planning: MRP Calculations, material handling. Job Evaluation: Incentive schemes, job redesign.

UNIT V ENTERPRISE RESOURCE PLANNING**9**

Enterprise resource planning: Role of information in managerial decision making, information needs for various levels of management, decision makers, management information system, resource monitoring and control. Product mix. Case studies.

TOTAL HOURS: 45

TEXT BOOKS:

1. Ormerod.A., "Textile Project Management", The Textile Institute, Manchester, New edition, ISBN: 1870812387, 2002.
2. ILO, Geneva, "Introduction to Workstudy", Universal Publishing Corporation, Mumbai, 2006.

REFERENCES:

1. Websites and Publications of Research Associations and Industry Associations.
2. Handouts of HRD programmes conducted by Research Associations and Industry Associations.
3. [http:// www. txcindia.com](http://www.txcindia.com)
4. [http:// www.texmin.nic.in](http://www.texmin.nic.in)
5. Khanna O.P “Industrial Engineering & Management”, Dhanpat Rai & sons, Delhi, 2004.
6. Kiell B.Zandin, “Maynard’s Industrial Engineering Hand Book”, Mc Graw Hill, Inc., New York, 2001
7. Jain K C and Chitale A K, “Quality Assurance & Total Quality Management”, Khanna Publishers, New Delhi, 2004.

P13TX7E007 PROTECTIVE CLOTHING FOR HAZARDOUS ENVIRONMENT 3 0 0
3

Objectives:

- To gain knowledge about fibre structure and its geometry
- To study the influence of comfort properties of protective clothing

UNIT I FIBRE STRUCTURE AND GEOMETRY

9

Fibre Structure and Geometry: Geometrical characterization of single fibers; basic parameters for porous media; characterization of fibrous materials; mathematical descriptions of the anisotropy of a fibrous material; pore distribution in a fibrous material; tortuosity distributions in a fibrous material; structural analysis of fibrous materials with special fiber orientations.

UNIT II MOISTURE IN TEXTILES

9

Moisture in Textiles: Surface tension, wetting and wicking- adhesive forces and interactions across interfaces; rate of change of moisture content; wetting phenomena in fibrous materials- curvature effects of surfaces; capillarity; interactions between liquid and fibrous materials- complete wetting of curved surfaces, liquid spreading dynamics on a solid surface.

UNIT III HEAT –MOISTURE INTERACTIONS

9

Heat & Moisture Interactions: heat transfer and moisture diffusion in fibrous materials- thermal conduction analysis, moisture diffusion; effect of fabric physical properties on the condensation/evaporation process; heat-moisture interactions and phase change in fibrous material- moisture regain and equilibrium relationships, sorption and condensation, mass and heat transport processes

UNIT IV CHEMICAL PROTECTIVE CLOTHING

9

Chemical Protective Clothing: protection from chemical hazards; chemical protective clothing- barrier effectiveness of chemical protective clothing, performance evaluation of chemical protective clothing, human exposure assessment, decontamination and reuse; refurbishment factors- chemical, thermal and mechanical energies.

UNIT V THERMOREGULATION AND COMFORT

9

Thermoregulation and Comfort: Introduction; structure of skin; heat exchange at the skin surface; moisture exchange at the skin surface; sensation and comfort; modeling human thermal regulation and comfort- phase change in fabrics.

TOTAL HOURS: 45

TEXTBOOKS:

1. Slater K., Textile Progress “Comfort properties of textiles”, A review published by the Textile Institute, Vol. 9/4, ISSN: 0040-5167, 1977.
2. Hearle J.W.S and Peters R.H., “Moisture in Textiles”, Butterworths Scientific Publications, Manchester, 1960.

REFERENCES:

1. Pan N and Gibson P., “Thermal and moisture transport in fibrous materials”, Woodhead Publishing limited and CRC press LLC, ISBN-13:978-1-84569-057-1.
2. Mastura Raheel., “Protective Clothing Systems and materials”, Marcel Dekker, Inc. NewYork. Basel. HongKong, ISBN: 0-8247-9118-5, 1994.

Objectives:

- To understand the theories of fibre chemistry
- To educate the parametrical influence on dyeing and assessment of colours

UNIT-I FIBRE CHEMISTRY:**9**

Chemical structure of textile fibres – Effects of acids, alkalies, enzymes and solvents on textile fibres – study of mechanism of desizing, scouring, bleaching and mercerizing of textile fibres.

UNIT-II PHYSICAL CHEMISTRY:**9**

First law of thermo dynamics and its application in thermo chemistry-Second law of thermo dynamics - free energy - thermodynamics of solutions - surface adsorption - adsorption at interface - activity of dye affinity – substantivity - heat of dyeing and entropy. Donor Membrane Equilibrium - order of reactions.

UNIT-III PHYSICAL AND CHEMICAL STRUCTURE OF FIBRES AND DYE UPTAKE

Effect of orientation, crystallinity, chemical structure and chemical modification of fibres Surface energy and interfacial effects on kinetics and equilibrium of sorption of solvent and dye molecules.

UNIT-IV DIFFUSION AND RATES OF DYEING:**9**

Fick's laws - of diffusion, diffusion in the steady and non-steady state - boundary layers in diffusion - diffusion in final bath - parameters that affect diffusion and rates of dyeing - diffusion coefficient and concentration - activation energies of diffusion.

UNIT-V COLOUR ASSESSMENT IN TEXTILES:**9**

Theories of colour measurement, Beer–Lambert's law and Kubelka-Munk theory; techniques of computer color matching; prediction of color recipe; limitations of computer color matching.

TOTAL HOURS: 45**TEXT BOOK:**

1. Johnson A, "The Theory of Colouration of Textiles", SDC, Second edition, ISBN: 978 0 901956 48 4, 1990.
2. Shah H S and Gandhi R S, " Instrumental Colour Measurements and Computer Aided Colour Matching", Mahajan Book Distributors, ISBN: 978-8185401003, 1990.

REFERENCES:

1. Peters A T and Freeman H S, "Physico – Chemical Principles of Colour Chemistry", Springer-Verlag New York, ISBN: 9780751402100, 1996.
2. Broadbent A, "Basic Principles of Textile Colouration", SDC, 2001. ISBN: 978 0 901956 76 7
3. Shore J, "Blends Dyeing", SDC, ISBN: 978 0 901956 74 3, 1998.
4. M Gulrajani, "Advances in the dyeing and finishing of technical textiles", The Textile Institute, woodhead publishing, 2013.
5. A.A. Vaidya, "Chemical Processing of Man-made Fibres and Blends", John Wiley and Sons, New York, 1984.

3**Objectives:**

- To understand the techniques of image processing and artificial neural networks
- To acquire knowledge on modeling and simulation techniques

UNIT-I INTRODUCTION TO IMAGE PROCESSING**9**

Computer Vision Based Image Processing: Elements of Digital Image Processing - Principle of Human eye, CCD camera - Image formation and measures. Pre-processing techniques, image transforms - enhancement - restoration – encoding.

UNIT-II ANALYSIS OF IMAGE PROCESSING**9**

Image analysis and feature extraction methods – Application of image processing to textile process/product feature extraction.

UNIT-III ARTIFICIAL NEURAL NETWORKS**9**

Basic concepts - Inference and Learning - models – Hardware implementation - supervised and unsupervised learning - Knowledge based Neural Networks - Application of ANN to fabric defect analysis, pattern recognition, prediction of clothing performance, garment manufacturing.

UNIT-IV ARTIFICIAL INTELLIGENCE AND DECISION SUPPORT SYSTEMS**9**

Scope of artificial intelligence - structure of Expert and Decision support systems – Application – Spinning, weaving and garment unit- Application of DSS to Fabric defect analysis.

UNIT-V MODELING AND SIMULATION**9**

Introduction – Basic modeling concepts, methods, FEM Technique. Modeling and Simulation of textile structures- Basics of computer graphics - graphic input techniques - Two dimensional transformation - 3-D concepts

TOTAL HOURS: 45**TEXT BOOKS:**

1. Gonzalez R C and Wintz P, “Digital Image Processing”, Pearson Education 2nd Edition, 2002.
2. Patterson D W, “Artificial Intelligence and Expert System”, Prentice Hall of India, 1996.

REFERENCES:

1. Rajaraman V, "Analysis and Design of information systems", Prentice Hall of India, 1992.
2. Li Min Fu, "Neural Networks in Computer Intelligence", Mc Graw Hill Inc, 1994
3. Computers in the World of Textiles – Textile Institute, 1984.
4. Information Technology in Production and Trading of Textiles- NCUTE Programmes series, 2001.

OBJECTIVES

At the end of the course, the students would be exposed to

- Properties of bio-polymers and medical textile products, wound dressing concepts, implants, cosmetic and odour textiles.
- Application of bandages, medical filters and super absorbents in medicine.
- Knowledge on tissue engineering, drug release and smart textiles.

UNIT-1 MEDICAL TEXTILES AND BIOPOLYMERS**9**

Medical textile products: properties, contacting behavior and transmission properties, engineering stability and compactness; Anti microbial agents: various forms & types; Structures and applications of nonwovens in medicine; Biopolymers from natural origins: polysaccharides, proteins, lipids-polyesters synthesized from bio-derived monomers -polymers from sugars-biopolymers from mineral origin-aliphatic polyester-aromatic polyester –PVA -modified polyolefin; PLA: rheological, thermal and mechanical properties; Biomaterials: invitro assessment of tissue compatibility by assay methods –invitro assessment of tissue compatibility.

UNIT-2 WOUND DRESSING AND TESTING**9**

Wound healing mechanism; wound dressing concept, structures, design criteria for wound coverage, material selection, types of dressing material- Interactive wound dressings: principles, types and structures of bioactive wound dressings –silver containing wound dressings-Delivery drugs to wounds- composite wound dressing: structures, materials & types-High tech wound dressing – Non-adherent dressings- odour absorption dressings-Antimicrobial wound dressing - Testing of dressing and wound handling materials: Fluid handling –Low adherence – Conformability –microbiological -odour control –biological tests.

UNIT-3 REUSABLE TEXTILES, IMPLANTS, COSMETIC AND ODOUR TEXTILES**9**

Reusable medical textiles: types, advantages - processing procedures – healthcare cost analysis; Textile implants : hernia mesh – vascular prosthesis – stents; Regenerative textile: materials, structures, cells- applications in cartilage, nerves & liver; Cosmetic textiles: application and release technology-functionalities –performance testing; Odour control textiles: measurement – qualitative description of wound and body odours –instrumental evaluation – antimicrobial efficacy test – control of odour with textiles.

UNIT-4 BANDAGES, MEDICAL FILTERS AND SUPER ABSORBENTS**9**

Compression therapy and elastic compression bandages: types, relationship between compression and pressure- ideal bandage pressure –novel bandages-applications- 3D Compression bandages; Medical filters: Hollow fibre bioreactors- measurement of diffusion / hydraulic permeability, pore size and distribution and surface properties; Super absorbents – chemical structure- forms-properties- applications in medicine, hygiene and comfort improvement.

UNIT-5 TISSUE ENGINEERING, DRUG RELEASE AND SMART TEXTILES

9

Tissue engineering: principle, properties and materials of fibrous scaffolds –relationship between textile architecture and cell behavior; Drug releasing textiles: classification – fabrication – characterization. Drug delivery system: Diffusion control delivery systems – water penetration controlled system - chemically controlled devices – regulated system; Sutures: Categories and characteristics-structures and materials; Phase change and shape memory Textiles: physical effects, material, applications; Use of electronics: power management, materials and application.

TOTAL HOURS: 45

TEXT BOOKS:

1. Bartel .V.T, “Hand Book of Medical Textiles,” The Textile Institute and Wood head Publishing, 2011.
2. Rajendran .S, “Advanced Textiles for Wound Care,” Wood head Publishing,2009.

REFERENCE:

1. Buddy D.Ratner, “Bio material Science-An Introduction to Material in Medicine”, Academic Press,1996.
2. Van Lagenhove , “Smart Textiles for Medicine and Health care – Materials, System and Application,” Wood head Publishing, 2007.
3. Rajendran .S and Anand .S.C, “Developments in Medical Textiles,” Textile Progress,Vol.32,No.4, 2006.
4. V.K.Kothari, “Progress in Textiles: Science & Technology”, Vol. 3, IAFL Publication, 2008.
5. G.E.Cusick and Teresa Hopkins, “Absorbent Incontinence Products”, Textile Institute, 1990.
6. Pour deyhimi B, “Vascular grafts: Textile Structures and Their Performance”, Textile Progress, Vol.15, No.3, 1986.

Objectives:

- To impart the knowledge of costing & optimization techniques using in manufacturing of textile products
- To understand the various concepts in costing & optimization
- To impart the knowledge about various costing tools for decision making

UNIT I INTRODUCTION**9**

An Introduction to cost terms and purposes - cost terminology - direct and indirect costs. Cost behavior patterns: variable costs - fixed costs - total costs - unit costs. Financial statements and inventory costs - types of inventory - production costs - prime costs - conversion costs. Costing for manufacturing, merchandising and service sector companies.

UNIT II ACTIVITY BASED COSTING AND MANAGEMENT**9**

Activity based costing and management - broad averaging via smooth or peanut- butter costing approaches - refining a cost system - costing hierarchies - comparison of alternate costing systems - ABC system for cost management and profitability improvement - Activity based costing and department costing systems.

UNIT III COST ANALYSIS**9**

Cost application and revenues - purpose of cost allocation - allocating cost from one department to another and support departments. Cost allocation of joint products and by products. Cost Volume Profit analysis – assumption – terminology - essentials of CVP analysis - the breakeven point. Target operative income and income taxes – service and non-profit organizations - effect of sales mix on income.

UNIT IV OPTIMIZATION OF COSTING**9**

Process costing - hybrid costing systems - operation costing - journal entries - spoilage rework and scrap costing - quality, time and theory of constraints. Control charts - Pareto diagrams, cause and effect diagrams. Inventory management - Just in Time (JIT) and back flush.

UNIT V COSTING TOOLS & DECISION MAKING**9**

Inventory costing and capacity analysis - standard costs - cost estimation approaches. Tools for planning and control - master budget and flexible budgets - Use of variances - flexible budget

variances and sales volume variance - primary variance and efficiency for direct cost input - planning variable and fixed over head costs. Decision marketing and retrieving information - pricing decisions and cost management - target costs.

TOTAL HOURS: 45

TEXT BOOKS:

1. Cost control and costing in spinning mills – SITRA, Edition 2008.
2. Cost control and accounting for Textile industry – TAIRO, Edition 2006.

REFERENCES:

1. Kalyanaraman.A.R. “Energy Conservation in Textile Industries”, SITRA, 2002.
2. V.Dudeja “Textile Industry Management” (ATIRA), 2000.
3. Modern production Technologies edited by M.L.Gulrajani, The Textile Association (India) Publications, 2004
4. James.C. Van Home – “Financial management & Policy”, Prentice hall of India (p) Ltd., NewDelhi (2002)
5. Larry M. Walther & Christopher J.Shewen, “Managerial & cost accounting” ventus publishing April, 2009 – ISBN: 978-87-7681-491-5

Objectives:

- To gain knowledge about apparel production concepts
- To acquire knowledge on apparel production planning & control

UNIT I INTROCUCTION**9**

Introduction-Objectives-Production management-Product design-Design of production system-Types of production system-Manufacturing process-Types of manufacturing process-Factors affecting the choice of manufacturing process-Production planning and control-Benefits to small entrepreneur-Steps of production planning and control- Planning & lead Time -Importance of pre- production activities.

UNIT-II PLANT LAYOUT AND PRODUCTION SYSTEMS**9**

Definition of Plant Layout - Types of Production Layout – Product and Process layout - Planning a layout- Calculation of minimum transport distance -Determining minimum space requirement for the layout - Formulating a layout for different styles of garments

Whole garment Production system – Group system-Unit flow system - Multiple flow and Progressive Bundle system –Synchro straight line system-Unit Production system-Quick response production system- Principles for choosing a Production system - Evaluation of production system.

UNIT-III OPERATION SEQUENCE DEVELOPMENT**9**

Operation required in garment construction - Operation specifications – Operation Break down-Product Flow charts- Men’s shirt-Trousers-Skirt-Shorts-Five pocket Jeans-T-Shirt; Flow Process grid-T-shirt-Preparation of Operation Bulletin-Work aids-attachments-Machinery specifications.

UNIT-IV PRODUCTION SCHEDULING AND BALANCING**9**

Production scheduling-Gantt chart preparation-Capacity calculation for cutting, sewing and finishing; determination of machine requirements for a new factory; Steps in line balancing: determination and allocation of manpower and machine for balanced production in existing plant for a given target

UNIT-V INDUSTRIAL ENGINEERING**9**

Method Study and Work Measurement -Techniques - Principles of Motion Economy – Classification to Movements - Process Flow Chart – Two-handed Process Chart, Micro-motion Study - Time Study – Definition - Steps in making a Time Study - Breaking the Job into Elements - Stop Watch Procedure. Time Study Rating, Calculation of Standard Time

TOTAL HOURS: 45

TEXT BOOKS:

1. Solinger Jacob, “Apparel Manufacturing Hand Book - Analysis, Principles and Practice”, Columbia Boblin Media Corp., 1988.
2. David J.Tyler, “Materials Management in Clothing Production”, 1991.

REFERENCES:

1. William K.Hodson, "Maynord's Industrial Engineering Handbook", IV edition, McGraw Hill Inc., New York, 1992.
2. Herold Carr and Barbara Lathem, " The Technology of Clothing Manufacturing", II nd Edition, Blackwell Scientific Publications, London, 1988.

Objectives:

- To gain knowledge about quality control and standards in apparel industry
- To impart the skills in statistical analysis in apparel industry

UNIT-I RAW MATERIALS INSPECTION AND QUALITY CONTROL IN CUTTING DEPARTMENT**9**

Purchasing specifications - Testing and Inspection of raw materials - Point Systems – 4 Point system, 10 point system, Graniteville "78" system. Spreading properties of fabrics - Tension in Spreading of fabrics – Quality factors in cutting, Bundling and ticketing as related to quality.

UNIT-II QUALITY CONTROL IN SEWING DEPARTMENT**9**

Stitching quality control- Stitch size, Stitch tension, Seam elasticity and elongation – Fabric distortions. Seam quality control- Seam size, Seam slippage and Seam strength- Fabric Sewability. Selection of stitches and seams for woven and knitted Apparels. Control of sewing, seaming and assembly defects. In process inspection in sewing.

UNIT-III QUALITY CONTROL IN PRESSING, PACKING AND FINISHED GARMENT**9**

Quality requirements for pressing operation - Quality control in functional package for apparel- Merchandise package, Stock storage, Shipping package. Visual inspection and definition of defects and tolerance – Methods of measuring.

UNIT-IV QUALITY CONTROL TOOLS AND STATISTICAL SAMPLING IN APPAREL MANUFACTURE UNIT:**9**

Quality control tools- Flowcharts, Control charts, Cause and Effect diagrams, Pareto charts, Check sheets and scatter diagram. Statistical Sampling- Acceptable Sampling - Acceptable Quality level (AQL) - Single sampling - Double Sampling.

UNIT-V CARE LABELING OF APPAREL AND QUALITY ASSURANCE IN APPAREL INDUSTRY:**9**

Care Labeling system- American Care labeling System, British Care Labeling System, International Care Labeling System, Canadian Care Labeling System, Japanese Care labeling

System - Symbols and meanings. Introduction and purpose of ISO series - Sequence of activities in implementing ISO series in a garment manufacturing unit.

TOTAL HOURS: 45

TEXT BOOK:

1. Metha Pradip V, "An Introduction to Quality Control for Apparel Industry", ASQC Quality Press, 1992.
2. Solinger Jacob, "Apparel Manufacturing Hand book - Analysis, Principles and Practice", Von Nostrand Reinhold Limited, 1980.

REFERENCES:

1. Samuel K H, "Encyclopedia of Management - TQM Vo1 3, Crest Publishing House, 1999.
2. NMP Nambiar, "A guide on ISO 9000", Systems and Resources, 1994.
3. Metha P V and Bharadwaj S K, "Managing Quality in the Apparel Industry", New Age International (P) Limited, 1998.

Objectives

- To gain knowledge about marketing concepts and organization
- To learn about market research and market measurement techniques
- To know about product life cycle
- To gain knowledge about various export documentations

UNIT – I MARKETING**9**

Marketing: Marketing Concepts, Marketing Management, Marketing System, Marketing environment Marketing Organization, Strategic Marketing Process, Competitive marketing strategy. Marketing of Apparel and Fashion Products

UNIT-II BUYING BEHAVIOUR**9**

Buying Behaviour: Factors influencing buying behavior - Buying process. Segmentation: Market segmentation, segmentation variables, Target Marketing. Marketing Research: Purpose, Procedure and applications

UNIT-III MARKET MEASUREMENT**9**

Market Measurement- Market Potential - estimation – Demand Forecasting – methods of forecasting. Marketing Mix: Product, Price, Promotional and Distribution, Advertising and Sales Promotion and Public Relations.

UNIT-IV PRODUCT LIFE CYCLE**9**

Product Life Cycle: Life cycle of product -Marketing strategy for various stages of life cycle. NEW Product Development: Stages. International Marketing: Introduction to international Trade, Need and basis for international trade, SWOT analysis for Indian textile an apparel exports.

UNIT-V EXPORT MARKETING MIX**9**

Export Marketing Mix: Pricing, packing and promotion and distribution. GATT, WTO. Export finance, ECGC, Incoterms, Types of L/C, Export Documentation - Transport document, commercial document, customs formalities. Merchandising: Terms Pertaining to Merchandising, Sourcing, components of merchandising activities – functions of merchandiser.

TOTAL HOURS: 45

TEXT BOOK:

1. Laine Stone, Jeen A Samples, "Fashion Merchandising – An Introduction", McGraw Hill Books., 1995.
2. Gini Stephens Frings, "Fashion: From Concept to Consumer", 4th Edition, Prentice Hall Inc., 1994.

REFERENCES:

1. Philip Kotler , "Marketing Management", 11th Edition, Prentice Hall Inc., 2004.
2. Ruth E Glock, Grace I Kunz, "Apparel Manufacturing – Sewn Product Analysis", Third Edition, Prentice Hall Inc., 2000.
3. "Clothing Retailing in Europe", Corporate Intelligence on Retailing, 1997.
4. Taarno, Guerreiro & Judelle, "Inside the fashion business" ,1995.
5. "The Textile Industry winning strategies for the new millennium", Vol. 2, Textile Institute., 1999.
6. Evelyn C Moore, Wey ll, "Math for Merchandising", 1999.

Objectives:

- To acquire knowledge on production technologies of nonwoven
- To obtain knowledge on testing of nonwovens

UNIT -I INTRODUCTION TO NONWOVEN**9**

Nonwovens: introduction, definition as per INDA and EDANA, market structure and development, key companies, fibres used in nonwovens, production rate of nonwovens and other fabric manufacturing systems, classification of web laying and web bonding systems, comparison of woven, knitted and nonwoven structures. Nonwoven properties including environmental considerations. Nonwoven applications in technical textiles sector.

UNIT-II WEB FORMATION SYSTEMS**9**

Dry laid web Formation: raw material - fibre opening – carding – cross lapping - perpendicular-laid web formation - airlaid web formation: air laying technology - bonding systems & finishing - properties & applications. Web laying machine designs: machine and control technology – calculations - web drafting. Wet-laid web formation: theoretical basis of wet forming – raw materials – fibre preparation – web forming technology – bonding systems – finishing-properties & applications. Polymer laid web formation: spun bonding and melt blown process: raw material - production technology – operating variables – bonding techniques – structure and properties – application. Flash spinning and Electrostatic spun bonding.

UNIT-III WEB BONDING SYSTEMS**9**

Mechanical Bonding: stitch bonding, Needle punching: needle design and selection – various factors influencing needle punching process – needle punching technology – properties and applications – Hydroentanglement: principle – fibre selection – process technology – properties and applications. Thermal Bonding: principle – raw materials – technologies such as calender bonding, thorough air bonding, ultrasonic & IR bonding – structure and properties – applications. Chemical Bonding: chemical binders – mechanism of chemical bonding – methods of binder application – drying – Limitations and applications.

UNIT-IV**FINISHING****OF****NONWOVENS****9**

Wet Finishing: washing, coloration – dyes, dyeing machines; printing. Application of chemical finishes- antistatic agents, antimicrobial finishes, softening, flameproof, waterproof, stiffeners, UV stabilizers; Methods for applying chemical finishes-padding, coating, lamination. Mechanical Finishing-splitting and winding, perforating, drying, compressive finishes, calendaring; Surface finishing- singeing, shearing, flocking, raising, polishing, softening.

Developing technologies – Plasma, microencapsulation, laser etching, biomimetic finishes and electrochemical finishes.

UNIT-V CHARACTERISATION AND TESTING OF NONWOVEN FABRICS 9

Characterisation of fabric bond structure – needle punched fabrics, spun laced fabrics, stitch bonded fabrics, thermal bonded fabrics and chemical bonded fabrics. Testing of Nonwoven fabrics: weight, thickness, fibre orientation, fabric porosity, pore size & pore size distribution, dry sieving, wet sieving, hydrodynamic sieving, bubble point test method, measuring tensile properties, measuring gas and liquid permeability, measuring water vapour transmission, measuring wetting and liquid absorption, measuring thermal conductivity and insulation

TOTAL HOURS: 45

TEXT BOOKS:

1. Hand Book of Nonwovens – Edited by S.J.Russell, Wood head publications Ltd., ISBN-13: 978-1-85573-603-0, 2007.
2. Nonwoven Fabrics: Raw Materials, Manufacture, Applications, Characteristics, Testing Processes, Edited by Wilhelm Albrecht , Hilmar Fuchs and Walter Kittelmann, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, ISBN: 3-527-30406-1, 2003.

REFERENCES:

1. The Nonwovens by Govianni Tanchis, ACIMIT,2006
2. Hand Book of Technical Textiles – Edited by S.C.Anand & A.R.Horrocks, Wood head publications Ltd., ISBN 1 85573 385 4, 2000.
3. An Introduction to Melt blown and Spun bond Systems, Fiber systems Technology Primer,
4. Applications of Nonwovens in Technical textiles, Edited by R.A.Chapman, CRC press, 2010.

3**Objectives:**

On completion of the course the student are expected

- To know about the control system & automation used in Textile Industry
- Analyze the production variation using computerized processing
- To gain knowledge about the automated textile machineries

UNIT-I INTRODUCTION ABOUT CONTROL SYSTEM**9**

Instrumentation and Transducers: Functional Description of Instruments; Types and applications of Instrumentation - generalized configuration - Tribo electric pick-up, Infrared Transducers - Torque measurement Elastic transducers - sound level meter - vibration measurements. Control System Components: Basics of control system – Control system examples - Stepper motors - Hydraulic valves - Pneumatic switches, proximity switches and flapper valves - Hydraulic and Pneumatic automation in textile machines- simple sequential logic circuit design - Programmable Logic Controllers (PLC), Block diagram – programming methods – programs – applications of PLC in textile machinery.

UNIT-II INDUSTRIAL AUTOMATION**9**

Industrial Automation: Introduction, integration, material handling system, simple systems for motions by electrical and mechanical devices- Mechanical design for automatic feeding assembly and transfer lines. Electronic Textile Instruments: Electronic principles in evenness tester, classification of faults, digital fibrograph, hairiness meter, Vibroscope - thickness measuring instruments, HVI, AFIS, Universal tensile testers.

UNIT-III CONTROL SYSTEM & AUTOMATION IN SPINNING INDUSTRY**9**

Control System and Automation in Spinning Machinery: Machinery material flow and its variation controls – Feeders and Stop motions – Auto levelers – safety switches. Production and quality monitors – Full doff and pre-set length monitors. Data acquisition system for spinning preparatory, ring spinning and rotor spinning. On-line monitoring system, case studies.

UNIT-IV CONTROL SYSTEM & AUTOMATION IN WEAVING INDUSTRY**9**

Control System and Automation in Weaving Machinery: Yarn clearer controls - knotter /splicer carriage controls - pre-set length/full cone monitors. Warping machine monitors and controls - sizing machine monitors and controls - auto-reaching/drawing-in and knotting machine monitors

and controls. Data acquisition system in weaving preparatory and weaving – humidification system.

UNIT-V COMPUTERISED PROCESSING IN TEXTILES

9

Computerised Processing: CAD/CAM/CIM in spinning, Weaving, Dyeing, Printing and Apparel production. Electronic Data Interchange and E-com, internet commerce, Business strategy in E-com, Application of E-com in textile industry – Robotics in textile industries.

TOTAL HOURS: 45

TEXT BOOKS:

1. Berkstresser G A, Buchanan D R and Grady P, "Automation in the Textile Industry from Fibres to Apparel", The Textile Institute, UK, 1995.
2. "Textiles Go On-line", The Textile Institute, UK, 1996.

REFERENCES:

1. Vassiliadis S G, "Automation and the Textile Industry", Eurotex, 1996.
2. Ormerod A, "Modern Development in Spinning and Weaving Machinery", Butterworths, 1993.
3. Gordon A. Berkstresser III et.al, "Automation and Robotics in the Textile and Apparel Industries", Noyers Publication Park Ridge, 1996.
4. Nalura B C, "Theory and Applications of Automatic Controls", New Age International (P) Ltd Pub, 1998.
5. George stylios, "Textile objective measurement and automation in garment manufacture", E.Horwood, 1991.

Objectives:

- To gain knowledge on energy conservation measure
- To develop knowledge of energy pattern in textile industry
- To gain knowledge about energy auditing

UNIT-I ENERGY NEEDS**9**

Introduction: Concept of energy management – need for energy conservation global energy scenario with specific reference to India –Demand side Management (DSM) - Role of Energy service companies (ESCOs)

UNIT II ENERGY CONSUMPTION ANALYSIS**9**

Energy Consumption Analysis: Textile Machines – Ancillaries – Component wise consumption – Specific energy consumption (UKG) – Cost of energy Vs sales value of textile product.

UNIT-III ENERGY CONSERVATION**9**

Energy Conservation: Electrical and Thermal audit - Productive machines - Preparatory, Spinning, Post Spinning, Weaving and Wet Processing Machines - Ancillaries – Humidification/Air conditioning ,Lighting, Compressors and Boilers – Generators and different types of fuels.

UNIT-IV ENERGY EFFICIENT EQUIPMENT & ENERGY INSTRUMENTATION**9**

Energy Efficient Equipment: Energy efficient equipment for various processing machines and ancillaries - economics with payback period and Return on Investment (ROI).

Energy Instrumentation: Energy monitoring instruments - Analog, Digital and computerized instruments and measurement techniques- maintenance of instruments / equipment.

UNIT – V NON CONVENTIONAL ENERGY SOURCES**9**

Application of Non Conventional Energy Sources: Solar energy: different type of collectors – photovoltaic cell, wind energy, bio energy, environmental impact on energy, co-generation.

TOTAL HOURS: 45**TEXT BOOKS:**

1. Palaniappan C et al, "Renewable Energy Applications to Industries", Narose Publishing House, 1998.
2. Proceedings of International seminar cum Exhibition ASIA Energy Vision 2020 - sustainable energy supply, November 15-17, 1996.

REFERENCES:

1. Proceedings of the Seminar, "Strategies for sustainability of energy efficient and environmental friendly technologies in small and medium scale sector", PSG College of Technology, November 24, 2000.
2. Proceedings of All India workshop, "Latest trends in energy audit systems", Institution of Engineers (I), December 12-13, 1993.
3. Pradeep Chaturvedi & Shalini Joshi, "Strategy for energy conservation in India", Concept publishing Co. ,1995
4. Ali Hasanbeigi "Energy efficiency improvement opportunities for the textile industry" September 2010, china energy group, energy analysis department publication.
5. B.Purushothama, "Humidification and ventilation management in textile industry" wood head publishing, India (P) Ltd, 2009.

Objectives:

- To acquire knowledge on functions, properties of geotextiles
- To impart design & analysis skills in the development of geotextiles
- To obtain knowledge in testing & applications of geotextiles

UNIT-I GEOTEXTILES - CLASSIFICATION AND FUNCTIONS**9**

Geotextiles: introduction – definition – classification – essential properties of geotextiles – fibres and fabric structures used – manufacturing process – engineering properties of soil - functions of geotextiles: separation – reinforcement - filtration – drainage - erosion control – soil stabilization – fluid barrier - protection. Selection of geotextiles: typical properties of polymers – functional properties – factor of safety.

UNIT-II GEOTEXTILES – PROPERTIES**9**

Introduction –Physical properties: thickness – mass per unit area – specific gravity. Mechanical properties: tensile properties – compressibility – seam strength – burst strength – tear strength - puncture strength – friction – pull-out resistance. Hydraulic properties: porosity - percentage open area (POA) - apparent opening size (AOS) – permittivity – transmissivity – soil retention. Endurance properties: creep and stress relaxation – abrasion – clogging. Degradation properties: temperature – oxidation – hydrolysis – chemical degradation – ultra violet light. Geotextile installation survivability requirements.

UNIT-III GEOTEXTILES – APPLICATIONS**9**

Retaining walls: functions – materials used – installation procedures – property requirement of geotextiles – factor of safety. Embankments: functions – materials used – installation procedures – property requirement of geotextiles – factor of safety. Road: unpaved roads – paved roads - geotextile layer at the soil subgrade level - functions – materials used – installation procedures – property requirement of geotextiles – rut depth – fatigue response of asphalt overlay with and without geotextiles. Filters and Drains: functions – materials used – installation procedures – design criteria - property requirement of geotextiles. Slopes: erosion control - functions – materials used – installation procedures – property requirement of geotextiles. Stabilization: functions – materials used – installation procedures – property requirement of geotextiles.

UNIT-IV GEOTEXTILES – ANALYSIS AND DESIGN CONCEPTS**9**

Design methodologies: design by experience – design by cost & availability – design by specification – design by function. Geotextile failure mechanisms: failure mode – possible causes. Design of geotextile for retaining walls: internal and external stability analysis – factor of safety - calculations. Design of geotextile for embankments: overall slope stability failure – lateral spreading – embankment settlement-overall bearing failure – pull-out failure - calculations. Design of geotextile for road: reinforcement function design concept – calculations – separation function design concept – calculations.

UNIT – V GEOTEXTILES TESTING

9

Sampling of geotextiles for testing – Testing procedures and construction of the testing equipment: deterioration of geotextiles from exposure to UV and water – water permeability of geotextile by permittivity – trapezoid tear strength – tensile testing by wide-width strip method – determination of apparent opening size (AOS) – index puncture resistance testing – dynamic puncture strength test – bursting strength test – fatigue test. Interface testing: direct shear test – pull-out test. Hydraulic property testing: dry sieving test method – hydrodynamic test method – bubble point method. Endurance and degradation testing: creep test – abrasion test.

TOTAL HOURS: 45

TEXT BOOKS:

1. Sanjay Kumar Shukla & Juan-Hua Yin, Taylor & Francis, “Fundamentals of Geosynthetic Engineering” UK, ISBN10 0-415-39444-9, 2006.
2. R.W.Sarsby, “Geosynthetics in Civil Engineering”, Wood head publications Ltd., ISBN-13: 978-1-85573-607-8, 2007.

REFERENCES:

1. Hand book of Geosynthetics – Geosynthetics materials Association.
2. Khalid a Meccai & Eyad al Hussain, “Geotextiles in Transportation Applications”, Second Gulf Conference on Roads, Abu Dhabi, March 2004.
3. S.C. Anand & A.R.Horrocks, “Hand Book of Technical Textiles”, Wood head publications Ltd., ISBN 1 85573 385 4, 2000.
4. Shobha Krishna Bhatia, L. David Suits, “Recent Developments in Geotextile Filters and Prefabricated Drainage Geocomposites”, Issue 1281, ASTM International, 1996.
5. Stephen Corbet, John King, Proceedings of the Conference Geofad '92: Geotextiles in Filtration and Drainage Organized by the U. K. Chapter of the International Geotextile Society, Held at Churchill College, Cambridge, U. K.1992.

Objectives:

- To gain knowledge on various effluents and their problems
- To study about various effluent treatment process & its testing

UNIT – I INTRODUCTION**9**

Textile Effluent Introduction - Textile waste characteristics- wastewater problems - Chemicals used in textile industry-treatment of textile effluents. Textile processing chemistry. Textile raw materials – fibres, chemicals, types of textile chemical processing properties, mercerization, coloring, finishing chemical operations – mechanical operations.

UNIT – II EFFLUENT TREATMENT**9**

Pollution control at mill stage, waste stress – cotton, wool, water & chemical recovery and rinse – cotton, wool, synthetics, waste water treatment std for textile effluent – nature of the problem – treatment systems – effluent treatment systems – rural area, urban area.

UNIT – III TECHNIQUES FOR EFFLUENT TREATMENT**9**

Techniques for effluent treatment - Chlorine dioxide treatment, ozone treatment, membrane technology – micro filtration, ultra filtration, nano filtration, reverse osmosis, electro dialysis, enzymatic de- coloration, biomass based Technologies – wastewater de coloration, chitin and chitosan, sorption of dyes, study of dye binding properties other bio-mass systems.

UNIT-IV TESTING**9**

Parameters and pollutants, testing of pollution parameters, regulations in developed countries-eco-friendly processing-effluent quality assurance programme-waste auditing and minimization-elements of a waste minimization assessment-programme initiation waste audit- feasibility analysis-monitoring and re-evaluation.

UNIT-V EFFLUENT MANAGEMENT**9**

Color removal technologies-biotechnology approach-color and organic pollutant removal – anaerobic –aerobic treatment process – sludge management – source reduction of sludge, bio elimination through sludge, solids separation, and solid waste disposal of textile industry – government regulation for effluents – S Bureau of Indian standards.

TOTAL HOURS: 45

TEXT BOOKS:

1. "Textile Effluent" Padma S. Vankar I.I.T. Kanpur.
2. H.R. (Harold R.), Park Ridge. N.J, "Pollution Control in the Textile Industry", Jones Noyes Data Corp., 1973.

REFERENCES:

1. Best Management Practices for Pollution Prevention in the Textile Industry –Manual by US Environmental Prevention Agency, 1996.
2. K.Slater, "Environmental Impact of Textiles" , Wood head publication,2003.
3. Pollution Prevention in Textile Industry manual by U.S EPA/SEMARNAP Pollution prevention work group, 1996.
4. S.C.Bhatia "Handbook of Industrial Pollution and Control (Vol. 1 & 2), CBS edition, 2002.
5. Peter I Norman and Roy Seddon , Low Moor, " Pollution Control in the Textile industry –the chemical auxiliary manufacturer's role", Allied Colloids plc, Bradford , UK, Journal of Society of Dyers and Colourists, Volume 107 May/June 1991.

UNIT – I MODELING & OPTIMIZATION**9**

Introduction to modeling: Mathematical modeling – geometric modeling – computer modeling – procedure with simple examples.

Introduction to optimization: Engineering applications, statement of an optimization problem, and classification formulation of optimization models with simple examples.

UNIT – II INTEGER PROGRAMMING**9**

Integer programming: Algorithms, applications, stochastic programming, linear, non linear and dynamic programming g applications. Introduction to linear programming.

UNIT – III NON LINEAR PROGRAMMING TECHNIQUES**9**

Non linear programming techniques: One dimensional minimization – elimination and interpolation methods, unconstrained optimization – Direct search and decent methods, constrained optimization – Direct and indirect methods. Box’s method.

UNIT – IV OPTIMIZATION ALGORITHMS**9**

Non traditional optimization algorithms: Genetic algorithms – working principle. Genetic algorithms for constrained optimization. Neural networks.

UNIT – V SIMULATION**9**

Introduction to simulation: Areas of application model of a system, types of models and steps in a simulation study. Design and evaluation of simulation experiments – Variance reduction techniques, experimental layout and validation.

TOTAL HOURS: 45**TEXT BOOKS:**

1. Cha D/ Philip et al, “Fundamentals of modeling and analyzing engineering systems”, Cambridge University press, 2000.
2. Rao S S, “Optimization”, Wiley Eastern, 1995.

REFERENCES:

1. Stephen G Nash and sofer A., "Linear and Non-Linear Programming", MCGRAW hill International Edition, 1996.
2. Gordon G, "Systems simulation", Prentice Hall of India Ltd., 2003.
3. AM and Kelton W D, "Simulation, modeling and analysis", McGra Hillm 2000.
4. Chandrupatla T R and Belegundu A D, "Introduction to Finite elements in Engineering", Pearson Education 2002.
5. Logan D L., "A first course in the Finite element method", third edition, Thomson learning, 2002.

Objectives:**On completion of the course, the students are expected**

- To develop skills in the mathematical modeling and solution for the models using LPP.
- To gain knowledge in dynamic programming problem.
- To gain knowledge in the project scheduling and project smoothing using advanced methods in CPM and PERT.
- To expertise with the analysis of finding optimum replacement period using replacement models.
- To gain knowledge in the queuing theory and to develop skills in the optimal arrangement of jobs in different machines using sequencing techniques.

UNIT I INTRODUCTION TO LINEAR PROGRAMMING (LP)**9**

Formulation of LP – Graphical method – Simplex algorithm – Transportation model: Initial basic feasible solution by NWC rule - LC method - Vogel's approximation method – MODI method- Assignment model: Hungarian method.

UNIT II DYNAMIC PROGRAMMING PROBLEM**9**

Bellman's optimality principle- Characteristics- Applications of DPP. Solution of LPP by DPP.

UNIT III NETWORK ANALYSIS**9**

Maximum flow – Shortest route – Spanning tree problems – PERT, CPM.

UNIT IV REPLACEMENT MODELS & ADVANCED TOPICS IN NETWORK ANALYSIS**9**

PERT Cost - Resource smoothing - Resource scheduling. Replacement models: Replacement policy for items that deteriorate gradually – Value of money does not change with time – Value of money changes with time – Replacement policies (individual and group) for items that fail suddenly.

UNIT V WAITING LINE MODELS AND SEQUENCING**9**

Queueing characteristics, single server and parallel server models:

(M / M / 1): $\infty/FIFO$, (M / M / k): $\infty/FIFO$, (M / M / 1): $N/FIFO$, (M / M / k): $N/FIFO$.Sequencing : n jobs \times 2 machines - n jobs \times 3 machines - 2 jobs through m machines.

TOTAL HOURS: 45

REFERENCES:

1. Hamdy A.Taha, "Operation Research: an introduction", 4th Edition, Mc Millan Co., 2003.
2. Don T.Phillips, A.Ravindran & James Solberg, Operations Research: Principles and practice, John Wiley & Sons, 2nd Edition, 1992.
3. Schaum's, "Operations Research", II Edition, Richard Bronson, Govindasami Naadimuthu, Tata Mcgraw – Hill Publishing Co. Ltd. 2000.
4. Hillier and Lieberman, "Introduction to Operations Research", McGraw Hill International Edition, 7th Edition, 2001.
5. Bhaskar S., "Operations Research", 2nd Edition, Anuradha publishers, 2004.