

Department of Textile Technology

Teaching and Evaluation Scheme & Course Content

(B Tech 3rd - 8th semester)



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JALANDHAR – 144011
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Preface

New curriculum for B Tech in Textile Technology has been designed to provide science-based engineering education with a view to produce quality engineering scientists. The attempt has been made to develop engineering skill with broad interdisciplinary knowledge, and simultaneously build a temper for the life long process of learning and exploring. Apart from foundation courses in the areas of basic science and engineering sciences, students are offered various core and elective courses constitute around 57% of the total curriculum. Core subjects are made more comprehensive and reoriented based on present day industry needs and higher research. With rapid technological development, it is also imperative to focus attention on various upcoming areas. Subject on Engineering Science such as *Unit Operation* is integrated with textile sciences. Course curriculum also provides wider choice of electives to develop niche areas in textiles and allied fields. To develop intellectual and communication skill seminar is introduced in two subsequent semesters. In addition student's project has become more intensive and extended for a span of two semesters. Present research area encompasses *Nano-composite filament, Structure-property relation in multi-component yarn, Development of specialty yarn to enhance comfort, Mechanics of various fabric formation processes, Bandage fabric for treatment of Edema, Antimicrobial fabric, Aerosol filtration, Sewing thread, Nonwoven fabric development, Fabric and Sewing thread interaction in garment formation, Chemical processing of garment, Waste water management etc.*

DR B R AMBEDKAR NATIONAL INSTITUTE OF TECHNOLOGY, JALANDHAR
Department of Textile Technology
Teaching and Evaluation Scheme (3rd - 8th semester)

3rd Semester

S. No	Course No.	Subjects	Periods			Credits	Prerequisite
			L	T	P		
1	TT -201	Natural Fibres	3	0	0	3	
2	TT-203	Preparatory to Yarn Formation	3	1	0	4	Elements of mechanical Engineering
3	TT-205	Basic Fabric Formation	3	0	0	3	Elements of mechanical Engineering
4	TT-207	Man-made Fibre	3	0	0	3	
5	MA-203	Probability and Statistics	3	1	0	4	
6	ME-251	Kinematics of Machine	3	1	0	4	
7	TT-209	Textile Fibre Lab	0	0	2	1	
8	TT-211	Yarn Formation Lab-I	0	0	2	1	
9.	TT-213	Fabric Formation Lab-I	0	0	2	1	
Total						24	

4th Semester

S. No	Course No.	Subjects	Periods			Credits	Prerequisite
			L	T	P		
1	TT-202	Properties of Fibres	3	0	0	3	Natural and man made fibres
2	TT-204	Yarn Formation	3	1	0	4	Preparatory to yarn formation
3	TT-206	Control Mechanism and Advancement to Fabric Formation	3	1	0	4	Kinematics of machine, Basic fabric formation process
4	TT-208	Textile Chemical Processing-I	3	0	0	3	Chemistry, Natural fibre, Man made fibres
5	TT-210	Unit operation	3	1	0	4	
6	MA-202	Numerical Methods	3	1	0	4	
7	TT-212	Yarn Formation Lab-II	0	0	2	1	Yarn Formation Lab-I
8	TT-214	Fabric Formation Lab-II	0	0	2	1	Fabric Formation Lab-I
Total						24	

5th Semester

S. No	Course No.	Subjects	Periods			Credits	Prerequisite
			L	T	P		
1	TT 301	Textile Testing	3	1	0	4	Properties of fibres
2	TT 303	Textile Chemical Processing-II	3	0	0	3	Textile chemical processing-I
3	TT	Departmental Elective-I	3	0	0	3	
4	TT 305	Textile Design	2	0	2	3	
5	ID					3	
6	HM	Humanities and Management*	3	0	0	3	
7	TT 307	Textile Testing Lab	0	0	2	1	
8	TT 309	Textile Chemical Processing Lab - I	0	0	3	2	
		Total				22	

* Subject from Humanities and Management

6th Semester

S. No	Course No.	Subjects	Periods			Credits	Prerequisite
			L	T	P		
1	TT 302	Process Control in Textiles	3	0	0	3	Yarn formation, Control mechanism and advancement in fabric formation
2	TT	Departmental Elective-II	3	0	0	3	
3	TT	Departmental Elective-III	3	0	0	3	
4	TT	Departmental Elective-IV	3	0	0	3	
5	ID		3	0	0	3	
6	EC 3XX	Digital Electronics and Microprocessor Architecture	3	1	0	4	
7	TT 304	Textile Chemical Processing Lab - II	0	0	3	2	
8	TT 306	Knitting Technology Lab	0	0	2	1	
9	EC 3XX	Digital Electronics and Microprocessor Architecture Lab	0	0	2	1	
10	TT 308	Seminar*	0	0	2	-	
		Total				23	

* to be awarded in 7th semester

In addition to the above industrial practical training of six weeks during summer vacation is compulsory

7th Semester

S. No	Course No.	Subjects	Periods			Credits	Prerequisite
			L	T	P		
1	TT 401	Theory of Textile Structure	3	1	0	4	Yarn formation, Control mechanism and advancement in fabric formation
2	TT 403	Quality Control in Textiles	3	0	0	3	Probability and statistics
3	TT	Departmental Elective-V	3	0	0	3	
4	TT	Departmental Elective-VI	3	0	0	3	
5	TT	Departmental Elective-VII	3	0	0	3	
6	ID		3	0	0	3	
7	TT 405	Garment Technology Lab	0	0	2	1	
	TT 407	Industrial Practical Training				4*	
8	TT 400	Project (Phase-I)	-	-	-	2	
9	TT 308	Seminar	0	0	2	1	
Total						27	

*Industrial practical training will be held during summer vacation after 6th Semester

8th Semester

S. No	Course No.	Subjects	Periods			Credits	Prerequisite
			L	T	P		
1	TT 402	Mechanics of Textile Processes	3	1	0	4	Yarn formation, Basic fabric formation process
2	TT	Departmental Elective - VIII	3	0	0	3	
3	TT	Departmental Elective - IX	3	0	0	3	
4	TT	Departmental Elective - X	3	0	0	3	
5	ID		3	0	0	3	
6	TT 400	Project (Phase-II)	-	-	-	4	
Total						20	

Total Credit: 140

Departmental Core Courses

S. No.	NAME OF SUBJECTS	L-T-P-C	PREREQUISITE
1.	Natural Fibres	3 1 0 4	
2.	Preparatory to yarn formation	3 1 0 4	Elements of mechanical Engineering
3.	Basic fabric formation process	3 1 0 4	-do-
4.	Man made fibres	3 1 0 4	
5.	Properties of fibres	3 1 0 4	Natural and man made fibres
6.	Yarn formation	3 1 0 4	Preparatory to yarn formation
7.	Control mechanism and advancement in fabric formation	3 1 0 4	Kinematics of machine, Basic fabric formation process
8.	Textile chemical processing-I	3 0 0 3	Chemistry, Natural fibre, Man-made fibres
9.	Textile testing	3 1 0 4	Properties of fibres
10.	Textile chemical processing-II	3 0 0 3	Textile chemical processing-I
11.	Theory of textile structures	3 1 0 4	Yarn formation, Control mechanism and advancement in fabric formation.
12.	Process control in textiles	3 0 0 3	-do-
13.	Quality control in textile industry	3 1 0 4	Probability and statistics
14.	Mechanics of textile process	3 1 0 4	Yarn formation, Basic fabric formation process
15.	Unit operation	3 1 0 4	-
16.	Yarn formation laboratory-I	0 0 2 1	-
17.	Textile fibre laboratory	0 0 2 1	-
18.	Fabric formation laboratory-I	0 0 2 1	-
19.	Textile design	2 0 2 3	
20.	Yarn formation laboratory-II	0 0 2 1	Yarn formation lab - I
21.	Fabric formation laboratory-II	0 0 2 1	Fabric formation lab - I
22.	Textile chemical processing lab-I	0 0 3 2	-
23.	Textile testing lab-I	0 0 2 1	-
24.	Textile chemical processing lab-II	0 0 3 2	Textile chemical processing lab-I
25.	Textile testing lab-II	0 0 2 1	Textile testing lab-I
26.	Knitting technology	0 0 0 2	-
27.	Garment technology	0 0 0 2	-
28.	Industrial practical training	0 0 8 4	-
29.	Project (Phase-I)	- - - 2	-
30.	Project (Phase-II)	- - - 4	-

Inter-disciplinary Core

NAME OF SUBJECTS	L-T-P-C
1. Kinematics of machines	3 1 0 4
2. Digital electronics and micro processor architecture	3 1 0 4
3. Digital electronics and micro processor architecture lab	0 0 2 1
4. Human resource management	3 0 0 3
5. Probability and statistics	3 1 0 4
6. Numerical methods	3 1 0 4

Departmental Electives

NAME OF SUBJECTS WITH CODE	L-T-P-C
1. Post Spinning Operations (TT 321)	3-0-0-3
2. Multi-fibre Process (TT 322)	3-0-0-3
3. Textile Printing and Finishing (TT 323)	3-0-0-3
4. Knitting Technology (TT 324)	3-0-0-3
5. Processing of Man made Fibres and Blended Textiles (TT 325)	3-0-0-3
6. Nonwoven Technology (TT 326)	3-0-0-3
7. Advances in Chemical Processing (TT 327)	3-0-0-3
8. Marketing and Financial Management in Textile (TT 328)	3-0-0-3
9. Production Management (TT 329)	3-0-0-3
10. Garment Technology (TT 330)	3-0-0-3
11. Textile Structural Composites (TT 421)	3-0-0-3
12. Advances in Fabric Manufacturing (TT 422)	3-0-0-3
13. Waste Management and Pollution Control in Textiles (TT 423)	3-0-0-3
14. Textiles and Fashion Designing (TT 424)	3-0-0-3
15. Apparel Marketing and Merchandising (TT 425)	3-0-0-3
16. Mill Management and Maintenance (TT 426)	3-0-0-3
17. Project Formulation and Appraisal (TT 427)	3-0-0-3
18. Advancement in Textile Testing and Statistical Analysis (TT 428)	3-0-0-3
19. Textile Process Simulation (TT 429)	3-0-0-3
20. Product Design (TT 430)	3-0-0-3
21. Colour and Design (TT 431)	3-0-0-3
22. Technical Textiles(TT 432)	3-0-0-3
23. Advances in Yarn Manufacturing (TT 433)	3-0-0-3
24. Woollen Technology (TT 434)	3-0-0-3

Open Electives

NAME OF SUBJECTS	L-T-P-C
1. Polymer and Fibre Science (TT 336)	3-0-0-3
2. Properties of Polymer and Fibre (TT337)	3-0-0-3
3. Textile Machines and Processes (TT 338)	3-0-0-3
4. Textile Design (TT 339)	2-1-0-2
5. Fashion and Textiles (TT 340)	3-0-0-3
6. Fashion Designing (TT 341)	3-0-0-3
7. Geotextiles (TT 342)	3-0-0-3
8. Design of Experiments (TT436)	3-1-0-4
9. Application of Nano-technology on Polymers and Fibres (TT 437)	3-0-0-3
10. Environmental Science and Management (TT 438)	3-0-0-3
11. Industrial Textiles (TT 439)	3-0-0-3
12. Marketing and Merchandising of Products (TT 440)	3-0-0-3
13. Product Design (TT 430)	3-0-0-3

Course Content

B Tech 3rd Semester

TT-201 Natural Fibres [3-0-0-3]

Fibres and polymers: Introduction of fibres. Introduction of polymers. Requirements for fiber forming polymers. Essential and desirable properties of textile fibers. Essential properties of fibre forming polymers. Classification of textile fibers.

Micro structure: Difference between conventional and polymeric material. Features of polymer structures, e.g. regularity and irregularity, molecular weight and size. Configuration and conformation in polymers. Effect of molecular arrangement and molecular weight on properties of polymers/fibers. Determination of molecular weight. Introduction to various methods of molecular weight determination, i.e., end group analysis, osmometry, GPC and viscosity method. Orientation and crystallinity in fibres. Effect of orientation and crystallinity on the physical and chemical properties of fibres. Concept of thermoplastic and thermoset material. Concept of rubbery state and rubber elasticity. Transition from glassy to rubbery state. Melting of polymers.

Natural fibres: Natural cellulosic and lignocellulosic fibres, i.e. cotton, jute, flax, micro and macro structure of fibres. Effect of oxidizing agent, reducing agent, acid, alkali and water on the structure, physical and chemical properties of fibres. Assessment of degradation in fiber structure. Properties and uses of cotton, jute and flax. Correlation of structures with properties. Natural protein fibres, i.e. wool and silk. Micro and macro structure of fibres. Effect of oxidizing agent, reducing agent, acid, alkali and water on the structure, physical and chemical properties of fibres. Assessment of degradation in fiber structure. Properties and uses of wool and silk. Correlation of structures with properties. Introduction to ramie, hemp, coir and pineapple fiber.

Polymerisation: Introduction to polymerisation methods and kinetics of condensation and addition polymerization.

Books Recommended:

1. Gohl E P G and Vilensky LD, "Textile Science", CBS Publishers, Delhi, 1983.
2. Cook Gordon J, "Hand Book of textile fibre", Vol. I and II, Woodhead Fibre Science Series, UK, 1984.
3. "Hand Book of Fibre Chemistry", Ed. M Lewin and E M Pearce, Mercel Dekker Inc., 1998.
4. Shenai V A, "Technology of Textile Processing", Vol. 1, Sevak Publications, Mumbai,
5. Gowariker V R, Viswanathan N V and Sridhar J, "Polymer Science", New Age International Ltd., New Delhi, 1996.

TT- 203 Preparatory to Yarn Formation – I [3-1-0-4]

Ginning: Objective of ginning, study of ginning machineries, Pre and post ginning, baling of fibers, latest developments.

Blow Room: Objectives, principles of mixing and blending, types of mixing and blending, mixing and blending machineries, blending performance, latest developments in blending machinery. Principles of opening and cleaning and its machinery, classification, study of opening and cleaning machine and its modern developments. Details of lap forming

mechanism, feed regulating motion, calendar roller pressure, length measuring device, lap build, lap defects and its remedies. Chute feed to card. Single line processing. Degree of opening and clearing. Performance assessment of blow room line. Machine and labour productivity. Norms. Calculations pertaining to blow room.

Carding: Objectives, principles of roller and clearer card, flat card, detail study of flat card and its components. Licker-in, cylinder, doffer and flats. Transfer of fiber. Card clothing. Web stripping and coiler system. Semi high production card. High production card. Neps in carding web. Autoleveller in card. Latest developments. Machine and labour productivity. Norms. Performance assessment and calculations pertaining to carding.

Drawing: Objectives, principles of drawing and doubling. Detailed study of draw frame machine. Top and bottom rollers, top roller cots, roller weighting, drafting wave, roller slip and roller eccentricity. Various drafting system, modern drawframe, autoleveller in drawframe, Machine and labour productivity. Norms. Performance assessment and calculation pertaining to draw frame machine.

Books Recommended:

1. Klein W, "Manual of Textile Technology", Vol. I – III, The Textile Institute, UK, 1987.
2. Oxtoby E, "Spun Yarn Technology", Butterworth and Co. Ltd., 1987.
3. Foster G A K, "Manual of Cotton Spinning", Vol. I –IV, The Textile Institute, Manchester, 1958.
4. Salhotra K R, "Spinning of Man Made Fibres and Blends on Cotton Spinning System", The Textile Association, Mumbai, 1989.
5. Khare A R, "Elements of Blowroom, Carding and Drawframe", Sai book Centre, Mumbai, 1999.

TT-205 Basic Fabric Formation [3-0-0-3]

Winding: Objectives, types of packages, types of winding machines, uniform build up of cones, Mechanical and electronic type yarn clearer. Yarn tensioners: Additive, multiplicative, combined and compensating type. Patterning: Reasons and remedies. Yarn fault classifying systems. Basic features of auto winders like Autoconer, Barbar colmman., Murata etc. Latest developments. Machine and labour productivity. Norms. Performance assessment and calculations.

Pirn winding: Objectives, types of pirns, yarn traversing system, different automation and standard winding parameters.

Warping: Objectives, conditions for warping, comparison of beam warping with sectional warping, basic features of warping machine, different types of creels, reeds, leasing systems. Latest developments. Machine and labour productivity. Norms. Performance assessment and calculations.

Sizing: Objectives, classification of sizing methods and sizing machines. Features of sizing machine, machine elements, sizing ingredients, size preparation, control points, principle of different non conventional sizing techniques. Latest developments. Machine and labour productivity. Norms. Performance assessment and calculations.

Drawing in: Importance, different ways to do it, standard norms. Latest developments.

Weaving: History of weaving with manual and automatic loom, and modern loom revolutions. Overall concept about looms and its elements. Different motions of looms: Primary, secondary and auxiliary motions.

Shedding: Different types of shedding with advantage and disadvantages, geometry of shedding, importance of bending factor, reed and reed counting systems, tappet shedding and its limitations, positive and negative shedding.

Picking: Types of conventional picking: over picking, under picking and parallel picking. Calculation of shuttle velocity and energy of picking, picking force. Different picking accessories and their functions. Picking timing such as late picking and early picking, reasons of false picking and shuttle fly.

Sley: Movement of sley, beat up, sley eccentricity and the factors which influence it, calculation related to sley eccentricity, effects of sley eccentricity on beat up force and timing available for shuttle passage.

Calculations: Production, efficiency and balancing of machine, Calculations related to winding, warping and sizing. Numerical based on shedding, picking and sley movement.

Books Recommended:

1. 'Winding', BTRA Monograph Series, Bombay Textile Research Association, Bombay, 1981.
2. 'Warping and Sizing', BTRA Monograph Series, Bombay Textile Research Association, Bombay, 1981.
3. Mark R, Robinson A T C, "Principles of Weaving", The Textile Institute, Manchester, 1986.
4. Talukdar M K, Sriramulu P K and Ajgaokar D B, "Weaving – Machine, Mechanism and Management", Mahajan Publisher Private Ltd., Ahmedabad, India, 1998.
5. Booth J E, "Textile Mathematics", Part III, Textile Institute, Manchester, 1977.
6. Goswami B C, Anandjiwala R D and Hall D M, "Textile Sizing", Marcel Dekker, USA, 2005

TT- 207 Man Made Fibres [3-0-0-3]

Introduction to man made fibres: Definition of made fibres. Brief history of manmade fibres. Relative merits and demerits of manmade fibres and natural fibres.

Conversion of polymers into fibres: Basic production systems of the man made fibre. Melt spinning, solution dry spinning and solution wet spinning. Factors influencing selection of a particular process for fiber formation. Relative merits and demerits of melt, dry and wet spinning processes. Behaviour of non-Newtonian fluids. Spinnability and factors affecting thread length. Variables of spinning. Different components of spinning process, i.e., extruder, gear pump, filters, manifold, spinning head, quenching chamber, winders. Different quenching/solidification techniques. Spinning of staple fibres and filaments. POY, MOY and FDY. High speed spinning.

Melt spinning: Raw material, technology of polymerization and extrusion of polyester, nylon 6, nylon 66 and polypropylene. Effect of process parameters on structure and properties of melt spun filament.

Solution dry spinning: Dry spinning of cellulose acetate. Acetylation of cellulose. Dope preparation and spinning of cellulose diacetate and triacetate. Dry spinning of acrylic. Significance and types of comonomers used during polymerisation of acrylic. Polymerisation,

dope preparation, extrusion and solidification of filaments. Effect of process parameters on structure and properties of solution dry spun filament.

Solution wet spinning: Process flow diagram and significance of each step for solution wet spinning of viscose rayon. Chemistry of viscose rayon formation process. Influence of various additives and temperature of the regeneration bath and their influence on the process and properties of viscose rayon. Various types of rayons, i.e. high wet modulus, Ten-X, etc. Introduction about alternative routes of regenerated cellulosic fibre formation. Properties and use. Wet spinning of acrylic. Different solvents and parameters of regeneration bath for wet spinning of acrylic. Effect of process parameters on structure and properties of acrylic.

Drawing and heat setting of fibres: Object of drawing. Concept of neck drawing. Effect of drawing conditions on the structure and properties of fiber. Object of heat setting. Effect of heat setting parameters on the structure and properties of fiber.

Spin finish: Objective, properties and application of spin finish.

High-performance fiber: Basic concept of high performance fibres. Basic concepts of liquid crystalline polymer, i.e. Nomex and Kevlar. Concept of dry-jet wet spinning and its application.

Introduction about lyocell and carbon fiber.

Books Recommended:

1. Vaidya A A, "Production of Synthetic Fibres", 1st Ed., Prentice Hall of India, New Delhi, 1988.
2. "Manufactured Fibre Technology", 1st Ed. V B Gupta and V K Kothari, 1st Ed., Chapman and Hall, London, 1997.
3. Mark H F, Atlas S M, Cernia E, "Man Made Fibre Science and Technology", 1st Ed., Vol. 1, 2, 3, Science Publishers, New York, 1967.
4. Macintyre J E, "Synthetic Fibres", Wood head Fiber Science Series, UK, 2003
5. Kothari V K Ed. "Textile Fibers: Developments and Innovations, IAFL Publications, New Delhi, 2000.

MA-203 Probability and Statistics [3 1 0 4]

Concept of statistics, collection and representation of data, frequency distribution, graphical representation of data, measure of central tendency and dispersion, coefficient of dispersion, moments, factorial moments, skewness and kurtosis.

Different approaches to probability, addition and multiplication theorem of probability, Boole's inequality, conditional probability, Bayes theorem and applications, Moment generating functions

Random variables – discrete and continuous, distribution function, probability mass function, probability density function, two dimensional random variables, mathematical expectation, expectation of discrete and continuous random variables, properties of expectation, conditional expectation.

Discrete and Continuous Probability Distribution: Binomial, Poisson, Normal, Exponential, Correlation analysis, Regression analysis, Curve fitting using least square method.

Sampling and sampling distribution: chi-square, student-t and F-test.

Books recommended:

1. Bhattacharya G.K. and Johnson R.A.: Statistical Concepts and Methods, John Wiley, New Delhi, 2002.

2. Hogg R. V. And Elliot A.T, "Probability and Statistical Inference", Pearson Education, 6th Edition.
3. Hogg R V, Craig A T , "Introduction to Mathematical Statistics", Sixth Edition, Pearson Education, Delhi

ME- 251 Kinematics of Machines [3-1-0-4]

Basic concepts: Kinematics of machine, kinematics link and their different type, types of kinematics pair, kinematics chain, mechanism and inversion of four bar chain and slider crank mechanism. Degree of freedom. Velocity Analysis: Motion of a link, velocity of a point on a link by relative velocity method, velocities and acceleration of four bar mechanism, slider crank mechanisms, rubbing velocity at a pin joint. Velocity of a point on a link by instantaneous centre method, properties and types of I-centre, Kennedy theorem and methods of locating I-centres in a mechanism.

Belt, rope and chain drive: Types of belt drives, velocity ratio, law of belting, length of belt, ratio of friction tensions, power transmitted, effect of centrifugal tension on power transmission, condition for maximum power transmission, concept of slip and creep. Use of V belts, ropes, chain, chain length and angular speed ratio, relative advantage and disadvantage of chain and belt drives.

Gears: Classification of gears, terminology used in gear, law of gearing velocity of sliding, forms of teeth, construction and properties of an involutes, cycloidal teeth, effect of centre distance variation on the velocity ratio, involutes profile tooth gear, length of path of contact, arc of contact, number of pairs in contact, interference, minimum number of teeth to avoid the interference between rack and pinion, undercutting, terminology of helical and worm gears.

Gear trains: Definition, simple, compound, reverted and epicyclic gear trains, velocity ratio of epicyclic gear trains.

Cams and follower: Types of cams and followers, cam terminology, types of motion of the follower, analysis of motion of the follower, analysis of motion of the follower for cams with specified contours.

Balancing: Static and dynamic balancing, balancing of several masses in different planes, balancing of reciprocating masses, balancing machines.

Flywheels: Turning moment diagram for steam engine, four stroke internal combustion engines, fluctuation of energy and speed in flywheels, use of flywheel

Application in Textiles: Belts, chains, gear drives in textile machines. Different types of cam followers used in textile machines.

Books Recommended:

1. Bevan T, "The Theory of Machines", CBS Publishers and Distributors, New Delhi, 2002.
2. Bansal R K, "A text book of Theory of Machines", Laxmi Publication Pvt. Ltd, New Delhi.
3. Rattan S S, "Theory of Machines", Tata Mc Graw Hill, New Delhi, 2001.
4. Ghosh A and Mallik A K, "Theory of mechanism and machines", Affiliated East West Press Pvt. Ltd, New Delhi, 1988.
5. Booth J E, "Textile Mathematics", Part III, Textile Institute, Manchester, 1978.

TT-209 Textile Fibre Laboratory [0-0-2-1]

Physical and Chemical identification of following Textile fibre(s)

1. Identification of cotton
2. Identification of wool
3. Identification of silk
4. Identification of Bast fibres
5. Identification of polyester
6. Identification of nylon
7. Identification of Acrylic
8. Identification of Polypropylene

Identification of fibres and their ratio in blended textile

9. Analysis of P/C blended fabric
10. Analysis of P/V blended fabric
11. Analysis of P/W blended fabric
12. Estimation of fibre/filament fineness using projection microscope.
13. Determination of moisture regain and diameter of natural and synthetic fibres under different relative humidity (R.H.).
14. Effects of acids, alkalies and oxidising agents on natural and synthetic fibres

TT-211 Yarn Formation Laboratory – I [0-0-2-1]

At least 10 experiments are to be performed by each student

1. Study of general outline of opener and clearer machine employed in B/R line process.
2. Study of following in shirley trash analyser machine.
 - Chief organs.
 - Gearing arrangements.
 - Teeth inclination and teeth per inch.
3. Determination of trash content and analysis of waste by using trash analyser machine.
4. Study of carding machine with technical details.
5. Study of gearing mechanism calculation of the speed of different organs of carding machine.
6. Calculation of draft between different zone and production of carding machine.
7. Study of card settings for different fibre lengths and types.
8. Maintenance and overhauling of carding machine.
9. Study of distribution of fibrous waste in a carding machine.
10. Study of the 'NEP -COUNT' in a card.
11. Study of drafting arrangement and top roller weighting system of draw frame machine.
12. Calculation of the total draft and its distribution in draw frame machine.
13. Effects of break draft and roller settings on sliver uniformity.
14. Measurement of nip-load pressure, roller eccentricity and shore hardness of top roller drafting rollers.
15. Maintenance and overhauling of draw frame machine.

TT-213 Fabric Formation Laboratory – I [0-0-2-1]

At least 10 experiments are to be performed by each student

1. Study of the motion transmission system in winding machine.
2. Study of the effect of slub catcher, yarn tensioner and yarn guide on package formation.
3. Study of Package stop motion in cone winding machine.
4. Calculation of winding speed on grooved drum winding system and study of anti-patterning system incorporated to it.
5. Study of precision winding machine and mechanism of package building.
6. Study of the motion transmission system in Pirn winding machine.
7. Calculation of winding speed and traversing speed of Pirn winding machine.
8. Study of the sectional working machine and plan the width of a section according to the given striped fabric keeping in view the pattern.
9. To study the passage of yarn on a sizing machine and the features of various parts/mechanism of the sizing machine.
10. To select the proper reed and heald for a weaver's beam keeping in mind the beam, loom size and fabric construction.
11. Study of shedding mechanism of shuttle loom and cam positioning with respect to loom cycle.
12. Study of picking mechanism. Picker movement in relation with crank shaft rotation and calculation of average velocity of shuttle.
13. Study of sley movement, construction and calculation of sley eccentricity.

4th Semester

TT-202 Properties of fibers [3-0-0-3]

Fiber structure: Traditional view of fibre structure. Chemical structure and physical structure. Degree of order and degree of orientation.

Structure investigation: Methods of investigation of fibre structure. Identification of chemical structure by IR spectroscopy. Identification of physical structure by X-ray, SEM, NMR.

Moisture absorption: Definitions of humidity, moisture regain and moisture content. Relation between regain and relative humidity. Effect of stress and temperature on regain. Heat of sorption. Swelling of fibres. Quantitative theory of moisture absorption.

Tensile properties: Factors influencing results of tensile experiment. Expressing results. Different experimental methods. Effect of variability. Elastic recovery. Effect of test conditions on recovery. Cyclic testing. Fibre fracture and fatigue. Time effect. Creep and stress relaxation. Introduction to dynamic testing and fatigue. Concept of models. Kelvin and Maxwell model. Bending and torsional rigidity of fibre. Structural effect on extension behaviour.

Dielectric properties: Definition and effect of different parameters on dielectric properties. Electric resistance and effect of different factors on the electrical resistance of fibres.

Static electricity: Introduction and significance. Measurement of static electricity. Explanation of static phenomena.

Optical properties: Refractive index and birefringence. Birefringence and orientation of fiber. Reflection and lustre.

Thermal properties: Structural changes on heating. Thermal transitions. Concept Heat setting of fibres.

Fibre friction: Technological importance. Measurement of friction. Effect of load and area of contact. Static and kinetic friction. General theory of friction and application to fiber.

Books Recommended:

1. Meredith R, "The Mechanical Properties of Textile Fibres", North Holland Publishing Co; Amsterdam 1959.
2. Morton W E and Hearle J W S, "Physical Properties of Textile Fibres", 1st reprint, The Textile Institute, Manchester, 1986.
3. Gupta V B and Kothari V K, "Manufactured Fibre Technology", 1st Ed., Chapman and Hall, London, 1997.
4. Hearle JWS, "Polymers and their properties", Vol. I, John Wiley and Sons, NY, 1982.
5. Gedde U W, "Polymer Physics", Chapman Hall, London, 1995.

TT-204 Yarn Formation [3-1-0-4]

Introduction to short staple spinning: Brief idea about short staple spinning technology.

Combing process: Objectives, combing for shorter and medium varieties of cotton, cottons suitable for combing, preparation of stock for combing, combing cycle, role of machine components and settings, noil extraction at backward feed and forward feed comber, mathematical problems, norms, performance assessment. Machine and labour productivity. Recent developments.

Process related to roving formation: Objectives, functions of different machine components and high drafting system, roving twist in speed frame, winding principles and equations related to bobbin leading and flyer leading, building motion, cone profile, numerical problems, norms, performance assessment. Machine and labour productivity. Developments in speed frame.

Ring spinning Process: Function and mode of operation of ring frame, role of drafting system, yarn guiding devices, forces acting between ring and traveler, yarn tension variation, balloon tension at maximum diameter, tasks of traveller, limiting speed, classification, form of traveler, traveler mass and material, different ring-traveller combinations, fiber lubrication, running on new-ring, winding process, cop building, cylinder and conical tip, spinning geometry, causes of end breaks, numerical problems, norms, performance assessment. Machine and labour productivity. Latest developments including compact spinning.

Non-conventional spinning processes: Principle of open end spinning, rotor spinning, chief organs and their functions, yarn properties in comparison with ring-spun yarn, principle of friction spinning, function of chief organs, yarn properties and comparison of Dref-II and Dref-III friction spinning machines, basic principle to air jet spun yarn, functions of chief organs, yarn properties, numerical problems, norms, performance assessment. Machine and labour productivity.

Books Recommended:

1. Klein W, "Manual of Textile Technology", The Textile Institute, 1995.
2. Khare A R, "Elements of Combing", Sai book center, Mumbai, 1999.
3. Khare A R "Elements of Ring Frame and Doubling", Sai book Centre, Mumbai, 1999.
4. Salhotra K R, "Spinning of Man Mades and Blends on Cotton System", The Textile Association of India, Mumbai, 1989.

5. Chattopadhyay R and Rengasamay R, "Spinning: Drawing, Combing and Roving", NCUTE-Pilot Programme, 1999.
6. Lawrence C A, "Fundamental of Spun Yarn Technology" CRC Press, USA,2003.

TT-206 Control Mechanism and Advancement to Fabric Formation [3-1-0-4]

Let-off System: Warp and cloth control, different types of let-off systems, control of tension variation.

Take-up: Types of take-up and their mechanisms, control of pick density, calculation related to it.

Warp Stop: Types of warp stop motions and their functioning.

Weft Stop: Weft stop mechanisms with advantages and disadvantages.

Weft Replenishment System: Pirn replenishment mechanism and its limitations. Different types of feelers used for it.

Box changing motion: Working mechanism of multiple box motions (2x1 and 4x1).

Dobby and Jacquard: Scope of dobbie, different types of dobbie and their mechanism pegging system as per design of weave, paper dobbie. Scope of jacquard, working of different types of jacquards and card punching methods.

Shuttle-less Weaving: Problem of shuttle weaving, Development of shuttleless weaving. An elementary idea on Projectile, Air-jet, Water-jet, Rapier weaving machine. Special features of these machines. Calculation related to weaving process

Nonwoven: An Introduction to Non-woven Technology.

Books Recommended:

1. Mark R, Robinson A T C, "Principles of Weaving", The Textile Institute, Manchester, 1986.
2. Talukdar M K, Sriramulu P K and Ajgaokar D B, "Weaving – Machine, Mechanism and Management", Mahajan Publisher Private Ltd., Ahmedabad, India, 1998.
3. Aswani K T, "Fancy Weaving mechanism", Mahajan Publisher Private Ltd., Ahmedabad, India 1990.
4. Talavasek and Svaty V, Shuttleless Weaving machine, Elsevier Scientific Publishing Co, Amsterdam, 1981.
5. Lord P and Mohamad.M.H., " Weaving Conversion of Yarn to fabric", Merrow Technical Library, UK,1988
6. Krcma R, "Mannual of Non wovens", Textile Trade Press, UK,1971

TT-208 Textile Chemical Processing – I [3 0 0 3]

Introduction: Process line for pretreatment, colouration and finishing of textiles.

Singeing: Object of the process, types of singeing, details of various singeing methods, drawbacks and advantages. Process and quality control aspects involved.

Desizing: Object, types, method details and mechanism of removal of starch in various methods. Efficiency of desizing.

Scouring: Objectives, mechanism of removal of impurities, recipe and controlling parameters involved. Scouring of coloured textiles. Scouring of natural, man made and blended textiles. Evaluation of scouring efficiency.

Bleaching: Objectives of bleaching. Hypochlorite, peroxide, chlorite and peracetic acid bleaching methods and their effectiveness on various textiles. Controlling parameters and mechanism involved in each method. Efficiency of bleaching.

Mercerization: Objectives, mechanism related to various physical and chemical changes in cotton during mercerisation. Process parameters and operation details. Causticization. Wet and hot mercerisation. Ammonia treatment of cotton. Performance of various mercerization / alkali treatment processes. Assessment of efficiency of mercerization : Barium activity number, its determination and interpretation.

Heat setting: Objectives and mechanism of setting. Different methods of heat setting and their effectiveness on various man made textiles and blends. Heat setting conditions and controls. Heat setting of polyester, nylon, acetate and their blends. Evaluation of degree of heat setting.

Concept of colour: Visible spectrum, wavelength and blindness of colour. Metamerism/ isomerism.

Theories of colour: Additive and subtractive theories. Primary, secondary, tertiary, complementary and contrasting colours. Tristimulus values of colour. Computer colour matching, Kubelka-Munk equation, reflectance factor, colour-co-ordinates, CIELAB values. Dye uptake on textiles.

Theory of dyeing: Dye-fibre interaction, free volume theory.

Dyeing of textiles: Dyeing technology of natural and manmade textiles with direct, reactive, vat, insoluble azoic, sulphur, solubalised vat, acid, metal-complex, basic and disperse dyes. Colouration with Pigments. Auxiliaries used in dyeing.

Books Recommended

1. A K Roy Choudhary, "*Textile Preparation & Dyeing*", Science Publishers, USA (2006).
2. Peters R. H, "*Textile Chemistry*", Vol - II, Elsevier Publishing Company, London (1967).
3. Shore J, "*Cellulosics dyeing*", Society of Dyers & Colourists, Bradford, UK (1979).
4. Mittal R M and Trivedi S S, "*Chemical Processing of polyester / cellulosic Blends*", Ahmedabad Textile Industries Research Association, Ahmedabad, India (1983).
5. Karmakar S R, "*Chemical Technology in the pretreatment processes of Textiles*", Textile Science & Technology Series, Vol-12, 1st Edition, Elsevier (1999).

TT-210 Unit Operations [3-1-0-4]

Fluid flow: Unit operations, basic equations, Hydrostatic equilibrium, Hydrostatic equilibrium in a centrifugal field, Manometer, Newtonian and non-Newtonian fluid, viscosity, Reynold number, Bernoulli equation and its application on pump work.

Transportation and Metering of Fluid: Pipe, fittings and valves, different type of pumps venturimeter, orifice meter, rotameter.

Conduction: Basic law of heat conduction- Fourier's law, thermal conductivity, its dependence on temperature, steady state heat conduction through a composite solid and its electric analogue, steady state heat conduction through cylinders, different insulating materials and their applications for process equipment and pipelines,

Convection: Convection heat transfer and the concept of heat transfer coefficient, individual and overall heat transfer coefficient, heat transfer between fluids separated by plane wall critical/ optimum insulation thickness. Boiling phenomena and analysis of boiling curve Nusselt equation.

Radiation: Basic principle of radiation from a surface, blackbody radiation, Planck's law Wein's displacement law, the Stefan Boltzmann law, Kirchoffs law, gray body, radiation exchange between black bodies & gray bodies.

Evaporation: Type of evaporators, single and multiple effect evaporators, boiling point elevation

Mass Transfer Operations: Classification of mass transfer operation, choice of separation methods. Fick's law of diffusion, Mass transfer coefficients.

Drying: Equilibrium in drying, batch drying, time of drying, continuous drying, and equipment of drying.

Books Recommended:

1. Geankopolis C J " Transport Processes and Separation Process Principles", Prentice Hall of India, 4th Edition , Eastern Economy Edition (2004)
2. Treybal R E, " Mass Transfer Operations" 3rd ed, McGraw Hill (1980)
3. McCabe W L and Smith J C " Unit Operations of Chemical Engineering". McGraw Hill (2001)
4. Coulson J M and Richardson J F " Chemical Engineering, Vol 2,5", McGraw Hill (1999)
5. Walter L, Badger & Julius T, Banchemo " Introduction to Chemical Engineering", McGraw Hill (1997)

MA-202 Numerical Methods [3 1 0 4]

Roots of Algebraic and Transcendental Equations, Bisection Method, Regula – Falsi method, Newton – Raphson method, Bairstow's method and Graeffe's root squaring method.

Solution of simultaneous Algebraic equations, Matrix Inversion and Eigen-value Problems, Triangularisation method, Jacobi's and Gauss-Siedel iteration method, Partition method for matrix inversion, Power method for largest eigen-values and Jacobi's method for finding all eigen-values.

Finite Differences Interpolation and Numerical Differentiation, Forward, Backward and Central differences, Newton's forward, backward and divided difference interpolation formulas, Lagrange's interpolation formula, Stirling's and Bessel's central difference interpolation formula, Numerical differentiations using Newton's forward and backward difference formulas and Numerical differentiations using Stirling's and Bessel's central difference interpolation formulas.

Numerical Integration, Trapezoidal rule, Simpson's one-third rule and Numerical double integrations using Trapezoidal rule and Simpson's one-third rule.

Taylor's series method, Euler's and modified Euler's methods, Runge-Kutta fourth order methods for Ordinary Differential equations , simultaneous first order differential equations and second order differential equations.

Boundary value problems, Finite difference methods for Boundary value problems.

Partial differential equations, Finite difference methods for Elliptic, Parabolic and Hyperbolic equations.

Books Recommended

1. S S Sastry, Introductionary Methods of Numerical Analysis, 3rd Edition, Prentice Hall of India Pvt.Ltd., New India -1999
2. S C Chapra and R P Canale, Numerical Methods for Engineers, 2nd Edition, McGraw Hill Book Company, Singapore 1990.
3. Grewal, B S ,”Numerical Methods”, Khanna Publishers ,Delhi.

TT-212 Yarn Formation Laboratory - II [0-0-2-1]

At least 10 experiments are to be performed by each student

1. To estimate head to head difference in noil level (mill based study).
2. To study the effect of feed per nip on percentage in nep level during combing (mill based study).
3. To study the drafting, twisting and winding zone of speed frame.
4. To study the building motion in speed frame.
5. To study the differential motion of speed frame and calculation of bobbin speed.
6. Calculation of break draft constant, draft constant and twist constant and production of speed frame.
7. To study the influence of machine and process parameters on roving unevenness (mill based study).
8. To study the drafting, twisting and winding zone in ring frame.
9. To study the building motion in ring frame.
10. Calculation of draft constants, twist constant, coils per inch and production of ring frame.
11. To ascertain the effect of break draft and total draft on yarn unevenness and strength (mill based study).
12. Estimation of spinning tension as a function of traveller weight, yarn count and balloon height (mill based study).
13. To perform various settings and maintenance operation on ring frame such as:
 - ◆ Ring rail levelling
 - ◆ Spindle gauging
 - ◆ Spindle eccentricity
 - ◆ Lappet eccentricity
14. To study the effect of shore hardness on yarn quality (mill based study).
15. To study the influence of spindle speed and traveller weight on hairiness.
16. Study the chief organs, mechanism and calculations of open end and friction spinning machines.
17. To study the timing diagram of a comber.
18. To study the function of top comb and its depth of penetration with reference to noil extraction and fractionating efficiency (mill based study).

19. To study the nature of movement of nipper assembly.
20. To study the mechanism of detaching roller drive and the nature of its motion.
21. To study the effect of type of feed and detachment setting on noil percentage and fractionating efficiency.

TT-214 Fabric Formation Laboratory-II [0-0-2-1]

At least 10 experiments are to be done:

1. Study of take up motion and calculation of loom take up constant.
2. Study of positive let-off system.
3. Study of Warp protection motion (both loose reed and fast reed).
4. Study of warp stop motion.
5. Study of Beating up system in Terry towel loom.
6. Study of temple motions.
7. Study of pirn changing mechanism.
8. Study of side/centre weft fork mechanism.
9. Study of (4x1) multiple box motion.
10. Study of let-off and take-up of shuttle less weaving machine.
11. Study of weft insertion mechanism of Air-jet and Rapier weaving machine.
12. Study of selvage formation technique of Air-jet weaving machine.
14. Identification of fabric faults by fabric inspection machine.

5th Semester

TT 301 Textile Testing

Introduction: Aim and scope of testing, Sample and Population, Sampling techniques for fibre, yarn and fabrics.

Testing of Fibres and Yarn intermediates: Cotton fibre testing such as length, fineness, crimp, maturity, neps, strength, elongation, trash-content, grading of different cotton, fibre contamination measurement, application of HVI and AFIS. Testing of wool and man made staple fibers, measurement of fiber friction and crimp. Evenness testing of silvers, rovings.

Testing of Yarn: Yarn numbering and conversion system, twist in continuous filament, spun and plied yarns, tensile properties, various type of measuring instruments and their working principles, factors affecting tensile properties, elastic recovery, effect of impact loading and fatigue behaviour, yarn friction, evenness testing of yarns, nature and causes of irregularities, principles and methods of evenness testing, evaluations and interpretation of evenness results, concept of index of irregularity. Analysis of periodic variations in mass per unit length. Variance - length curves and spectrogram analysis, yarn faults classification, Uster Classimat and Classifault. Yarn hairiness, principle of measurement, measuring instruments. Test for filament and textured yarn.

Testing of Fabric: Measurement of fabric dimensions and other physical properties such as thickness, weight, yarn crimp, fabric shrinkage, air-permeability, thermal properties, wettability, water proof-ness, and flame resistance, Fabric low stress mechanical properties such as smoothness, stiffness, softness and shear, drape behaviour. Test related to fabric appearance such as pilling, crease and wrinkle recovery, fabric handle and factors

influencing it, fabric comfort. Air, water and water-vapour transmission through fabrics, thermal resistance of fabrics. Serviceability testing parameters such as abrasion resistance, fabric strength, tear strength, bursting strength and snagging test, assessment of barre and other form of fabric defects.

Chemical Testing of Textiles: Colour fastness, Rubbing fastness, Laundering fastness.

Books Recommended:

1. Saville B P, "Physical Testing of Textiles", Woodhead Publishing Ltd, Cambridge, 2002.
2. "Testing and Quality Management", Ed. V. K. Kothari, IAFL Publications, New Delhi, 1999.
3. Booth J E, "Principles of Textile Testing", CBS Publishers and Distributors, New Delhi, 1999.
4. Angappan P & Gopalakrishnan R, "Textile Testing", SSM Institute of Textile Technology, Komarapalayam, 2002.
5. Basu A, "Textile Testing", SITRA Coimbatore, 2002.

TT 303 Textile Chemical Processing-II

Dyeing of blends: Classification of blends, shades and methods for dyeing of blends. Suitability of each method for dyeing of specific blend.

Pretreatment and dyeing machineries: Singeing m/c, J-box, kier, mercerizing machine, loose fibre, yarn and package dyeing machines. Jigger, winch, jet and HTHP beam dyeing m/cs. Padding mangles.

Carbonisation: Objectives, selection of chemical, process details, trouble shoots, precautionary measures and efficiency of carbonisation.

Printing methods: Hand block, roller and screen printing processes. Construction and working of roller printing machine, photoelectric method of screen preparation. Drawback and advantage of each method.

Print Paste: Constituent and characteristics of print paste, classification and mechanism of working of thickeners.

Printing after treatments: Importance of steaming, curing, ageing of prints. Mechanism of each process.

Printing Styles: Direct, discharge and resist styles of printing on natural, man made and blended textiles.

Transfer Printing: Types, mechanism of transfer in each type and machineries. Transfer printing of natural, man made and blended textiles.

Mechanical Finishes: Physical and chemical softening processes, selection of chemical and evaluation of softening. Calendering - its types, construction and function of various calendering m/cs. Sanforizing - method, mechanism and machineries involved. Evaluation of sanforizing.

Functional finishes : Problem of creasing, anti-crease finish on cotton. Choice of chemical, catalyst and process parameters. Drawback and advantages associated with use of various anti-crease chemicals. Measures to reduce release of formaldehyde. Water repellency and water repellent finishes on cotton. Evaluation of water repellency.

Identification of dyes: Identification of dye on dyed natural and man made textiles.

Books Recommended:

1. Miles L W C, "Textile Printing", Dyers Company Publication Trust, Bradford, England, 1981.
2. Shenai V A, "Technology of Printing", Sevak Publications, Mumbai, 1990.
3. Hall A J, "Textile Finishing", Haywood Books, London, 1996.
4. Shenai V A and Saraf, N M, "Technology of Textile Finishing", Sevak Publications, Mumbai, 1990.
5. Nunn D M, "The Dyeing of Synthetic Polymer and Acetate Fibres", Dyers Company Publication Trust, London, 1979.

TT 305 Textile Design

Introduction: Different types of yarn such as spun, filament, textured and fancy yarns and their impact on textile design. Concept of fabric designing through fabric structure and textile printing. Fabric cover and crimp, importance of fabric structure and analysis, detection of directions of warp and weft, classification of woven fabrics, method of fabric presentation, weaving plans.

Basic Weaves: Method of construction, features and uses of plain weave and its derivatives, twill weave and its derivatives, Satin and sateen weaves and their derivatives.

Absorbent Fabrics: Method of preparation, features and uses of Diamond and Diaper Weaves, Honey comb weaves, Huck-a-back and Mockleno weaves.

Crepe Weave: Special feature, construction of the weave, method of preparation of its derivatives and uses.

Bedford Cord weaves: Method of construction, features, cross-sectional view, derivatives and uses.

Stripe and Check Weaves: Features, criteria for selection of weaves for combination, rules governing the joining of different weaves. Method of preparation and uses.

Colour and Weave Effect: Weave and colour combinations, features, method of preparation of Continuous line effect, Hounds tooth, Birds eye, Crows foot, Hair lines and Step pattern.

Terry Weaves: Definition, classification, process of formation of pile, graphical representation of terry weaves, loop sprouting, extra attachments.

Backed fabrics: Definition, features, classification and usage. Graphical representation, warp backed and weft backed cloth, reversible backed fabric, wadded backed fabric.

Double Cloth: Definition, features, classification and uses. Method of preparation of self stitched and centre stitched double cloths, their salient feature and uses. Wadded double cloth.

Calculations: Raw material calculations to produce different weaves. Technical specification of important fabrics.

Books Recommended:

1. Groscicki Z J, "Watsons Textile Design and Colour", Newnes Buttersworth, 1988.
2. Groscicki Z J, "Watsons Advanced Textile Design", Newnes Buttersworth, 1989.
3. Klibbe J W, "Structural Fabric Design", Revised edition, 1965, North Carolina State University.
4. Nisbeth H, "Grammar of Textile Design", 3rd edition, D B Tarapore Wala sons and Co., 1994.
5. Gokarneshan N, "Fabric Structure and Design", New Age International, New Delhi, 2004.

HM Human Resource Management

Introduction : Nature of Human Resource Management (HRM), importance of Human Resource Management, Functions of Human Resource Management, The changing environmental of HRM, Role of HRM in changing business scenario.

Procurement: Job , job Analysis, job Description and job Specifications, Manpower planning, demand and supply forecasting, recruitment, methods of recruitment, Employees testing and selection, types of psychological tests and interviews, placement and induction.

Development: Operative Training and Management Development, methods of training and development, Performance Appraisal: Traditional and Modern methods, Career development: Career anchors, Career development programme, the modern career problems.

Compensation: Factors affecting compensation policy, Job evaluation, methods of job evaluation, Variable compensation: Individual and Group, Supplementary compensation-Fringe benefits, current trends in compensation.

Integration: Human relations, industrial relations, importance of industrial relations, Causes and effects of industrial disputes, Machinery for settlement of industrial disputes in India., Role of trade unions in maintaining relations, Collective Bargaining: concept, features, process and advantages.

Maintenance and separation: Employees safety, health and welfare, Provisions under Factory Act, 1948, Turnover, Retirement and Layoff.

International HRM: The growth of International business, HR and the international business challenge, effect of inter country difference on HRM, international staffing, International compensation and appraisal, International labour relations, Information Technology and HR.

Books recommended:

1. Flippo Edwin B.,“Personnel Management” 6th Ed, McGraw Hills.
2. Memoria C B,“Personnel Management (Management of HRM)” Himalaya Publication New Delhi 1999.
3. Garry Dresler,“Human Resource Management” 8th Ed. Pearson Education, New Delhi, 2002.
4. Becanzo David A, and Robbins S P,“Personnel/ Human Resource Management”, 3rd Ed, Prentice and Hall.
5. Chabra T N, “Human Resource Management”3rd.Ed. Dhanpat Rai, Delhi.2004.

TT 307 Textile Testing –I Laboratory

At least 10 experiments are to be performed by each student

1. To prepare a Baer Sorter diagram and determine the following:
 - Mean length
 - Effective length
 - Short fibres percentage
 - Dispersion percentage
2. Determine moisture content/regain of a fibre sample by hot air oven method.
3. Determine 2.5 % S.L., 50 % S.L., and uniformity ratio of a given cotton using fibrograph. Construct a fibrogram by re-setting the counters for various S.L. between 5 % to 90 %. Compare the fibrogram of manmade fibre with cotton.

4. Determine the micronaire value of a given cotton sample by Air-Flow method. Convert the result into SI units and give a suitable rating to the fibre sample.
5. Determine maturity coefficient and maturity ratio of a given sample by caustic soda method. Give appropriate rating to the fibre sample.
6. Determine Pressley Index of a cotton sample by Pressley Tester at zero and 3mm gauge length and convert result into tenacity. Compare and comment on the results at different gauge lengths.
7. Determine the bundle strength and elongation of a given manmade fibre using Stelometer. Study the effect of rate of loading on tensile properties of the fibre.
8. Cotton fibre testing by HVI.
9. Determine crimp (crimp %) of a given manmade fibre sample.
10. Determine fibre fineness of a manmade fibres/filaments by:
 - whole fibre method
 - vibroscope
11. Tensile properties of a staple fibre by:
 - vibromat
 - Instron/zwick UTM
12. Determine stress relaxation and creep recovery of fibre.
13. Study evenness and imperfection in the given yarn and compare the results with Uster statistics. Study the spectrogram and irregularity trace to determine type of irregularity present. Study the imperfections at different sensitivity level for different yarn samples.
14. Prepare yarns Appearance Boards and compare with ASTM standards.
15. Study the hairiness of a given yarns using Hairiness Tester. Compare the results of Evenness Tester and Hairiness Tester with ASTM grade.
16. Determine coefficient of friction of a spun yarn and see the effect of waxing on coefficient of friction.
17. Determine bending rigidity by (HEART) loop method.
18. Determine the Lea C.S.P by Lea CSP Tester and Autosorter and compare the results of various yarn.
19. Determine the percentage crimp and corrected count with the help of crimp Tester.
20. Determine the crimp rigidity by using hot crimp contraction method.
21. Classimat fault analysis (yarn fault classifying system).
22. Determine the tensile properties of yarn by single thread strength tester.
23. Determine twist of yarn by various twist measuring instrument.
24. Characterize a woven fabric with respect to its dimensional properties.

a. thread density	e. cover factor
b. yarn number	f. areal density
c. yarn crimp	g. skewness
d. weave	h. thickness
25. Determine the tensile strength and elongation of a woven fabric and compare the load-elongation curve with non-woven and knitted fabric.
26. Determine the tear resistance of a fabric using Elmendorf Tear Tester.
27. Determine the bursting strength of a fabric on a hydraulic bursting tester.
28. Determine the abrasion resistance and pilling resistance of a fabric.
29. Determine the crease recovery of fabric and observe effect of loading time and recovery time on crease recovery.
30. Determine the Drape coefficient of a fabric sample.

31. Determine the compression property of a fabric (thickness).
32. Determine the Air permeability, water permeability and water repellency of a fabric.
33. Determine the thermal resistance of a fabric.
34. Determine the stiffness of a fabric.

TT 309 Textile Chemical Processing – I Laboratory

At least 10 experiments are to be performed by each student

1. Scouring of cotton goods
2. Scouring of polyester goods
3. Scouring of P/C blended goods
4. Scouring of wool fibre
5. Degumming of silk
6. Bleaching of cotton with H_2O_2
7. Bleaching of cotton with $NaClO_2$
8. Bleaching of cotton with $NaOCl$
9. Bleaching of Polyester
10. Bleaching of P/C blend
11. Bleaching of jute yarns / fabric
12. To dye the fabric with direct dye and it's after treatment
13. To dye the fabric with reactive dyes
14. To dye fabric with Sulphur dyes

6th Semester

TT 302 Process Control in Textiles

System of process control in spinning: Role and scope, key variables, establishing norms or standards. Collection and interpretation of data and corrective action.

Mixing quality and Cost: Instrumental evaluation of cotton, control of mixing quality through fibre characteristics control of mixing cost and quality, linear programming for cotton mixing and its formulation and approach.

Yarn realisation: Records and estimation of yarn realization and waste in spinning mill, norms for yarn realisation.

Waste and cleaning in Blow room and carding: Calculation of Trash content and cleaning efficiency, Norms for waste and cleaning efficiency. Assessing the performance of Blow room and card.

Comber waste control: Technological conditions, optimization of comber waste extraction, norms and procedures for control of comber waste.

Control of yarn quality: Measurement, assessment and control of count, strength, unevenness and imperfections of yarn.

System of process control in weaving: Scope and approach to process control in weaving. Establishing and standards schedule of checks and machinery audit.

Quality Control and Productivity in winding warping and sizing: Approach, scope, control and optimization.

Control of productivity in Loom shed: scope and approach, control of loom speed, efficiency and stops. Quality of yarn. Expected loom efficiency, loom allocation.

Fabrics Quality in Weaving: Scope and approach, control of some specific fabric defects, grey fabric imperfection.

System of Process Control in Chemical Processing: Scope and approach, norms and standards,

Quality control and Productivity: Quality control and productivity in Bleaching, dyeing, printing and finishing. Control of damages in chemical processing.

Books Recommended:

1. Garde A R and Subramanian T A, "Process Control in Cotton Spinning," ATIRA, Ahmedabad, 2nd Ed., 1978.
2. Paliwal M C and Kimothi P D," Process Control in weaving", ATIRA, Ahmedabad 2nd Ed, 1978.
3. Gokhale S V and Modi J R, " Process and Quality Control in Chemical Processing of Textiles", ATIRA, Ahmedabad, 1992
4. Ratanam T V, "Quality control in spinning", SITRA, Coimbatore, 1994.
5. Salhotra K R, Chattopadhyay R and Ishtiaque S M, "Process control in spinning", IIT, Delhi, CD cell, 2001

EC 3XX Digital Electronics and Microprocessor Architecture

Review of number systems and codes: Decimal, binary, hexadecimal, octal number systems and their conversions binary arithmetic, signed and unsigned numbers, excess-3 codes, gray codes, error detecting codes

Boolean algebra and logic gates: Introduction to Boolean algebra, theories of Boolean algebra, logic circuits and logic gates, minimization of Boolean expressions by using theorems and K- maps

Combinational and sequential logic circuits: Introduction to adder and subtractor circuit, multiplexers, de-multiplexers, decoders, encoders., an introduction to shift registers and counters , semiconductors memories like ROM and RAM, an introduction to A/D and D/A converters

Microprocessor based systems: Evolution of microprocessors, system block diagram, microprocessor operation, hardware/software requirements, from large computers to single chip-microcomputers, machine language and assembly language writing and executing an assembly language program.

Microprocessor-architecture and microcomputer systems: An introduction to (8-bit) microprocessor, microprocessor architecture and its operations, the 8085 MPU and 8080 MPU, interfacing devices

Instruction and timings: Instruction clarification, instruction format, how to write and execute a simple programme, introduction to 8085/8080 basic instructions and timing, dynamic debugging

Introduction to input/output interfacing: Basic interfacing concepts, memory mapped I/O and I/O mapped I/O, an introduction to serial I/O techniques

Trends in microprocessor Technology: Contemporary-8-bits microprocessor, 16-bits microprocessor, 32-bits microprocessors.

Applications

Books Recommended:

1. Gaonkar S R, "Microprocessor Architecture, Programming and Applications with 8085/8080A", 5th Ed., Prentice Hall Pvt. India Ltd., New Delhi, 2000.
2. Antonakes L J, "An introduction to Intel Family of Microprocessors", 3rd Ed., Pearson Education India, New Delhi, 2000.
3. Malvino P and Leach, "Digital Principle and Applications", 5th Ed., Tata McGraw Hill, New Delhi, 2003.
4. Jain R P, "Modern Digital Electronics", 3rd Ed., Tata McGraw Hill, New Delhi, 2003.
5. Mano M Morris, "Digital Design", 3rd Ed., Pearson Education India, New Delhi, 2002.

TT 304 Textile Chemical Processing – II Laboratory

At least 10 experiments are to be performed by each student

1. To dye cotton with Azoic dyes
2. To dye cotton with Vat dyes
3. To dye cotton with Indigoid dyes
4. To dye wool fibre with
 - Reactive dyes
 - Acid dyes
 - Metal complex dyes
5. To dye silk with acid dyes / acid mordant dyes
6. To dye polyester with disperse dyes
7. To dye nylon with acid dyes / metal complex dye
8. To dye acrylic with basic dyes
9. To print cotton fabric with hand block method in direct style
10. To print cotton fabric with hand block in discharge style
11. To print cotton fabric with hand block in resist style
12. Study of fastness properties of different dyed samples
13. Identification of dyes on dyed textiles
14. To finish cotton fabric with
 - Water repelling agent
 - Urea - formaldehyde

TT 306 Knitting Technology Laboratory

At least 10 experiments are to be performed by each student

1. To study the path of yarn through plain knitting machine.
2. To study the different knitting elements including the cam system.
3. To study the driving mechanism of plain knitting m/c.
4. To study the cloth take-up mechanism of plain knitting m/c.
5. To study the rib knitting m/c including arrangement of dial and cylinder needles, cam system and driving mechanism.
6. To study the Interlock knitting m/c including arrangement of dial and cylinder needles, cam system and driving mechanism.
7. To study cam system of V - bed rib knitting m/c.
8. To study driving mechanism of V - bed rib knitting m/c.

9. Preparation of Fabric sample (rib, circular, half cardigan and full cardigan) in V-bed rib knitting machine.
10. To study the effect on loop length with the change in cam setting in flat knitting machine.
11. To study the effect of variation in yarn input tension on the loop length in V-bed rib flat knitting machine.
12. To study plain, rib and Interlock knitted fabrics (course per inch, wales per inch, loop length etc.)

EC 3XX Digital Electronics

1. Verification of the truth tables of logic gates, e.g., 7400, 7402, 7404, 7408, 7432, 7486.
2. a) Verification of truth table of the Multiplexure 74150.
b) Verification of truth table of the De-Multiplexure 74154.
3. Design and verification of truth tables of adder and subtractor circuit.
4. a) Design and test of an S-R flip-flop using NAND gates.
b) Verify the truth table of a J-K flip-flop (7476).
c) Verify the truth table of a D flip-flop (7474).
5. Write a program to add two hexadecimal numbers and store the sum into a memory location.
6. Write a program to sort a list of numbers in ascending and descending order.
7. Write a program to multiply two 8-bit numbers.
8. Write a program to find the square root of 8-bit number.
9. Write a program to load the data byte in some register, mask the high order bits, and display the low order bits in some memory location.
10. Write a program to clear the CY flag, to load number FF in register B, and the increment B. If the CY flag is set, display 01 at the output port; otherwise, display the contents of register B.
11. The block of data is stored on the memory locations starting from XX55 to XX5A. Transfer the data to the locations XX80 to XX85 in the reverse order.

7th Semester

TT 401 Theory of Textile Structure

Yarn Geometry: Basic geometry of twisted yarns. The idealized helical yarn structure, Deviation.

Real Yarn: Twist contraction and retraction, Packing of fibres in yarn Forms of Twisting.

Fibre Migration: Ideal migration, Parameters affecting migration, characterization of migration behaviour, mechanism of migration in single and plied structure.

Structural Mechanics: Extension of yarn under small load. Analysis of tensile forces of yarn under stress. Prediction of breakage, Nature of rupture for continuous filament yarn. Extension and breakage of spun yarn: Traditional view and approach by Hearle and E1-Sheikh.

Blended Yarn: Blended yarn structure, Hamburgers Theory. Structure property relationship of ring, rotor, air-jet, friction spun yarn.

Fabric Geometry: Engineering approach to the analysis of fabric, Pierce geometrical model relationship between h, p, c, Crimp interchange, Jammed Structure, concept of similar cloth. Minimum possible cover factor. Race track geometry, close limit of weaving concept of pierce elastic thread model, Geometry of plain knitted fabric.

Fabric Properties: An elementary idea about tensile, bending, shear and drape behaviour of fabric. An elementary idea about fabric objective measurement technology.

Books Recommended:

1. Hearle J W S, Grosberg P and Backer S, “Structural Mechanics of Fibres Yarns and Fabrics”, Wiley Interscience, New York, 1969.
2. Goswami B C, Martindale J G and Scardino F, “Textured yarn technology, structure and applications”, Wiley Interscience Publisher, New York, 1995.
3. Peirce F T and Womersley J R, “Cloth Geometry”, reprint, The Textile Institute, Manchester 1978.
4. Hearle J W S, Thwaites J J and Amirbayat, “Mechanics of Flexible Fibre Assemblies”, Sijthff and Noordhoff International Publishers BV, Alphen aan den Rijn, Netherlands 1980.
5. Journals: Textile Research Journal, Princeton, USA and Journal of Textile Institute, Manchester, UK

TT 403 Quality Control in Textile Industry

Quality Management: Definition of quality and its importance, different approaches to quality, Description of Deming’s fourteen points and Ishikawa’s seven tools of quality, utility of statistical method for quality control and improvement, concept of Total Quality Management (TQM), ISO 9000 Standards, Quality Function Deployment (QFD) and Quality Costs.

Basic Approaches to Statistical Quality Control: Population and sample, descriptive and inductive statistics, discrete and continuous variables, subjective tests, collection and classification of data, frequency distributions, measures of central tendency, measures of dispersion, random variables and probability distribution, differences and applications of normal, binomial, Poisson’s and other form of distribution.

Statistical Analysis for Continuous Function: Population and sampling distribution of mean, statistical estimation theory, points estimates, concept of single tail and double tail test, Student’s t distribution, confidence limit, statistical decision theory, tests of hypotheses and significances, type I and type II errors, difference between two sample means. Test for single variance, Chi-square test, the F distribution, test for the difference between two variances, confidence limits for variance and ratio of two variances, choice of sample size.

Statistical Analysis for Discrete Function: Application of binomial and Poisson’s distribution, normal approximation, test for a single proportion and difference between two proportions, application of χ^2 distribution, contingency table.

Subjective Tests: Rank correlation, tied rank, coefficient of concordance.

Acceptance Sampling: Basic idea about acceptance sampling, OC curve, producer’s risk and customer’s risk.

Control Charts: Advantages using quality control charts, random and assignable causes, action and warning limits, \bar{X} , R, \bar{p} , $n\bar{p}$ and \bar{c} chart, Process Capability Ratio (C_p and C_{pk}), concept of 6 sigma process control, brief idea about CUSUM and EWMA chart.

ANOVA and Regression: Some basic concept of Analysis of Variance, method of least squares, linear regression methodology, correlation and standard error.

Books Recommended:

1. Leaf G A V, “Practical Statistics for the Textile Industry”, Part-I and II, The Textile Institute, U.K, 1984.
2. Montgomery D C, “Introduction to Statistical Quality Control”, Fourth Ed., John Wiley & Sons (Asia) Pte. Ltd., Singapore, 2004.
3. Mehta P V, “Quality Management: An Overview”, in ‘*Testing and Quality Management*’, Vol. 1, Ed. V K Kothari, IAFL Publication, New Delhi, 1999.
4. Spiegel M R and Stephens L J, “Schaum’s Outlines Statistics”, Third Ed., Tata McGraw Hill, New Delhi, 2000.
5. Walpole R. E. and Myers R.H., “Probability and Statistics for Engineers and Scientists”, McMillan Publishing Company, New York, 1985.

TT 405 Garment Technology Lab

(15 practical are given below at least 10 are to be performed by students)

1. Study of sewing machine & its parts (01 Lab)
2. Study and construction of hand stitches - Basting, Running, Hemming, Back stitch and its variations (01 Lab)
3. Study and construction of seams - Plain, French, Lapped, Flat fell, Hongkong, eased and top stitched (01 Lab)
4. Study and construction of Gathers, Pleats and Tucks (01 Lab)
5. Study and development of patterns for simple designs using basic blocks (02Lab)
6. Study and construction of basic blocks to assemble a garment (02 Lab)
7. Garment stitching and finishing (03 Lab)
 - Darts
 - Waist bands
 - Pockets
 - Placket - slit and seam
 - Neckline finish
 - Sleeve attachments
8. To explain important skill that enables the designer to convert a design sketch into a three dimensional form (01 Lab)
9. Designing of T –shirts, Skirts, Pant and shirt using garment software. (03 Lab)

8th Semester

TT 402 Mechanics of Textile Processes

Opening and clearing: Elementary ideas of tuft opening and dust and foreign matter separation. Analysis of piano feed regulating motion. Evaluation of Blow Room performance.

Carding: Mechanics of fibre entanglement and hook formation during carding. Theories of carding. Transfer mechanism of fibres. Cylinder load and transfer efficiency. Fibre

configuration and estimation of degree of disorder. Effect of different parameters on hook formation.

Draw frame: Role of drawframe on yarn quality and process parameters. Hook removal in roller drafting.

Combing: Theoretical aspects of combing. Fractionation in combing. Parameters affecting FEI and combing efficiency.

Speed frame: Mechanism of package building and twisting in speed frame.

Ring Spinning: Drives on modern ring frames. Yarn tension in ring spinning. Balloon theory in spinning.

Preparatory to Weaving: Mechanics of package building during winding, Performance of sensors, Splicing and yarn tension during unwinding, Yarn tension controlling devices, Cone angle and traverse in sectional warping, Stretch control in sizing, Weft package sloughing and its control.

Weaving: Kinematics of sley and heald motion, Shed depth and interference factor, Shedding cam design, Mechanism of picking, Shuttle retardation and its importance, Causes of pick variation, Cloth fell equation, Bumping condition.

Books recommended:

1. Booth J E, Textile Mathematics vol. 3 1st ed, The Textile Institute, Manchester 1975.
2. Chattopadhyay R, Advances in Technology of Yarn Production, 1st Ed, NCUTE, IIT Delhi 2002.
3. Winding, BTRA Monograph series, The Bombay Textile Research Association, Bombay, 1981.
4. Warping and Sizing, BTRA Monograph Series, The Bombay Textile Research Association, Bombay, 1981.
5. Marks R and Robinson A T C, Principle of Weaving, The Textile Institute, Manchester, 1986.

Departmental Electives

TT 321 Post Spinning Operation

Introduction: Introduction and objective of post spinning operation. Operations involved in post spinning.

Drawing: Introduction of drawing filament/fibre. Theoretical considerations of drawing. Concept of neck drawing. Prediction of neck formation. Significance and stabilization of neck. Drawing unit. Drawing behavior of thermoplastic polymers. Influence of drawing parameters on structure and properties of fibres. High speed spinning and spin draw process. Drawing of pre-oriented yarns and draw-warping.

Heat-setting: Introduction and concept of heat-setting. Objective of heat-setting. Different nature of set. Heat-setting behaviour of fibres. Methods of heat-setting. Influence of heat-setting parameters on structure and properties of fibres. Settability and measurement of set.

Tow conversion: Introduction of Tow to Top conversion. Different methods for tow to top conversion.

Bulk yarn: Introduction of bulk yarn. Objectives of producing bulk yarns. Different methods of producing bulk yarns. Principles of manufacturing acrylic high bulk yarn. Concept and classification textured yarns. Different texturing methods and brief working principles of

different texturing methods. Principles of false twist texturing. Material and Machine variables and their influence on the structure and properties of false twist textured yarn. Concept of air-jet texturing. Material and process variables in air-jet texturing and their influence on the structure and properties of air-jet textured yarns. Testing and evaluation of textured yarns. Recent developments in texturing. Air entanglement process.

Books Recommended:

1. Gupta V B and Kothari V K, “Manufactured Fibre Technology”, Chapman and Hall, London, 1999.
2. Vaidya A A, “Production of Synthetic Fibres” 1st Ed., Prentice Hall of India, New Delhi, 1988.
3. Hearle J W S, Hollick L and Wilson D K, “Yarn Texturing Technology”, Woodhead Publishing Ltd., UK, 2002.
4. Goswami B C, Martindle J G and Scardino F L, “Textile Yarns Technology, Structure and Applications”, Wiley-Interscience Publication, New York, 1976.
5. Mark H F, Atlas S M, Cernia E, “Man Made Fibre Science and Technology”, 1st Ed., Vol. 1, 2, 3, Science Publishers, New York, 1967.

TT 322 Multifibre Process

General: Survey of the established practices for spinning of man made fibres. Fibre quality requirements for spinning.

Blended Yarn: Humburger’s theory. Stages of blending. Development in blending machines. Conventional spinning system. Detailed study of the changes required in processing short and long staple man made fibres on cotton system. Spinning of dyed fibres.

Rotor Spinning: Aspects of Spinning of man made fibres and wool on rotor spinning system.

Advancement: Spinning of micro fibres. Mellange and fancy yarn production.

Worsted/Woolen System: Processing of long fibres on woollen/worsted system. Silk reeling

Jute and Flax Spinning: Introduction & process sequence. Blending of jute. End use of jute and jute blended yarns and fabrics. End use of linen blended and linen yarn and fabrics.

Books Recommended:

1. Salhotra K R, “Spinning of Manmades and blends on cotton system”, 2nd Ed; The textile Association, India, 1989.
2. Lawrence C A, Fundamentals of Spun Yarn Technology, 1st Ed; CRC Press LLC, Florida, USA (2003)
3. Richards R T D and Sykes A B, “Manual of Textile Technology: Woollen Yarn Manufacture”, The Textile Institute, Manchester 1994.
4. Chattopadhyay R, “Advance in Technology of yarn Production”, 1st Ed; Nodal Centre for Upgradation of Textile Education, IIT, Delhi, 2002.
5. Atkinson R R, “Jute fibre to Yarn”, 1st Amercian Edition; Chemical Publishing Co., INC., New York, 1965.

TT 323 Textile Printing and Finishing

Print paste: Constituents and characteristics, thickeners and its types, function and suitability of thickener for a specific printing style.

Printing After-treatments: Importance of after-treatment of printed textiles, process and mechanism of steaming, curing, ageing and open soaping.

Printing Methods: Hand block, roller and screen printing methods, advantages and drawbacks. Photoelectric method of screen preparation.

Printing Styles: Direct, discharge and resist styles of printing with dyes and pigments on natural as well as man made textiles.

Transfer Printing: Concept, classification, method and mechanism of print transfer. Transfer printing of pet/cot blends. Transfer printing machineries.

Mechanical Finish: Sanforizing of textiles, objectives, process, mechanism and machineries involved. Evaluation of process efficiency. Objects of calendaring, classification, types of calendars and choice of right calendaring machines.

Softening of textiles: Decatising process, mechanism and parameters of decatsing. Chemical softening, classification, selection criteria of suitable softener for specific textiles. Evaluation of softener.

Functional finish: Problem of creasing and anti-crease finish on cotton, process parameters, selection of chemicals, drawback and advantages associated with each chemical. Water repellent finish-temporary, semi permanent and permanent finishes; evaluation of water repellency. Mechanism of burning of textiles, choice of chemical for all types of flame retardant finishes, Determination of LOI. Soil release finish - mechanism of soiling, application of soil, evaluation of soil release efficiency, Anti-microbial finishes on natural, man made and blended textiles.

Books Recommended:

1. Miles L.W.C, Textile Printing, Dyers Company Publication Trust, Bradford, England, 1981.
2. Shenai V.A, Technology of Printing, Sevak Publications, Mumbai, 1990.
3. Hall A.J, Textile Finishing, Haywood Books, London, 1996.
4. Shenai V.A. and Saraf, N.M, Technology of Textile Finishing, Sevak Publications, Mumbai, 1990.
5. Peters R H, "Textile Chemistry", Vol- III, Elsevier Scientific Publishing Co., New York, 1975.

TT 324 Knitting Technology

Knitting: Process, comparison of weaving and knitting, warp and weft knitting, classification of weft knitting machines.

Weft Knitting Elements: Knitting needles, sinkers, cam systems, type of feeding systems, tensioning devices, stop motions.

Weft Knitted Structures: Properties and uses of basic weft knitted structures- Plain, Rib, Interlock and Purl alongwith their derivatives. Different types of stitches.

Flat Knitting Machines: Process of loop formation, cam track, features, and structures produced.

Patterning: Devices for patterning in circular knitting machine Electronic needle selection.

Science of Knitting: Concept of loop length, knitting tension, spirality, production calculations, fabric faults in weft knitting.

Warp Knitting: Machines and mechanism. Study of let-off and take up mechanism. Lapping diagrams. Production calculations.

Latest developments: Knitting machines, other structures in knitting, blanket manufacturing.

Books Recommended:

1. Spencer D J, "Knitting Technology", 2nd edition, Pergamon Press, 1989
2. Ajaonkar D B, "Knitting Technology", Universal Publishing Corporation, 1998.
3. Booth J E, "Textile Mathematics", Vol. 3, Textile Institute, Manchester, 1977.
4. Reichman Charles, Lancashire J B and Darlington K D, "Knitted Fabric Primer", National Knitted outdoor Association, New York, 1967.
5. Iyer C, Mammel B & Schach W, "Circular Knitting", Meisenbach Bamberg

TT 325 Processing of Man made Fibres and Blended Textiles

Introduction: Structural study of man made and their blends Stability of man made fibres against chemical treatment.

Classification of blends: Objectives of blending. Classification, compatibility of components in a blend.

Pretreatment of man made and blends : Pretreatment of polyester, nylon, acrylic, acetate fibres and their blends, viz. singeing, desizing, scouring, bleaching, mercerizing and heat setting. Pretreatments machineries.

Dyeing of man made: Dye-fibre attachment. Role of fibre structure in dyeing of man made. Dyeing of polyester in HTHP machines, carrier dyeing, thermosol dyeing. Mechanism of carrier action. Dyeing of nylon with acid, metal complex, disperse, reactive and direct dyes. Dyeing of acrylic with disperse, acid and cationic dyes. Dyeing of differentially dyeable man made.

Dyeing of blends : Characterisation of blends, dyeing of primary, binary and ternary blends, viz. A, B, D, A-B, A-D, D-B and A-D-B.

Blend dyeing methods: Single bath single step, single bath two step and two bath two step methods to produce different shades.

Blend dyeing shades: Reserve, cross, shadow and solid shades. Possibilities of producing various shades on a specific blend.

Printing of man made and blends: Direct, resist and discharge styles of printing of polyester and its blends. Pigment printing. Carbonised prints. Transfer printing of polyester, nylon, acrylic and their blends.

Finishing of man made and blends: Mechanical finishing of man made. Optical whitening, anti-pilling and durable press finishes. Soil release, water repellent and flame retardant finishes on man made and blends. Anti-static finish.

Finishing of terry-woolen textiles: Crabbing, blowing, cropping, anti-felting, pressing and decatizing.

Books Recommended:

1. Nunn D.M, "The Dyeing of Synthetic Polymer and Acetate Fibres", Dyers Company Publication Trust, London, 1979.
2. Shore J, "Colorants and Auxiliaries", Vol- I and II, Society of Dyers and Colorists, Bradford, England, 1990
3. Gulrajani M.L, "Polyester Textiles", Book of papers: 37th National Textile Conference, The Textile Association (India), Mumbai, 1980.
4. Gulrajani M.L, "Blended Textiles", Book of papers: 38th National Textile Conference, The Textile Association (India), Mumbai, 1981.
5. Datye K.V and Vaidye A.A, "Chemical Processing of Synthetic Fibres and Blends", John Wiley and Sons, New York, 1984

TT 326 Nonwoven Technology

Introduction: Historical Development, Definitions of nonwovens, Classification of Non-Woven fabrics, Development of nonwoven industry & future perspective.

Raw materials: Natural and Synthetic fibres, Bonding agents, Types of bonding agents, Basic structure of bonding agent formulation, Characteristic properties of polymer dispersions, thermosensibility, cross linking, Adhesive fibres, Soluble fibres.

Web formation techniques: Fibre preparation, Dry laying, wet laying, Parallel laying, Cross laying and random laying methods, Spunlaying, Melt blowing, SM, SMS fabrics.

Mechanical Bonding: Needle punching technology, needle punching machine, Felting needles, needle classification and their specifications, Developments in needle punching technology, Factors affecting the properties of needle punched fabrics, Spunlacing technology, factors affecting the spunlaced fabric, Stitch bonding technique.

Chemical Bonding: Adhesive Bonding, Methods of bonding agent application, Cohesive bonding, Drying by convection, conduction, radiation, infra red drier and high frequency driers.

Thermal bonding: Thermal bonding techniques, Area bonding, Point bonding & their properties.

Finishing of nonwoven fabrics: Shrinkage, Calendering, Pressing, Splitting, Grinding, Washing, Dyeing, Printing, Softening, Coating and Laminating.

Applications: Medical and Hygiene, Apparel, Household & Home Textiles, Geotextiles, Filtration, automotive textiles, agriculture, leather industry

Testing of Nonwoven fabrics: Standards and methods of testing nonwoven fabrics

Books Recommended:

1. Lunenschloss J and Albrecht W, "Non-Woven Bonded Fabric", Ellis and Horwood Ltd., UK, 1985
2. Albrecht W, Fuchs H & Kittelmann, "Nonwoven Fabrics", Wiley-VCH Weinheim, 2003.
3. Mrstina V & Fejgal F, "Needle punching textile technology", Elsevier, 1990.
4. Krcma Radco, "Manual of nonwovens", Textile Trade Press, UK, 1971
5. Gulrajani M L, "Book of Papers of International Conference on Nonwovens", The Textile Institute, UK, 1992

TT 327 Advances in Chemical Processing

Combined pretreatment methods: Basic criteria for combining pretreatment methods, combined desizing and bleaching, scouring and bleaching, desizing - scouring and bleaching of natural, man made and blended textiles.

Short liquor methods: Concept of short liquor processing, advantages and limitations. Short liquor pretreatment and dyeing of various textiles.

Fastness determination: Various Fastness criteria of dyed and printed textile. Grading and methods to determine fastness relating to washing, light, perspiration, sublimation and chlorine treatment.

Evaluation of auxiliaries: Importance and method of evaluation of wetting agents, optical brighteners, flame retardants, water repellents and soil release agents.

Reduction in wastage of energy: Development of new continuous and batch machines as well as modified processes.

Reduction in waste water load: Specification of water for use in industries and its discharge to public sewage, bio-degradation of chemicals. Measurement of waste water load. Preventive measures to reduce this load.

Theory of coloration of textiles: Basic approaches for application of colouring materials on various textiles, dye-fibre interaction through physical and chemical forces.

Thermodynamic study of dyeing: Study of vat dye on cotton, acid dye on wool and nylon. Dyeing equilibrium and concept of half time dyeing.

Development in chemical processing: Various developments in pre-treatments, dyeing, printing and finishing of textiles in reference to use of water, right first time dyeing and controlled application techniques.

Process and quality control: Detailed study of chemical processing methods. Control of process parameters. Quality of raw and processed materials. Evaluation of quality of processed textiles after each processing step.

Shade reproduction and repetition : Theory and tristimulus values of colour, colour co-ordinates. Primary, secondary and tertiary colours. Colour yield. Analysis of shade. Preparation of shade datas for reproduction.

Automation in dye house: Automation in dyeing machineries, colour rooms. On- line monitoring of concentration of dye and chemicals.

Books Recommended:

1. Bird C L and Boston W S, "The theory of coloration of textiles", Dyers Company Publication Trust, Bradford, England, 1975.
2. Manivaskaram N, "Treatment of Textile Processing Effluent", Sakthi Publications, Coimbatore, 1995.
3. Peters R H, "Textile Chemistry", Vol- III, Elsevier Scientific Publishing Co., New York, 1975,
4. Smethwurst G, "Basic water Treatment", IBT Publications, Delhi, 1989.
5. Sule A D , "Computer colour analysis", New Age International (P) Ltd., New Delhi, 1997.

TT 328 Marketing and Financial Management in Textiles

Marketing Management: Definitions, Products life cycle, pricing, marketing channels. Promotion Mix.

Marketing Research. Basic concepts, research process, market segment, product research, Advertisement Research.

Frame work of Retailing in Textiles, career in retailing, Factors affecting retail pricing, Various Textile Industry marketing practices in fibres, yarns, grey fabrics, finished fabrics.

Elements of Costs: The cost of material, labor, over head and waste in relation to textile production and finishing.

Mill Organization in conjunction with the costing systems:

Production Management ; The costing Department, operating costs and Process costs

Marginal costs and methods to calculate. Different types of costs like opportunity cost, Sunk Cost etc.

References:

1. Kotler P, "Marketing Management", Prentice Hall of India, Delhi, 9th Edition, 1998.
2. Dudeja V D, "Management of Textile Industry", Textile Trade Press, Ahmedabad, 1981.

3. Barry Band Joel R.E. "Retail Management" Metmiiam Publishing Co., New York 1989.
4. Ernest H R "Retail Merchandising" Macmillian Publishing Co., New York, 1991.
5. Pandey I M, "Financial Management" Vikas Publishing House, New Delhi, 1999.

TT 329 Production Management

Managing Operations: Historical evolution of production and operations Management, strategic role of operations, trends in operations Management, process and control of operations strategies.

Enterprise Resource Planning: What ERP does, ERP Applications, ways to use ERP.

Planning and Conversion System: New product Design, Developing New products and processes.

Location and Layout: Need for location planning, General procedures for facility location, Free trade and location alternatives, layout concepts, Developing the different types of layouts.

Inventory Management: Inventory concepts, inventory reduction tactics, ABC analysis, EOQ, P and Q systems.

Resource Planning: Overview of material requirement planning, Benefits of MRP, outputs of MRP.

Work Management: Basics of work study and time study.

Productivity: Different types of machine and labour productivity.

Books Recomendaded:

1. Raymond R Mayer, "Production and Operations Management", Tata McGraw Hill, 3rd Edidtion, 1989.
2. Asawathappa K and Shridhara Bhat, "Production and Operations Management", Himalaya Publishing House, 1999.
3. Buffa S E and Sarin R "Modern Production/ Operations Management", John Wiley and Sons, Delhi, 1995.
4. Selvan R P, "Production and Operation Management", Prentice Hall India, New Delhi, 2002.
5. Ahuja K K, "Production Management", CBS Publishers and Distributors, Delhi, 1998.

TT 330 Garment Technology

Garment Manufacturing: Introduction, Indian apparel industry. Different garment production systems.

Selection of Fabrics: Garment from Woven and knitted fabrics, Various fabrics available in market, their characteristics and applications to suit to different purposes

Pattern making: Introduction to pattern making and garment, Construction. Different terminologies. Drafting, Basic bodies blocks, Muslin pattern. Commercial pattern, Methods of making basic pattern, grading of pattern, size, size charts.

Spreading and lay planning: Introduction to symmetrical and asymmetrical fabrics, criteria of spreading, methods of spreading, spreading m/cs. Principles of lay plan, types of lay plan.

Garment Cutting: Introduction to cutting room processes, cutting methods and their merit demerits. Bundling system.

Garment Sewing: Introduction to sewing m/c and its parts, sewing room processes and working details. Different types of sewing m/c and its suitability, Different sewing m/c driving system. Attachment of sewing m/c, Sewing needle and its sizes.

Sewing stitches and seams types: Stitch formation, types of stitches, seam classification, seam geometry seam strength and slippage, seam puckering. Thread calculation and its consumption

Trimming and Garment accessories: Definition, types, trimming methodologies and accessories application.

Garment finishing: Fasteners, thread tucking, care and size labeling system, checking, pressing, folding and packing, packing standards for domestic and export markets.

Quality Control in Garment manufacturing: Control in pattern making, grading, fabric laying, marking, sewing and finishing, control of garment defects.

Computer Application in Garment Manufacturing: Application in pattern making, grading, lay planning, sewing and finishing, computer aided embroidery designs. Concepts of computer integrated manufacturing (CIM) to the garment industry.

Books Recommended:

1. Carr H and Lantham B, "The Technology of Clothing Manufacture", Om Book Service, Delhi.
2. Mehta P V and Bhardwaj S K, "Managing Quality in apparel industry", Om Book Service, New Delhi
3. Aldrich W, "Metric Pattern Cutting", OM Book Service, New Delhi, 1998.
4. Cooklin Gerry, "Garment Technology for Fashion Designers", OM Book Service, New Delhi, 1997.
5. Eveleyn M and Ucas, "Clothing Construction", 2nd Edition Hughton Mifflin Co, Boston 1974.

TT 421 Textile Structural Composites

Introduction to fibres for high performance composites. Different fibre architectures used for composites and their characteristics and properties. Influence of fibre architectures on the properties of composites. Unidirectional, planar, 3D and net-shaped performing. Introduction to matrix types and their properties. Polymeric matrices for rigid and flexible composites. Reinforcing materials and the effect of their geometry on the properties of composites. The fibre-matrix interface; role of coupling agents. Mechanism of stress transfer. Toughness and thermal behaviour of composites. Various techniques of composites design and fabrication. Composites for structural engineering, electrical, civil, aerospace, defense, automobile, sporting goods and other applications. Design and analysis of textile structural composites.

Books Recommended:

1. Reinhart T J, "Introduction to Composites", in Engineering Materials Handbook, Vol. 1, Composites, ASM International, 1993.
2. Chau T, and Ko F K, eds., "Textile Structural Composites", Elsevier, 1989.
3. Russell Diefendorf, "Carbon/Graphite Fibers", in Engineering Materials Handbook, Vol. 1, Composites, ASM International, 1993.
4. Adanaur S, "Textile Structural Composites", in Handbbook of Industrial Textiles. ed. S Adanaur, Technomic Publishing Co., USA, 231-274.

TT 422 Advanced Fabric Manufacturing

Preparation of Yarn For shuttleless weaving : Winding, warping, sizing and weft preparation.

Problems of shuttle loom: Maximum speed of shuttle loom, design problem of shuttle loom, basic concept of increasing the weft insertion rate in weaving machine.

Projectile Weaving Machine: Basic principle of projectile loom, sequence of weft insertion, cam drive shedding mechanism, beat-up, torsion bar picking, loom timing, checking of gripper, let-off and take-up motion, selvedge formation.

Air jet weaving machine: Problem in air jet weft insertion. Sequence of weft insertion in air jet loom. Design of confuser guide, design of profile reed and relay jet. Loom timing.

Water-jet Weaving machine: Weft insertion mechanism, quality of warp required for water jet, selvedge formation, environmental problem, quality of water, problem of water-jet loom.

Rapier Weaving Machine: Different types of rapier weaving machines, weft insertion sequence in rapier weaving process. Different methods to drive the rapier head. Single phase double acting rapier. Velocity of the rapier. Loom timing.

Multi phase Weaving Machine: Basic concept of multiphase weaving. shedding operation in warp way and weft way multiphase loom. Advantages and disadvantages of multiphase weaving process, circular loom, yarn path and weft insertion in circular loom.

Narrow Fabric Loom: Different type of narrow fabrics. Mechanism of weft insertion and fabric formation in narrow fabric weaving machine.

Carpet Weaving: Woven carpet, design and process of manufacturing Wilton and Brussel carpets technical specifications and its uses.

Non Woven Technology: Fibres for nonwoven, non woven fabric and its classification, reason for development, web making (Parallel, transverse, cross and random laid web). Elementary idea about manufacturing of adhesive bonded and needle punch fabrics.

Multi Axial Warp knitted Fabric: Fabric Structure, Properties and end uses

Books Recommended:

1. Marks R and Robinsons A T C, "Principles of weaving", Textile Institute, UK, 1986.
2. Lord P R and Mohamad M H, "Weaving: Conversion of Yarn to Fabric", Merrow Technical Library, UK, 1988.
3. Ormerod A, "Modern preparations and weaving machinery", Butterworth and co., UK, 1983.
4. Talavasek O and Svaty V, "Shuttleless weaving machine", Elsevier Scientific Publishing Co., Amsterdam, 1981.
5. Lunenschloss J and Albrecht W, "Non-Woven Bonded Fabric", Ellis and Horwood Ltd., UK, 1985

TT 423 Waste Management and Pollution Control in Textile Industry

Spinning waste: Its generation, classification, its re-use and management. Soft waste, hard waste. Different types of pollution in spinning industry.

Weaving waste: Its generation, different types, its re-use and management. Different types of pollution in weaving industry. Its impact on human being.

Textile waste water characteristics: Chemical nature of discharged bath after each process, contribution of chemicals to the waste water load. Concept of biological and chemical oxygen demand.

Textile waste water problem: Effect of waste-water on sewage and land.

Chemical used in textile industry: Toxicity of various chemicals, viz alkalis, oxidizing and reducing agents, acids, carriers, resins and bleaching agents etc. Role of each chemical on waste water load.

Treatment of textile effluents: Primary, secondary and tertiary treatments in ETP. Colour removal, various chemicals used in ETP.

Effluent Testing: Testing of BOD, COD, TOC and interforetalion of results.

Books Recommended:

1. Asolekar S, "Environmental problems in chemical processing of textiles" 1st Ed. NCUTE, Department of Textile Technology, IIT-Delhi, 2000.
2. Padma Vankar, "Textile Effluents" 1st Ed. NCUTE, Department of Textile Technology, IIT-Delhi, 2002.
3. Edmund B, "The Treatment of Industrial Wastes" 2nd Ed. McGraw-Hill kogaskusha, New Delhi, 1976
4. Peavy, Rowe and Tchobanoglous, "Environmental Engineering" 2nd Ed. McGraw-Hill, Singapore, 1985.
5. Vaidya A A, "Production of Synthetic fibres", Prentice-Hall India Ltd, New Delhi, 1988.

TT 424 Textiles and Fashion Designing

Introduction to textiles: Natural and synthetic Fibers – Classification, Physical and chemical properties, uses.

Yarn: Types of yarns, Quality parameter of yarns and uses.

Fabric: Types of fabric, fabric design, comforts properties of fabric and uses.

Fashion: Introduction to fashion and apparel design. Origin of fashion, concept, analysis, trends and creations.

Fashion Theories: Fashion of different eras, French and Greek revolutions, fashion promotion, style-fad-trends.

Fashion Design fundamentals: Basic concept of fashion design, elements of art, Definition of line shape, form, size, space, texture and colour. Structural and decorative dress designing, creating varieties through designs.

Psychology of Clothes: First impression, role of socio- psychological and economical aspects. Meaning and application of clothing psychology.

Display of fashion materials: definition and importance, source technique and window display, classic fashion shows. Important fashion centers of the world and India.

Computer aided designing: Fashion sketching, color matching and computer graphics.

Folios: Creative, Dress designer.

Books Recommended

1. E.P.G Gohl, "Textile Science" CBS Publishers & Distributors, New Delhi , (India)
2. Bernard P. Corbman, " Textiles Fiber to Fabric" McGraw-Hill International Editions, singapore
3. Erwin Model, "*Clothing for Moderns*", Mac Millan Publications, New York (1994).
4. Tate and Sharon Lee, "*Inside fashion design*", Harper Publication Inc., UK (1976).
5. Mary Kefgen, "*Individuality in Clothing – Selection and Personal Appearance*", Mac Millan Publications, New York (1981).

6. Mikell P, Grover and E Mory, “*Computer Aided Design and Manufacturing*”, Prentice Hall of India
7. Mehta P V and Bhardwaj S K, “*Managing Quality in apparel industry*”, Om Book Service, New Delhi
8. Cooklin Gerry, “*Garment Technology for Fashion Designers*”, OM Book Service, New Delhi (1997).

TT 425 Apparel Marketing and Merchandising

Marketing: Domestic & International marketing, challenges for international marketing, Development of a product line, design, costing, developing a sample, specifications, market research, identification of markets, promotion mix, advertising, sale promotion, promotion budget, coordination between sales and production,

Merchandising: Export houses, star trading export houses, Outsourcing, Merchandise buying and handling process, Merchandise plans, determining merchandise sources, demand analysis, evaluating merchandise, merchandise forecasting and budgeting, planning inventory levels, development of relationship between the textile and retailing industry, setting up the dealers and merchandisers

Books Recommended:

1. Kotler Philip, “Marketing Management”, Prentice Hall of India, Delhi, 9th Edition, 1998.
2. Bheda R, “Managing Productivity in the apparel Industry”, Communications, New Delhi, 2000.
3. Cooklin G, “Introduction to Clothing Manufacture”, Om book service, New Delhi, 2002.
4. Mehta P V & Bhardwaj S K, “Managing Quality”, New Age International, New Delhi, 2001.
5. Rosenau J A & Wilson D L, “Apparel Merchandising”, Amazon, USA, 2001.

TT 426 Mill Management and Maintenance

Location and Layout: Plant location and site selection, Factors affecting location, Plant layout, Different types of layouts, Layout plan for spinning, weaving and process house.

Air conditioning and humidification: Humidification systems used in Textile Mills, Developments in humidification systems, Heat load, Calculations of total heat, air circulation required.

Machine Balancing: Calculation for different machines required for carded and combed yarns, weaving, preparatory and chemical processing.

Costing: Elements of cost, Cost sheet, Costing the products, conversion cost, cost reduction techniques, impact of end breaks in ring spinning on productivity and cost.

Power consumption: Energy consumption in textile machines, Measures to reduce power consumption.

Working environment: Measures of good working environment, Different types of noise and remedial measures to minimize noise of different departments, terms related to lighting, illumination level required for different departments, lighting plan for different departments, Material handling equipments, Classification of material handling equipments, work load, work assignment, Calculation for work assignment, effect of end breaks on work assignment.

Maintenance Management: Maintenance systems, Maintenance cost, Maintenance schedules, Maintenance scheduling, Down time management, Down time analysis, Accidents and safety engineering, Fire prevention and protection.

Books Recommended:

1. Dudeja V D, "Management of Textile Industry", Textile Trade Press, Ahmedabad, 1981.
2. Ormerod A, "Textile Project Management", The Textile Institute, Manchester UK, 1992.
3. Talukdar M K, Sriramulu P K and Ajgaokar D B, "Weaving – Machine, Mechanism and Management", Mahajan Publisher Private Ltd., Ahmedabad, India, 1998.
4. Garde A R and Subramanian T A, "Process Control in Spinning", ATIRA Ahmedabad, 3rd edition, 1987.
5. Higgins, "Handbook of Maintenance Management", Prentice Hall New York, 1999.

TT427 Project Formulation and Appraisal

Project Planning – Capital expenditure, phases of capital budgeting, generation and screening of project ideas, project rating index, resource allocation framework.

Project Analysis - Feasibility study, product life cycle, market analysis, market planning, market survey and characterisation of markets, demand analysis, demand forecasting, technical analysis, project charts and layouts.

Financial analysis – Time value of money and cost of capital, Cost of project, sources of finance, projected financial statements, working capital requirement, estimate of sale and production, cost of production, cash flow.

Appraisal criteria – net present value, benefit cost ratio, internal rate of return, payback period, analysis of risk and social cost benefit analysis.

Project implementation - Network techniques, PERT, CPM. Project Review and Administration.

Books Recommended:

1. Jain S P, Narang K L and Dhingra T R, "Cost Accounting", 6th Ed., Kalyani publishers, N Delhi, 2000.
2. Kerzner H, "Project Management" 1st Ed., CBS Publishers and distributors, Delhi, 1987.
3. Prasana C, "Projects- Planning, Analysis, Selection, Implementation and Review", 6th Ed., Tata Mc Grawhill Publishing Co. Ltd., N. Delhi, 1996.
4. Ormerod A, "Textile Project Management", The Textile Institute, Manchester UK, 1992.

TT 428 Advancement in Textile Testing and Statistical Analysis

Innovations in yarn testing instruments (dynamic, continuous and on-line testing of yarn quality) and fabric testing. Standard tests, analysis of data and test reports such as HVI, AFIS, Classimat, Colour matching. Analysis of KES and FAST data.

Testing of Garments: Tests related to garment appearance and performance such as measurement of seam pucker, seams slippage, seam strength and buffer strength etc.

Testing of Technical Textiles: Testing of filtration characteristics, test for geotextiles, test for protective clothing, test of various form of medical textiles, moisture transmission through breathable fabrics, Special tests for carpets and nonwoven fabrics.

Statistical Techniques: Concept of reproducibility and repeatability, Significant testing of means and variance. Quality control charts and their interpretation. Textile product leveling. International quality parameters and standards like Uster standards, AITCC, JIS and ASTM.

Books Recommended:

1. Saville B P, "Physical Testing of Textiles", Woodhead Publishing Ltd, Cambridge, 2002.
2. Booth J E, "Principles of Textile Testing", CBS Publishers and Distributors, New Delhi, 1999.
3. Angappan P & Gopalakrishnan R, "Textile Testing", SSM Institute of Textile Technology, Komarapalayam, 2002.
4. Basu A, "Textile Testing", SITRA Coimbatore, 2002.
5. V. K. Kothari, Ed., "Testing and Quality Management", IAFL Publications, New Delhi, 1999.

TT 429 Textile Process Simulation

Introduction: Understanding process simulation and its usefulness in textile processes.

Simulation techniques: Different simulation techniques, mathematical simulation with examples, concept of fuzzy model, artificial neural network, expert system, Combination of different systems, comparison of different techniques.

Process simulation in yarn manufacturing: Simulation of cotton mixing and fibre blending, carding process, drafting, yarn formation, package building, balloon theory.

Process simulation in fabric manufacturing: Application of different simulation techniques during weaving and knitting process, monitoring of online process performance.

Simulation of properties: Simulation of yarn tensile and bending properties, fabric low stress characteristics, fabric ultimate properties.

Books Recommended:

1. "Computers in the World of Textiles", Paper presented at the Annual World Conference, Hong Kong, September 26 – 29, 1984.
2. Textile Research Journal, Princeton, USA and Journal of Textile Institute, Manchester, UK.
3. Hearle J W S, Thwaites J J and Amirbayat, "Mechanics of Flexible Fibre Assemblies", Sijthff and Noordhoff International Publishers BV, Alphen aan den Rijn, Netherlands 1980.
4. Haykin S, "Neural Networks: A comprehensive Foundation", MacMillan, New York, 1994.
5. Fausett L, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Prentice Hall International, New York, 1994.

TT 430 Product Design

Introduction, Characteristics of successful product design, Product development process tools, Understanding customer needs, Establishing product function and product specification, Concept generation, Concept selection, Concept testing, Product architecture.

Design for manufacturing, Analytical and Numerical model solutions, Physical models and experimentation Product design economics.

Book Recommended:

1. Otto Kevin, & Wood Kristin, Product Design Techniques in Reverse Engineering and New product Development Pearson Education publication, 1st Ed, 2006.
2. Ulrich K T, Product Design and Development, TMG, 3rd Ed, 2004.

TT 431 Colour and Design

Concepts and specifications of colour, light and colour phenomenon, Additive and Subtractive combinations, colour theories as light theory, pigment/ Brewster colour, theory, Colour wheel-primary, secondary, sub-secondary and tertiary colours, Rainbow colours, Colour combination techniques in fabric and garments. Psychological effects of colours, Warm and cool colours. Colour harmony. Colour contrast in fabric and garments. Application of colour combination and harmony in designing of clothing/ fabric. Modification of colours as formation of tint, shades & coloured grays etc. Colour intensity charts. Outlines for the movement of colours in fashion with the factors affecting the choice of colour. DESIGN- Elements of design as line, dot, print etc, type of lines and their application in designing. Types of dots as polka dot etc.

Composition of designs- by Geometric ornamentation by the conventional treatment of natural and artificial forms and by the adoption reproduction of earlier designs. Geometric ornamentation. Construction of symmetrical figures, Reversing inclined figures.

Arrangement of figures – unit repeating design, the drop device, drops reverse designs, sateen system of distribution (with reference to half drop) diamond base, ogee base, rectangular base lines). Construction of designs from incomplete repeat.

Border designing- Study of pattern – historical precedents. Symmetry- principle concepts, perspectives and its application, classification of motifs, border patterns, all over patterns, Counterchange motifs, border patterns and all over patterns.

TT 432 Technical Textiles

Introduction: Definition and scope for technical textiles, brief idea about technical fibres, role of yarn and fabric construction, composite material.

Filtration textiles: Definition of filtration parameters, theory of dust collection and solid liquid separation, filtration requirements, concept of pore size and particle size, role of fiber, fabric construction and finishing treatments.

Geotextiles: Brief idea about geosynthetics and their uses, essential properties of geotextiles, geotextile testing and evaluation, application examples of geotextiles.

Medical textiles: Classification of medical textiles, description of different medical textiles.

Protective Clothing: Brief idea about different type of protective clothing, functional requirement of textiles in defence including ballistic protection materials and parachute cloth, temperature and flame retardant clothing, chemical protective clothing, water proof breathable fabrics.

Sports and recreation textiles: Functional requirement of different type of product and their construction.

Automotive Textiles: Application of textiles in automobiles, requirement and design for different tyres, airbags and belts, methods of production and properties of textiles used in these applications.

Sewing threads, cords and ropes: Types, method of production and applications, functional requirements, structure and properties.

Other uses of technical textile: Functional requirements and types of textiles used for paper making, agricultural, electronics, power transmission belting, hoses, canvas covers and tarpaulins.

Books Recommended:

1. "Handbook of Technical Textiles", Ed. A R Horrocks and S C Anand, Woodhead Publication Ltd., Cambridge, 2000.
2. "Wellington Sears Handbook of Industrial Textiles", Ed. Sabit Adanaur, Technimic Publishing Company, Inc., Pennsylvania, USA, 1995.
3. "Engineering with Geosynthetics", Ed. G V Rao and G V S Raju, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.
4. "Industrial Textile", Ed., J Svedova, Elsevier, New York, 1990.
5. "Modern Textile Characterization Methods", Ed. M Raheel, Marcel Dekker, Inc., 1996.
6. Mukhopadhyay S K and Partridge J F, "Automotive Textiles", Vol. 29, No. ½, The Textile Institute, 1999.
7. 'Sewing Threads' (Textile Progress, Vol. 30, No. 3/4, 2000) J. O. Ukponmwan, A. Mukhopadhyay & K. N. Chatterjee, Textile Institute, Manchester, UK, ISBN 1 870372 38 7.

TT 433 Advances in Yarn Manufacturing

Introduction: Fibre characteristics requirements for different leading spinning technologies. Possibilities and limitations of different spinning technologies.

Rotor Spinning: Principle and raw material preparation. Specifications of different organs and effect of each on the process and product quality. New developments

Air-jet Spinning: Principle and raw material preparation. Process and machine parameters affecting product quality. Principle of vortex yarn manufacture. Difference between air jet spun and vortex spun yarn structure.

Friction Spinning: Principle and raw material preparation, process and machine parameters affecting product quality. Assessment of DREF-II and DREF-III yarn structures and properties. **Compact Spinning:** Principle and raw material preparation. Comparative assessment of the structure and performance with respect to ring yarn.

Tow conversion: Principles of different converters.

Other Spinning system: Self twist, twistless, warp spinning, Electrostatic spinning, Core-spinning, Siro spinning, Bobtex yarn manufacture, solo spun yarn manufacture. New Developments.

Texturing: Basic principles of textured yarn manufacture.

Books Recommended:

1. Salhotra K R and Ishtiaque S M, Rotor Spinning : Its advantages, limitations and prospects in India, 1st Ed; National Information Centre for Textile and Allied Subjects, 1995.
2. Klein W, Manual of Textile Technology: New Spinning Systems, 1st Ed; The Textile Institute, Manchester, UK 1993.
3. Lawrence C A, Fundamentals of Spun Yarn Technology, 1st Ed; CRC Press LLC, Florida, USA (2003)
4. Chattopadhyay R and Ishtiaque S M, Advances in Yarn Manufacturing Process, Department of Textile Technology, IIT Delhi 1991.
5. Hearle J W S, Hollick L and Wilson D K, “ Yarn Texturing Technology”, Woodhead Publishing Ltd., UK, 2002.

TT 434 Woollen Technology

Wool fibre and its properties: Morphological structure, components of fibre, fibre diameter, fibre contour, crimp, length, luster, specific gravity and refractive index, moisture relations, wet ability, fibre mechanical properties, gross composition of raw wool, molecular structures.

Manufacturing wastes: Noils, soft wastes, hard wastes, finishing wastes, recovered wools, method of recovery, rag picking and garneting.

Wool blends with manmade fibres: Purpose of blending, effect of blend composition on performance of fabrics.

Woolen or carded Yarns: Preliminary processes, blending or mixing, oiling of the stock, woolen carding, woolen spinning, yarn number and wool grade.

Worsted top making and spinning of worsted yarn: Worsted carding, backwashing, oiling, gilling or preparing, worsted combing, tow-to-top conversion systems, worsted drawing, worsted yarn spinning, norms and modern developments.

Manufacture of woolen fabrics: Woven Fabrics produced by projectile and rapier weaving machines, knitted and nonwoven woolen fabrics, use of FAST in worsted garment manufacturing.

Chemical Processing: Objects and different methods of carbonizing of wool batch and continuous methods of scouring fibre, yarn and fabric; peroxide and per-acetic acid bleach of wool; production of anti-shrink wool, basic principle of treatment and parameters; dyeing, printing and finishing, testing and quality control of woollen processing.

Wool Dyeing: Chemistry of dyeing wool and blend with acid, mordant, metal-complex and reactive dyes, Top and tip dyeing of wool.

Wool Finishing: Scooping, damping, decatizing and paper pressing of wool, Testing and Quality Control.

Books Recommended:

1. Blended Textiles, Textile Association (India), 1981.
2. Lepenkov Y, “Wool Spinning”, Vol. 1 and 2, 1st Ed. Mir Publisher, Moscow, 1983.
3. Bergen W V, “Wool Handbook,” vol.1 and 2, 3rd Ed., Interscience publisher, London.
4. Teasdale D C, “The Wool Handbook”, 4th Ed., 1996.
5. Trotman E R, “Dyeing and Chemical Technology of Textile Fibres”, Charles Griffin and Co. Ltd., London, 1975

Open Electives

TT 336 Polymer and Fibre Science

Introduction: Introduction about polymer. Differences between low molecular weight material and high molecular weight material. Specific features of high molecular weight materials.

Classification of polymers: Homopolymer and copolymer. Classification based on structure and methods of polymerization. Molecular weight and molecular weight distribution. Number and weight average molecular weight. Polydispersity and its significance.

Polymerisation: Different mechanisms of polymerisation. Basic concept of step and chain growth polymerisation with special reference to polyester, polyamide, acrylic, and polypropylene. Kinetics of polymerisation. Prediction of gel point. Different methods of polymerization. Basic concept of bulk, solution, suspension and emulsion polymerisation.

Structure of polymers: Specific features of polymer structure, i.e., regularity and irregularity, molecular weight and size. Configuration and conformation of molecules. Determination of molecular weight and effect of molecular weight on the structure and properties of polymer. Basic concept of methods of investigation of polymer structure, e.g., x-ray, electron microscopy.

Concept of rubbery state and rubber elasticity. Transition from glassy to rubbery state. Melting of polymers. Factors influencing T_g and T_m of polymers. Practical importance of phases and aggregation of states of polymers.

Structure property relation in polymer: Deformation in glassy and crystalline polymers. Basic concept of strength and durability. Factors affecting strength of polymers. Mechanism of polymer fracture. Concept of relaxation in polymers. Effect of relaxation process on the strength of polymers. Effect of fillers, cross-links etc on mechanical property.

Books Recommended:

1. Billmeyer W, "Textbook of Polymer Science", John Wiley and Sons, New York, 1994.
2. Tager A, "Physical Chemistry of Polymers", Mir Publishers, Moscow, 1978.
3. Gowariker V. R, Viswanathan N.V and Sridhar J, "Polymer Science", New Age International Ltd. Publishers, New Delhi, 1996.
4. Hearle JWS, "Polymers and their properties", Vol. I, John Wiley and Sons, NY, 1982.
5. Gedde U W, "Polymer Physics", Chapman Hall, London, 1995.

TT 337 Properties of polymer and fibers

Fiber structure: Traditional view of fibre structure. Chemical structure and physical structure. Degree of order and degree of orientation.

Structure investigation: Methods of investigation of fibre structure. Identification of chemical structure by IR spectroscopy. Identification of physical structure by X-ray, SEM, NMR.

Moisture absorption: Definitions of humidity, moisture regain and moisture content. Relation between regain and relative humidity. Effect of stress and temperature on regain. Heat of sorption. Swelling of fibres. Quantitative theory of moisture absorption.

Tensile properties: Factors influencing results of tensile experiment. Expressing results. Different experimental methods. Effect of variability. Elastic recovery. Effect of test conditions on recovery. Cyclic testing. Fibre fracture and fatigue. Time effect. Creep and stress relaxation. Introduction to dynamic testing and fatigue. Concept of models. Kelvin and Maxwell model. Bending and torsional rigidity of fibre. Structural effect on extension behaviour.

Dielectric properties: Definition and effect of different parameters on dielectric properties. Electric resistance and effect of different factors on the electrical resistance of fibres.

Static electricity: Introduction and significance. Measurement of static electricity. Explanation of static phenomena.

Optical properties: Refractive index and birefringence. Birefringence and orientation of fiber. Reflection and lustre.

Thermal properties: Structural changes on heating. Thermal transitions. Concept Heat setting of fibres.

Fibre friction: Technological importance. Measurement of friction. Effect of load and area of contact. Static and kinetic friction. General theory of friction and application to fiber.

Books Recommended:

6. Meredith R, "The Mechanical Properties of Textile Fibres", North Holland Publishing Co; Amsterdam 1959.
7. Morton W E and Hearle J W S, "Physical Properties of Textile Fibres", 1st reprint, The Textile Institute, Manchester, 1986.
8. Gupta V B and Kothari V K, "Manufactured Fibre Technology", 1st Ed., Chapman and Hall, London, 1997.
9. Hearle JWS, "Polymers and their properties", Vol. I, John Wiley and Sons, NY, 1982.
10. Gedde U W, "Polymer Physics", Chapman Hall, London, 1995.

TT 338 Textile Machines and processes

Introduction: Different textile product, product specifications and their quality parameters, classification of different textile industries, basic concept of textile fiber, filament, yarn and fabric, flow of material from raw material to the finished product.

Textile machine for fiber spinning: Concept of fibre spinning, machines involved in fibre production.

Yarn manufacturing: Machines for opening and cleaning, drafting stages, twisting and winding, package formation.

Fabric manufacturing: Mechanics of weaving process, weaving machineries, development of machines, basic concept of knitting process and machines, classification of nonwoven fabric, method of manufacturing of nonwoven fabric, development of nonwoven machines.

Dying, printing and finishing: Basic concept of dyeing, printing and finishing, machineries involved in the above process.

Books Recommended:

1. Gohl E P G and Valensky, "Textile Science", CBS Publishers, Delhi, 1983.
5. Klein W, "Manual of Textile Technology" Vol. I - V, 1st Ed., The Textile Institute, Manchester, 1995.
6. Talukdar M K, Srirammulu P K and Ajaokar D B, "Weaving – Machine, Mechanism and Management", Mahajan Publisher Private Ltd., Ahmedabad, India, 1998.

4. Spencer D J, "Knitting Technology" 2nd edition, Pergamon Press, 1989
5. Lunenschloss J and Albrecht W, "Nonwoven Bonded Fabric", Ellis and Horwood Ltd., UK, 1985.

TT 339 Textile Design

Introduction: Different types of yarn such as spun, filament, textured and fancy yarns and their impact on textile design. Concept of fabric designing through fabric structure and textile printing. Fabric cover and crimp, importance of fabric structure and analysis, detection of directions of warp and weft, classification of woven fabrics, method of fabric presentation, weaving plans.

Basic Weaves: Method of construction, features and uses of plain weave and its derivatives, twill weave and its derivatives, Satin and sateen weaves and their derivatives.

Absorbent Fabrics: Method of preparation, features and uses of Diamond and Diaper Weaves, Honey comb weaves, Huck-a-back and Mockleno weaves.

Crepe Weave: Special feature, construction of the weave, method of preparation of its derivatives and uses.

Bedford Cord weaves: Method of construction, features, cross-sectional view, derivatives and uses.

Stripe and Check Weaves: Features, criteria for selection of weaves for combination, rules governing the joining of different weaves. Method of preparation and uses.

Colour and Weave Effect: Weave and colour combinations, features, method of preparation of Continuous line effect, Hounds tooth, Birds eye, Crows foot, Hair lines and Step pattern.

Terry Weaves: Definition, classification, process of formation of pile, graphical representation of terry weaves, loop sprouting, extra attachments.

Backed fabrics: Definition, features, classification and usage. Graphical representation, warp backed and weft backed cloth, reversible backed fabric, wadded backed fabric.

Double Cloth: Definition, features, classification and uses. Method of preparation of self stitched and centre stitched double cloths, their salient feature and uses. Wadded double cloth.

Calculations: Raw material calculations to produce different weaves. Technical specification of important fabrics.

Books Recommended:

1. Groscicki Z J, "Watsons Textile Design and Colour", Newnes Buttersworth, 1988.
2. Groscicki Z J, "Watsons Advanced Textile Design", Newnes Buttersworth, 1989.
3. Klibbe J W, "Structural Fabric Design", Revised edition, 1965, North Carolina State University.
4. Nisbeth H, "Grammar of Textile Design", 3rd edition, D B Tarapore Wala sons and Co., 1994.
5. Gokarneshan N, "Fabric Structure and Design", New Age International, New Delhi, 2004

TT 340 Fashion and Textiles

Fashion:-Introduction to fashion and apparel design, Origin of fashion, Definition, Terminology, Fashion concepts, Fashion analysis, Fashion trends, Fashion creations. Fashion

theories:- Fashion of different eras, French revolution. Fashion promotion:- From design to production. Style, Fad, Trends, Fashion industry. Design, Definition, Structural, decorative, Dress designing and creating varieties, Through designs. Principals of design, Definition, Harmony, Proportion balance, Rhythm, Emphasis, Meaning, Types and application on apparel. Colour:- definition dimension of colour, Hue, Value, Intensity. Colour scheme:- importance, And application of colour in apparel. Psychology of clothing:- First impression, role of socio psychological and economical aspects of clothing. Comfort of the apparel. Textiles:- Historical development of textile fibres. Classification of fibres, definition & general properties. Natural fibres- cellulose, cotton, Wool and silk, Minor fibres, Mineral fibres. Physical and chemical properties. Man- made and synthetic fibres, Rayon, Nylon, Polyester, Acrylic fibres, Physical and chemical properties. Identification of fibres. Yarn:- Yarn properties, yarn count, , Yarn twist, yarn types single , plied and cord yarn, Sewing thread, Complex Yarns:- Novelty Yarns, Textured Yarns and metallic Yarns. Fabric :- characteristics, Types, weaves- plain, Twill, Satin and variations. Fancy weaves:- dobby, jacquard, Leno, Lappet, swiss, double cloth. Knitting:- circular, Tubular, Jersey. Non wovens:- films, foams, felting, braiding, bonding and laminating.

Recommended Books

1. Erwin Mabel (1994):- Clothing for Moderns, Macmillan Co. London.
2. Tate (1977) Sharon lee:- “Inside Fashion Design” Farnisco Canfield Press.
3. Bhattacharya Anand:- “Garment Technology” NCUTE, IIT, Delhi(2003).
4. Cooklin Gerry:- “Garment technology for fashion designers” OM Book service, New Delhi.
5. Bernard P. Corbman :- “Textile- Fiber to Fabric” McGraw –Hill international editions.
6. E P G Gohl and Vilensky :- “Textile Science” CBS Publishers& Distributors, New Delhi

TT 341 Fashion Designing

Fashion: Introduction to fashion and apparel design. Origin of fashion, concept, analysis, trends and creations.

Fashion Theories: Fashion of different eras, French and Greek revolutions, fashion promotion, style-fad-trends.

Fashion Design fundamentals: Basic concept of design, elements of art, Definition of line shape, form, size, space, texture and colour. Structural and decorative dress designing, creating varieties through designs.

Principles of Design: Definition Harmony, Proportion, Balance, Rhythm, Emphasis, meaning types and application on apparel psychology of clothing.

Anatomy for designers: Human Proportion and figure construction. Methods of determining individual proportions.

Psychology of Clothes: First impression, role of socio- psychological and economical aspects.

Display of fashion materials: definition and importance, source technique and window display, classic fashion shows. Important fashion centers of the world and India.

Computer aided designing: Fashion sketching, colour matching and computer graphics.

Folios: Creative, Dress, designer.

Books Recommended:

1. Erwin Model, "Clothing for Moderns", Mac Millan Publications, New York, 1994.
2. Tate and Sharon Lee, "Inside fashion design", Harper Publication Inc., UK, 1976.
3. Mary Kefgen, "Individuality in Clothing – Selection and Personal Appearance", Mac Millan Publications, New York, 1981.
4. Mikell P, Grover and E Mory, "Computer Aided Design and Manufacturing", Prentice Hall of India Ltd. Delhi, 1993.
5. Bhattacharya Anand, "Garment Technology", NCUTE, IIT, Delhi, 2003.

TT 342 Geotextiles

Usefulness of geotextiles, Understanding soil characteristics, properties affecting engineering behaviour of soil, identification, classifications, permeability, effective stress and pore water pressure, seepage of soils and design of filter criteria.

Geosynthetics types, functions and application areas of geotextiles, fibres and fabric selection criteria for geotextile applications. Mechanics of reinforcement, filtration and drainage by geotextiles and functions, material construction and manufacturing processes in case of geotextiles, evaluation of geotextiles with and without soil, evaluation of filtration and drainage functions, reinforcement, creep, moisture barrier characteristics, durability and ageing.

Geotextiles and reinforced soil structures: Retaining walls, embankment, foundation. Geotextiles in roads and railways: separation, draining and filtering. Geotextiles in environmental control: covers and liners, landslides, and erosion control.

Books Recommended:

- 1 "Handbook of Technical Textiles", Ed. A R Horrocks and S C Anand, Woodhead Publication Ltd., Cambridge, 2000.
2. "Wellington Sears Handbook of Industrial Textiles", Ed. Sabit Adanaur, Technimic Publishing Company, Inc., Pennsylvania, USA, 1995.
3. "Engineering with Geosynthetics", Ed. G V Rao and G V S Raju, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.
4. John N W M, "Geotextiles", Blakie, Chapman and Hall, New York, USA, 1987.

TT 436 Design of Experiments

General introduction about various statistical tools and their usefulness. Objectives and principles of experimental design. Experimental design terminology. Increasing accuracy of experiments. Completely randomized designs. Blocking designs. Latin square designs.

Analysis of variance (ANOVA). Correlation and regression. Principles of experimental design. Typical application of experimental design. Simple comparative experiments. Experiment with single factor, Introduction to factorial designs. Concept of fractional factorial design. Two level design. Three level design, Response surface designs. Central composite and Box-Behnken designs. Concept of Split-plot design.

Fitting regression models. Multiple regression and correlation analysis, Partial correlation. Test of significance and model lack of fit. Use of replicates. Orthogonal design and Taguchi Approach. Use of computers and software package.

Books Recommended:

1. Cochran W G and Cox G M, "Experimental Designs", Second Edition, John Wiley and Sons, Inc., New York, 1957.
2. Montgomery D C, "Design and Analysis of Experiments", Fifth Edition, John Wiley and Sons, Inc., New York, 2001.
3. Leaf G A V, "Practical Statistics for the Textile Industry", (Part-I and II), The Textile Institute, UK, 1984.
4. Khuri, A. I., and Cornell, J. A., *Response Surfaces: Design and Analyses*, Marcel Dekker, New York, NY, 1987.
5. Diamond William J., Practical Experiment Designs, first Indian Edition, CBS Publishers and Distributors, New Delhi, 1987.
6. Motogomery D C, Peck E A, Vinning G G, "Introduction to Linear Regression Analysis", Third Edition, John Willey and Sons., Inc., 2004.

TT 437 Application of nanotechnology on polymers and fibres

Introduction and Definition of Nanotechnology. Knowing the Size. Understanding Nanotechnology. Nanotechnology and Today's World. Importance of Nanoscale Science and Technology. Contribution of Different Scientist in Nanotechnology. Nanotechnology in Different Fields. Use of Nanotechnology in the field of Fibres and polymers. Latest Development in Nanotechnology

Books Recommended:

1. Nanotechnology: Science, Innovation, and Opportunity by Lynn E. Foster. Publisher: Prentice Hall Professional Technical Reference December 2005.
2. Nanotechnology: A Gentle Introduction to the Next Big Idea by Mark Ratner, Daniel Ratner. Prentice Hall Professional Technical Reference. 2002
3. Nanocomposite Science And Technology by Braun Paul V. Wiley-VCH.

TT 438 Environmental Science and Management

The Environment: Its definition, the impact of human beings upon the environment, biosphere, hydrologic cycle, nutrient cycle. Improvement of environment quality, role of environmental engineer. Environment laws

Environment pollution: Different types of pollution:-Water, air, soil, noise, odours etc.

Air pollution: Definition and concentrations, classification and properties of air pollutants, emission sources, effect of air pollution ,air pollution laws and standards, pollution analysis and measurement ,its control methods and management.

Water pollution: Definition, types of water pollution and their effects, waste water sampling and analysis, water quality standards, waste water treatment and management.

Solid waste management: Definition, sources and classification, different methods of collection, disposal methods and its management.

Noise pollution: Definition, sources and classification, its impact, its analysis and management.

Soil pollution: Definition, sources and classification, its impact its analysis and management.

Odour pollution: Definition sources and classification, its impact, its analysis and management.

Books Recommended:

1. Peavy, Rowe and Tchobanoglous, "Environmental Engineering", 2nd Ed. McGraw-Hill, Singapore, 1985.
2. Khoppar S M, "Environmental Pollution Analysis", 2nd Ed. New Age International, New Delhi, 1993.
3. Gilbert, "Introduction to Environmental Engineering and Science", 1st Ed., Prentice Hall of India, New Delhi, 1995.
4. Rao MN, "Environmental Engineering", 2nd Ed., Tata McGraw-Hill, New Delhi, 1993.
5. Puneet Mohan, "Environmental Studies", 1st Ed., Sun India Publications, New Delhi, 2004.

TT 439 Industrial Textiles

Introduction: Classification and growth of industrial textiles, brief idea about technical fibres, role of yarn and fabric construction, composite material.

Geotextiles: Usefulness of geotextiles, Understanding soil characteristics, properties affecting engineering behaviour of soil, identification, classifications, permeability, effective stress and pore water pressure, seepage of soils and design of filter criteria.

Geosynthetics types, functions and application areas of geotextiles, fibres and fabric selection criteria for geotextile applications. Mechanics of reinforcement, filtration and drainage by geotextiles and functions, material construction and manufacturing processes in case of geotextiles, evaluation of geotextiles with and without soil, evaluation of filtration and drainage functions, reinforcement, creep, moisture barrier characteristics, durability and ageing.

Geotextiles and reinforced soil structures: Retaining walls, embankment, foundation. Geotextiles in roads and railways: separation, draining and filtering. Geotextiles in environmental control: covers and liners, landslides, and erosion control.

Filtration textiles: Definition of filtration parameters, Dust collection and solid liquid separation, filtration requirements, concept of pore size and particle size, role of fiber, fabric construction and finishing treatments.

Protective Clothing: Brief idea about different type of protective clothing, cut resistant fabric, functional requirement of textiles in defence including ballistic protection materials and parachute cloth, temperature and flame retardant clothing, chemical protective clothing, water proof breathable fabrics.

Automotive Textiles: Application of textiles in automobiles, requirement and design for different tyres, airbags and belts, methods of production and properties of textiles used in these applications.

Other uses of industrial textile: Cords and ropes, functional requirements and types of textiles used for paper making, agricultural, electronics, power transmission belting, hoses, canvas covers and tarpaulins.

Books Recommended:

1. "Handbook of Technical Textiles", Ed. A R Horrocks and S C Anand, Woodhead Publication Ltd., Cambridge, 2000.
2. "Wellington Sears Handbook of Industrial Textiles", Ed. Sabit Adanaur, Technimic Publishing Company, Inc., Pennsylvania, USA, 1995.
3. "Engineering with Geosynthetics", Ed. G V Rao and G V S Raju, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.
4. John N W M, "Geotextiles", Blakie, Chapman and Hall, New York, USA, 1987.
5. Mukhopadhyay S K and Partridge J F, "Automotive Textiles", Vol. 29, No. ½, The Textile Institute, 1999.

TT440 Marketing and Merchandising of Products

Marketing Management: Product development, Product life cycle, pricing, marketing channels and promotion Mix.

Marketing Research: Basic concepts, research process, identifying market segment, product research, Advertising Research.

Merchandising: Philosophy, Types of Merchandising, Buying and holding process, merchandise pricing, Framework of retailing, Factors affecting retail pricing, selection of manpower and job of executives, career in retailing..

Books Recommended:

1. Kotler P: "Marketing Management", 9th ed, Prentice Hall India New Delhi, 1998.
2. Barry Band Joel R.E. "Retail Management" Metmiiam Publishing Co., New York 1989
3. Ernest H R " Retail Merchandising" Macmillian Publishing Co., New York, 1991.