

Department of Textile Technology

Teaching and Evaluation Scheme and Course Content

(B Tech 3rd – 8th semester)



Dr B R AMBEDKAR
NATIONAL INSTITUTE OF TECHNOLOGY JALANDHAR – 144011
Year 2013

**DR B R AMBEDKAR NATIONAL INSTITUTE OF TECHNOLOGY,
JALANDHAR**

Department of Textile Technology
Teaching and Evaluation Scheme (3rd – 8th semester) - 2013

3rd Semester

S.No	CourseNo.	Subjects	Periods			Credits	Prerequisite/Remarks
			L	T	P		
1	TTX-201	Fundamentals of Textile Machines and Processes	3	0	0	3	
2	TTX-203	Natural Fibres	3	0	0	3	
3	TTX-205	Yarn Formation-I	3	1	0	4	Elements of Mechanical Engineering
4	TTX-207	Preparatory and Basic Fabric Formation	3	1	0	4	Elements of Mechanical Engineering
5	MAX-201	Mathematics	3	1	0	4	
6	MEX-213	Kinematics of Machines	3	1	0	4	
7	TTX-209	Textile Fibre Lab	0	0	2	1	
8	TTX-211	Yarn Formation Lab-I	0	0	2	1	
9	TTX-213	Fabric Formation Lab-I	0	0	2	1	
Total						25	

4th Semester

S.No	CourseNo.	Subjects	Periods			Credits	Prerequisite/Remarks
			L	T	P		
1	TTX-202	Man-made Fibres	3	0	0	3	
2	TTX-204	Unit Operation	3	1	0	4	
3	TTX-206	Yarn Formation- II	3	1	0	4	Yarn Formation-I
4	TTX-208	Fabric Formation Systems	3	1	0	4	Kinematics of Machines, Preparatory and Basic Fabric Formation
5	TTX-210	Preparatory and Coloration of Textiles	3	0	0	3	
6	MAX-204	Probability and Statistics	3	1	0	4	
7	TTX-212	Yarn Formation Lab-II	0	0	2	1	Yarn Formation Lab-I
8	TTX-214	Fabric Formation Lab-II	0	0	2	1	Fabric Formation Lab-I
9	TTX-216	Textile Chemical Processing Lab - I	0	0	3	2	
Total						26	

5th Semester

S.No	CourseNo.	Subjects	Periods			Credits	Prerequisite
			L	T	P		
1	TTX-301	Printing and Finishing	3	0	0	3	Chemistry, Natural Fibres, Man-made Fibres
2	TTX-304	Textile Testing	3	1	0	4	
3	TTX-305	Fundamentals of Knitting and Nonwoven Technology	3	0	0	3	
4	TTX -307	Fabric Structure and Design Analysis	3	0	0	3	
5	TTX-XXX	Departmental Elective-I	3	0	0	3	
6	HM-XXX*	Entrepreneurial Development and Management	3	0	0	3	
7	TTX-309	Textile Chemical Processing Lab – II	0	0	3	2	
8	TTX-311	Knitting Technology Lab	0	0	2	1	
9	TTX-308	Textile Testing Lab	0	0	2	1	
10	TTX-313	Fabric Structure and Design Analysis Lab	0	0	2	1	
Total						24	

* Subject from Humanities and Management

6th Semester

S.No	Course No.	Subjects	Periods			Credits	Prerequisite/Remarks
			L	T	P		
1	TTX-302	Properties of Fibres	3	0	0	3	Natural Fibres, Man-made Fibres
2	TTX 303	Process Control in Textiles	3	0	0	3	Yarn Formation, Preparatory and Basic Fabric Formation, Fabric Formation Systems, Preparatory and Coloration of Textiles
3	TTX-306	Garment Technology	3	0	0	3	
4	TTX-XXX	Departmental Elective-II	3	0	0	3	
5	TTX-XXX	Departmental Elective-III	3	0	0	3	
6	EC-XXX	Application of Electronics in Textiles	3	1	0	4	
7	TTX- 310	Garment Technology Lab	0	0	2	1	
8	EC-XXX	Application of Electronics in Textiles Lab	0	0	2	1	
9	TTX-314	Scientific Computation Lab	0	0	2	1	
10	TTX-312	Seminar*	0	0	2	1	
Total						23	

In addition to the above Industrial Practical Training of six weeks during summer vacation is compulsory.

7th Semester

S.No	CourseNo.	Subjects	Periods			Credits	Prerequisite
			L	T	P		
1	TTX 401	Theory of Textile Structure	3	1	0	4	Yarn formation, Preparatory and Basic Fabric Formation, Fabric Formation Systems
2	TTX-403	Statistical Quality Control in Textile	3	1	0	4	Probability and Statistics
3	TTX-XXX	Departmental Elective-IV	3	0	0	3	
4	TTX-XXX	Departmental Elective-V	3	0	0	3	
5	TTX-XXX	Departmental Elective-VI	3	0	0	3	
6	ID-XXX	Open Elective	3	0	0	3	
7	TTX 405	Industrial Practical Training				4*	
8	TTX 400	Project (Phase-I)	-	-	-	2	
Total						26	

*Industrial Practical Training will be held during summer vacation after 6th Semester.

8th Semester

S.No	CourseNo.	Subjects	Periods			Credits	Prerequisite
			L	T	P		
1	TTX-402	Technical textiles	3	0	0	3	
2	TTX- 404	Mechanics of Textile Processes	3	1	0	4	Yarn formation, Preparatory and Basic Fabric Formation, Fabric Formation Systems
3	TTX-XXX	Departmental Elective-VII	3	0	0	3	
4	HM-XXX	Human Resource Management and Industrial Relation	3	0	0	3	
5	ID-XXX	Open Elective	3	0	0	3	
6	TTX 400	Project (Phase-II)	-	-	-	4	
Total						20	

Total Credits: 144;

[Total credit including first year = 192].

Two open electives are retained in final year only.

Assuming total 48 credits for first year, credit distribution is as follows;

DE (%) = 21/192 = 11%; ID (%) = 6/192 = 3%; Departmental course = 114/192 = 59.4%

Departmental Core Courses

S. No.	NAME OF SUBJECTS	L-T-P-C	PREREQUISITE
1.	Fundamental of Textile Machine and Process	3-0-0-3	
2.	Natural Fibres	3-0-0-3	
3.	Yarn Formation-I	3-1-0-4	Elements of Mechanical Engineering
4.	Preparatory and Basic Fabric Formation	3 -0-1-4	-do-
5.	Man Made Fibres	3-1-0-3	
6.	Unit Operation	3-1-0-4	
7.	Yarn Formation-II	3-1-0-4	Yarn Formation-I
8.	Fabric Formation Systems	3 -1-0-4	Kinematics of Machine, Preparatory and Basic Fabric Formation Process
9.	Preparatory and Coloration of Textiles	3-0-0-3	Chemistry, Natural fibre, Man-made fibres
10.	Printing and Finishing	3-0-0-3	Preparatory and Colouration of Textiles
11.	Process Control in Textiles	3-0-0-3	Yarn Formation, Preparatory and Basic Fabric Formation, Fabric Formation System, Preparatory and Colouration of Textiles
12.	Fundamentals of Knitting and Nonwoven Technology	3-0-0-3	
13.	Fabric Structure and Design Analysis	3-0-0-3	
14.	Properties of Fibres	3-1-0-4	Natural and Man-made Fibres
15.	Textile Testing	3-1-0-4	
16.	Garment Technology	3-0-0-3	---
17.	Theory of Textile Structures	3-1-0-4	Yarn Formation, Preparatory and Basic Fabric Formation, Fabric Formation System
18.	Statistical Textile Quality control in textiles	3-1-0-4	Probability and Statistics
19.	Technical Textiles	3-0-0-3	
20.	Mechanics of Textile Process	3-1-0-4	Yarn formation, Basic fabric Formation Processes
21.	Textile Fibre Lab	0-0-2-1	-
22.	Yarn Formation Lab-I	0-0-2-1	-
23.	Fabric Formation Lab-I	0-0-2-1	-
24.	Yarn Formation Lab -II	0-0-2-1	Yarn Formation Lab - I
25.	Fabric Formation Lab -II	0-0-2-1	Fabric Formation Lab - I
26.	Textile Chemical Processing Lab-I	0-0-3-2	-
27.	Textile Chemical Processing Lab-II	0-0-3-2	Textile Chemical Processing Lab-I

28.	Knitting Technology Lab	0-0-2-1	-
29.	Fabric Structure and Design Analysis Lab	0-0-2-1	-
30.	Textile Testing Lab	0-0-2-1	-
31.	Garment Technology Lab	0-0-2-1	-
32.	Scientific Computation Lab	0-0-2-1	-
33.	Seminar	0-0-2-1	-
34.	Industrial Practical Training	0-0-8-4	-
35.	Project (Phase-I)	--2	-
36.	Project (Phase-II)	--- 4	-

Inter-disciplinary Core

NAME OF SUBJECTS	L-T-P-C
1. Mathematics	3-1-0-4
2. Kinematics of machines	3-1-0-4
3. Probability and Statistics	3-1-0-4
4. Entrepreneurial Development and Management	3-0-0-3
5. Application of Electronics in Textiles	3-1-0-4
6. Application of Electronics in Textiles Lab	0-0-2-1
7. Human Resource Management and Industrial Relation	3-0-0-3

Departmental Electives

Name of Subjects with Code

L-T-P-C

5th and 6th Semester

1. Characterization of Fibre and Polymers (TTX 321)	3-0-0-3
2. Post Spinning Operations (TTX 322)	3-0-0-3
3. Multi-fibre Process (TTX 323)	3-0-0-3
4. Advances in Yarn Manufacturing (TTX 324)	3-0-0-3
5. Advances in Fabric Manufacturing (TTX 325)	3-0-0-3
6. Textile Printing and Finishing (TTX 327)	3-0-0-3
7. Marketing Management in Textiles (TTX 330)	3-0-0-3
8. Costing and its application in Textiles (TTX 331)	3-0-0-3
9. Product Design (TTX 431)	3-0-0-3
10. Chemical Processing of Manmade Fibres and Blends (TTX 421)	3-0-0-3
11. Textiles and Fashion Designing (TTX 425)	3-0-0-3
12. Financial Management in Textiles (TTX 332)	3-0-0-3

7th and 8th Semester

13. Advances in Knitting Technology (TTX 326)	3-0-0-3
14. Advances in Chemical Processing (TTX 328)	3-0-0-3
15. Advancement in Textile Testing (TTX 329)	3-0-0-3
16. Production Management (TTX 422)	3-0-0-3
17. Textile Structural Composites (TTX 423)	3-0-0-3
18. Waste Management and Pollution Control in Textiles (TTX 424)	3-0-0-3
19. Apparel Marketing and Merchandising (TTX 426)	3-0-0-3
20. Mill Management and Maintenance (TTX 427)	3-0-0-3
21. Project Formulation and Appraisal (TTX 428)	3-0-0-3
22. Textile Process Simulation and Modeling (TTX 429)	3-0-0-3
23. Woolen Technology (TTX 430)	3-0-0-3
24. Intelligent and Functional Textile (TTX 432)	3-0-0-3
25. Advancement of Nonwoven Technology (TTX 433)	3-0-0-3
26. Quality Control in Chemical Processing (TTX 434)	3-0-0-3
27. Advancement in Manmade fibres (TTX 435)	3-0-0-3
28. Application of Operations Research in Textiles (TTX 436)	3-0-0-3
29. Clothing Science (TTX 437)	3-0-0-3
30. High Performance Fibres (TTX 438)	3-0-0-3

Open Electives

Name of Subjects	L-T-P-C
1. Polymer and Fibre Science (TTX 451)	3-0-0-3
2. Properties of Polymer and Fibre (TTX452)	3-0-0-3
3. Textile Machines and Processes (TTX 453)	3-0-0-3
4. Textile Design (TTX 454)	3-0-0-3
5. Fashion and Textiles (TTX 455)	3-0-0-3
6. Fashion Designing (TTX 456)	3-0-0-3
7. Geotextiles (TTX 457)	3-0-0-3
8. Design of Experiments (TTX458)	3-1-0-4
9. Application of Nanotechnology on Polymers and Fibres (TTX 459)	3-0-0-3
10. Environmental Science and Management (TTX 460)	3-0-0-3
11. Industrial Textiles (TTX 461)	3-0-0-3
12. Marketing and Merchandising of Products (TTX 462)	3-0-0-3
13. Clothing Science (TTX 463)	3-0-0-3
14. High Performance Fibres (TTX 464)	3-0-0-3

Course Content

BTech 3rd Semester

TTX-201 Fundamentals of Textile Machines and Processes [3 0 0 3]

Basic characteristics of textile materials; Concept of dimensional characteristics of textiles; Applications of textiles in diversified fields; Variations in textile structure and properties based on applications; Role of different structure and material constituents for fulfillment of target requirements; Different machine sequences for processing textile materials differing in structure; Product properties and their measurement; Understanding the significance of parameters characterizing product properties; Need for process control and use of statistics; Improvement in product quality; Current trends in research and development of textile machines and processes.

Recommended Books:

1. Gohl E P G and Vilensky L D, Textile Science, CBS Publishers and Distributors, New Delhi.
2. Corbman Bernard P., "Textiles Fiber to Fabric", McGraw-Hill International Editions, Singapore, 1983.
3. "Handbook of Technical Textiles", Ed. A R Horrocks and S C Anand, Woodhead Publication Ltd., Cambridge, 2000.
4. Textile Design: Principles, Advances and Applications, Edited by A Briggs-Goode and K Townsend, Woodhead Publishing Series in Textiles No. 112, 2011.
5. Handbook of Nonwovens, Edited by S Russell, Woodhead Publishing Series in Textiles No. 58, 2006, UK.
6. Morton W E and Hearle J W S, "Physical Properties of Textile Fibres", Woodhead Publishing Series in Textiles No. 68, 2008, UK.

TTX-203 Natural Fibres [3-0-0-3]

Fibres and polymers: Introduction to fibres; Introduction to polymers; Requirements of fiber forming polymers; Essential and desirable properties of textile fibers; Essential properties of fiber 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 of 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 of 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 lingo cellulosic 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; Properties and uses of wool and silk; Introduction to ramie, hemp, coir and pineapple fiber.

Polymerization: Introduction to polymerization 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.

TTX-205 Yarn Formation -I [3-1-0-4]

Ginning - Classification and importance; Introduction to the important fibre characteristics for yarn production.

Opening and cleaning in blow room–Introduction, Methods, Recent developments.

Mixing and blending-Definition;Compatibility requirements; Perfect blend; Blending deficiencies; Index of blend irregularity; Blending methods and techniques;Mixing and blendingmachines.

Carding-Objectives; Revolving flat card; Card clothing;Operating regions of the card; Forces acting on the fibres; Carding disposition and doffing disposition; Centrifugal forces;Action between feed roller and licker-in, Cylinder and Flats, Transfer zone at doffer, Numerical problems, norms, performance assessment, Developments in carding machine.

Doubling and Drafting- Basic principles; drafting operation in the drafting arrangement; behavior of fibres in the drafting zone; fibre friction field; numerical problems; norms; performance assessment; Latest developments

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. Lawrence C A, “Fundamental of Spun Yarn Technology” CRC Press, USA, 2003.
4. Lord P R, “Handbook of Yarn Production”, The Textile Institute, Woodhead Publication Limited, Cambridge, 2003.

TT-207 Preparatory and 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

MA-XXX Mathematics [3-1-0-4]

ME-XXX 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.

TTX-209 Textile Fiber Laboratory [0-0-2-1]

Physical and Chemical identification of following textile fibres

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 fibers 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 fiber/filament fineness using projection microscope.

TTX-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 analyses machine.
 - i. Chief organs.
 - ii. Gearing arrangements.
 - iii. 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 zones of carding machine and its production.
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.

TTX-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 direct warping machine.
9. Study of the sectional warping machine and planning the width of a section according to pattern of the given striped fabric.
10. To study the passage of yarn on a sizing machine and the features of various parts/ mechanism of the sizing machine.
11. To select the proper reed and heald for a weaver's beam keeping in mind the beam, loom size and fabric construction.
12. Study of shedding mechanism of shuttle loom and cam positioning with respect to loom cycle.
13. Study of picking mechanism, Picker movement in relation with crank shaft rotation and calculation of average velocity of shuttle.
14. Study of sley movement, construction and calculation of sley eccentricity.

4th Semester

TTX- 202 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. Meltspinning, solution dry spinning and solution wet spinning. Factors influencing selection of aParticular process for fiber formation, Relative merits and demerits of melt, dry and wetspinning processes, 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 co-monomers 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.

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. "Hand Book of Fibre Chemistry", Ed. M Lewin and E M Pearce, Merce Dekker Inc., 1998.

TTX-204 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 venture meter, orifice meter, Rota meter.

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 of Nusselt equation.

Radiation: Basic principle of radiation from a surface, blackbody radiation, Planck's law Wein's displacement law, the Stefan Boltzmann law, Kirchoff's law, gray body, radiation exchange between black bodies and 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, and 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” 3rdEd., 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 and Julius T, Banchero, “ Introduction to Chemical Engineering”, McGraw Hill (1997)

TTX-206 Yarn Formation II [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. 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.. 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 structure, spinning geometry, causes of end breaks, numerical problems, norms, performance assessment, 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.

Books Recommended:

1. Klein W, “Manual of Textile Technology”, The Textile Institute, Manchester, Vol.1and3, 2002.
2. Klein W, “A Practical Guide to Ring Spinning”, The Textile Institute, Manchester, Vol 4. 2002.
3. Klein W, “New Spinning Process”, The Textile Institute, Manchester, Vol.5, 2002.
4. Lawrence C A, “Fundamental of Spun Yarn Technology” CRC Press, USA, 2003.
5. Lord P R, “Handbook of Yarn Production”, The Textile Institute, Woodhead Publication Limited, Cambridge, 2003.

TTX-208 Fabric Formation Systems [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 doobby, different types of doobby and their mechanism pegging system as per design of weave, paper doobby, Scope of jacquard, working of different types of jacquards and card punching methods.

Concept of Quick style change

Shuttle-less Weaving: Problem of shuttle weaving, Development of shuttle less 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

TTX-210 Preparatory and Colouration of Textiles [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 mercerization, Process parameters and operation details, Causticization. Wet and hot mercerization, 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, solubilised vat, acid, metal-complex, basic and disperse dyes. Colouration with Pigments. Auxiliaries used in dyeing.

Books Recommended

1. A K Roy Choudhary, "*Textile Preparation and 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 and 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 and Technology Series, Vol-12, 1st Edition, Elsevier (1999).

MA-XXX Probability and Statistics [3 0 0 3]

Section A

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.

Section B

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, conditionalexpectation. Discrete and Continuous Probability Distribution: Binomial, Poisson, Normal, Exponential.

Section C

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

TTX-212 Yarn Formation Laboratory - II [0021]

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 leveling
 - ◆ 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.

TTX-214 Fabric Formation Laboratory-II [0021]

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.

TTX-216 Textile Chemical Processing Lab- I [0 0 3 2]

At least 10 experiments are to be performed by each student

1. Scouring of cotton
2. Scouring of polyester
3. Scouring of blend
4. Scouring of wool
5. Degumming of silk
6. Bleaching of cotton with NaOCl
7. Bleaching of cotton with H₂O₂
8. Bleaching of cotton with NaClO₂
9. Bleaching of polyester
10. Bleaching of blend
11. Bleaching of jute yarns / fabric
12. Dyeing of cotton with direct dye and after treatment
13. Dyeing of cotton with reactive dye
14. Dyeing of cotton with Sulphur dye

5th Semester

TTX- 301 Printing and Finishing [3 00 3]

Dyeing of blends: Classification of blends and fancy shades, 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 parameters, 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: classification, 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: Influence of working parameters, construction and function of various calendering m/cs. Sanforizing: Method, mechanism and machineries involved, Evaluation of sanforizing.

Functional finishes: Problem of creasing and 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. Soil release finish: Classification of soil and mechanism of their adherence on cotton. Various soil releases finishes. Flame retardant finish: Burning cycle, Limiting Oxygen Index (LOI), various proposals for application of flame retardants on various textiles.

Identification of dyes: Identification of dye on dyed natural and manmade 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.

TTX- 304 Textile Testing [3 1 0 4]

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 behavior, 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-vapor 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: Color 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 and Gopalakrishnan R, "Textile Testing", SSM Institute of Textile Technology, Komarapalayam, 2002.
5. Basu A, "Textile Testing", SITRA Coimbatore, 2002.

TTX-305 Fundamentals of Knitting and Nonwoven Technology [3 0 0 3]

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 along with 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.

Nonwoven: Historical Development, Classification of Nonwoven fabrics, Development of nonwoven industry and future perspective, Types of fibres and bonding agents used Characteristic properties of polymer dispersions, thermo sensibility and cross linking, Various techniques of dry and wet lying of fibrous web. Needle punching technology, Felting needles, needle classification and their specifications, Factors affecting the properties of needle punched fabrics, Brief idea about the Spun

lacing, spun bonding, melt blowing, thermal bonding and Stitch bonding techniques, Adhesive Bonding, Methods of bonding agent application, various types of dryers in adhesive bonding.

Books Recommended:

1. Spencer D J, "Knitting Technology", 2nd edition, Pergamon Press, 1989
2. Ajgaonkar D B, "Knitting Technology", Universal Publishing Corporation, 1998.
3. Booth J E, "Textile Mathematics", Vol. 3, Textile Institute, Manchester, 1977.
4. Lunenschloss J and Albrecht W, "Non-Woven Bonded Fabric", Ellis and Horwood Ltd.,UK, 1985
5. Albrecht W, Fuchs H and Kittelmann, "Nonwoven Fabrics", Wiley-VCH Weinheim,2003.
6. Kréma Radco, "Manual of nonwovens", Textile Trade Press, UK, 1971.
7. Gulrajani M L, "Book of Papers of International Conference on Nonwovens", TheTextile Institute, UK, 1992.

TTX- 307 Fabric structure and design analysis [3 0 0 3]

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 mock -leno 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.

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

Color and Weave Effect: Weave and color 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 centres stitched double cloths, theirsalient feature and uses, Wadded double cloth.

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

Books Recommended:

1. Groszicki Z J, "Watsons Textile Design and Colour", Newnes Buttersworth, 1988.
2. Groszicki Z J, "Watsons Advanced Textile Design", Newnes Buttersworth, 1989.
3. Klibbe J W, "Structural Fabric Design", revised edition, 1965, North CarolinaStateUniversity.

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-XXX Entrepreneurial Development and Management [3 0 03 3]

Entrepreneurship Development: Meaning, objectives, scope and philosophy, type of entrepreneurs, factors affecting entrepreneurship, entrepreneurial qualities, need for promotion of entrepreneurship and small business, linkage between entrepreneurship and economic development, problem of increasing unemployment, creativity and entrepreneurship, harnessing locally available resources.

Entrepreneurship Support System: SIDBI, SISIs, SSIEC, SFCs, DICs, NSIC, EDI (Ahmadabad), NRDC, NIESBUD, PSIEC and Technical Consultancy Organizations.

Project Report Preparation: Planning a small scale industry, identifying business opportunities, project report and its importance, various contents of project report: managerial and entrepreneurial capabilities, socio-economic benefits, demand analysis, technical feasibility and financial viability.

Introduction to Marketing Management: Brief introduction to various types of product strategies, pricing strategies, channel strategies and promotional strategies.

Introduction to Production Management: Types of production systems, production planning and control, functions of production manager and materials management.

Introduction to Human Resource Management: Manpower planning, recruitment, selection, placement and induction, training and development, compensation.

Introduction to Financial Management: Sources of finance and working capital management.

Books Recommended:

1. Prasanna Chandra , Projects : Planning, Analysis, Selection, Implementation and Review, Tata McGraw Hill
2. Kenneth R., Van Voorthis, Entrepreneurship and Small Business Management.
3. B. Gupta and N.P. Srinivasan, Entrepreneurial Development.
4. Gopala Krishnan and V.E Rama Moorthy, 'Project Management', Macmillan India Ltd.
5. Jose Paul and Kumar Ajith N, 'Entrepreneurship Development and Management', Himalaya Publishers, New Delhi (2000).
6. Dollinger, 'Entrepreneurship Strategies and Resources', Pearson Education (2003).
7. Holt David H, 'Entrepreneurship: New Venture Creation', Prentice Hall of India (2000)
8. Kuratko and Hodgetts, 'Entrepreneurship Management: Theory, Process, Practice', (7th Ed), Thomson.

TTX- 309 Textile Chemical Processing Lab–II [0 0 3 2]

At least 10 experiments are to be performed by each student

1. Dyeing of cotton with azoic dyes
2. Dyeing of cotton with Vat dyes
3. Dyeing of cotton with solubilised vat dyes
4. To dye wool fiber with
 - Reactive dyes
 - Acid dyes
 - Metal complex dyes
5. Dyeing of silk with acid dyes / acid mordant dyes/metal-complex dyes
6. Dyeing of polyester with disperse dyes
7. Dyeing of nylon with acid dyes / metal complex dye
8. Dyeing of acrylic with basic dyes
9. Printing of cotton fabric in direct style
10. Printing of cotton fabric in discharge style
11. Printing of cotton fabric in resist style
12. Identification of dyes on dyed textiles
14. To finish cotton fabric with
 - Water repelling agent
 - Anti-crease finish

TTX- 311 Knitting Technology Laboratory [0 0 21]

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.)

TTX- 308 Textile Testing Laboratories [0 0 2 1]

At least 10 experiments are to be performed by each student

1. To prepare and analyze Baer Sorter diagram. and determine the following:
2. Determine moisture content/regain of a fibre sample by hot air oven method.
3. 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.
4. Determine maturity coefficient and maturity ratio of a given sample by caustic soda method. Give appropriate rating to the fibre sample.
5. 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.
6. Determine the bundle strength and elongation of a given manmade fibre using Stelometer. Analyze the effect of rate of loading on tensile properties of the fibre.
7. Cotton fibre testing by HVI.
8. Determine crimp (crimp %) of a given manmade fibre sample.
9. Determine fibre fineness of a manmade fibres/filaments by:
10. Tensile properties of a staple fibre by UTM
11. Determine stress relaxation and creep recovery of fibre.
12. 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.
13. Prepare yarns Appearance Boards and compare with ASTM standards.
14. Study the hairiness of a given yarns using Hairiness Tester. Compare the results of Evenness Tester and Hairiness Tester with ASTM grade.
15. Determine coefficient of friction of a spun yarn and indicate the effect of waxing on coefficient of friction.
16. Determine bending rigidity by (HEART) loop method.
17. Determine the Lea C.S.P by Lea CSP Tester and Autosorter and compare the results of various yarn.
18. Determine the percentage crimp and corrected count with the help of crimp Tester.
19. Determine the crimp rigidity by using hot crimp contraction method.
20. Classimat fault analysis (yarn fault classifying system).
21. Determine the tensile properties of yarn by single thread strength tester.
22. Determine twist of yarn using different principle of measurement.
23. Characterize a woven fabric with respect to its dimensional properties.
24. Determine the tensile strength and elongation of a woven fabric and compare the Load-elongation curve with non-woven and knitted fabric.
25. Determine the tear resistance of a fabric using Elmendorf Tear Tester.
26. Determine the bursting strength of a fabric on a hydraulic bursting tester.
27. Determine the abrasion resistance and pilling resistance of a fabric.
28. Determine the crease recovery of fabric and observe effect of loading time and recovery time on crease recovery.
29. Determine the Drape coefficient of a fabric sample.
30. Determine the compression property of a fabric (thickness).
31. Determine the Air permeability, water permeability and water repellency of a fabric.
32. Determine the thermal resistance of a fabric.
33. Determine the stiffness of a fabric.

TTX- 313 Fabric structure and design analysis laboratory [0 0 2 1]

At least 10 experiments are to be performed by each student

To analyze the yarn and fabric particulars of the different weave structures along with their graphical presentation and weaving plans.

- a. Plain weave
- b. Twill weave
- c. Satin/sateen weave
- d. Diamond weave
- e. Honeycomb weaves
- f. Perforated weaves
- g. Bedfordcord weaves
- h. Stripe and check weaves
- i. Crepe weaves
- j. Huck a back weaves
- k. Backed fabrics
- l. Terry weaves

6th Semester

TTX-302 Properties of Fibers [3-0-0-3]

Fiber structure: Traditional view of fiber structure. Chemical structure and physical Structure, Degree of order and degree of orientation.

Structure investigation: Methods of investigation of fiber structure. Basic understanding of IR spectroscopy, X-ray, SEM and TEM.

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 loading and fatigue. Fibre fracture and fatigue. Time effect. Creep and stress relaxation. Introduction to dynamic testing. Concept of models. Kelvin and Maxwell model. Bending and torsional rigidity of fibre.

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.

TTX- 303 Process Control in Textiles [3 0 0 3]

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 fiber 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

TTX- 306 Garment Technologies [3 0 0 3]

Garment Manufacturing: Introduction, present scenario and future of Indian apparel industry.

Raw material: Woven and knitted fabrics with their characteristics and applications for different uses, Garment manufacturing from woven and knitted fabrics.

Designing and Pattern making: Introduction to designing, Pattern making – draft construction, advanced Pattern making, grading of pattern, marker planning, fabric spreading, laying methods, Factors affecting spreading, 3D body scanner for measurements, fabric cutting, computerized cutting machines, easy match system, automatic ticketing and bundling, garment size and size charts.

Garment Sewing: Introduction to sewing m/c and its parts and working details, Different types of sewing m/c, driving system of sewing machines, Various attachments of sewing m/c, high speed sewing, LAN in Sewing machine and sewing room planning, Preparation of seamless garments and its applications.

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

Sewing Needles and Threads - Needle – functions, special needles, Needle size, Needle points; sewing thread – construction, material, thread size and packages.

Trimming and Garment accessories: linings, interlinings, wadding, lace, braid, elastic, hock and loop fastening shoulder pads, eyelets and laces, Zip fasteners and buttons.

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

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

Manufacturing systems and Planning – Various production system with their characteristics, lay out planning, Work study methods, motion and time study, computer Integrated production planning and management systems. Concepts of CAD, computer aided embroidery designs, computer integrated manufacturing (CIM) in the garment manufacturing and technological advancement in garment manufacturing.

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.

TTX 310 Garment Technology Lab[0 0 2 1]

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

1. Study of sewing machine and 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 (01Lab).
6. Study and construction of basic blocks to assemble a garment (01 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. Study and applications of various type of software used in apparel manufacturing processes (based on tuka-tech and all reach software) (01 Lab).
10. Designing of T –shirts, Skirts, Pant and shirt using garment software (02 Lab).
11. Design wedding dresses for women / man using fashion studio (CAD) software (01 Lab).
12. Design dresses for women / man sport player using fashion studio (CAD) software (01 Lab).

TTX - 314 Scientific Computational Lab [0 0 2 1]

At Least 10 experiments are to be performed by each student

1. Analysis of given data to find Mean, Median, Mode, Range, Mean Deviation, Percent Mean Deviation, Standard Deviation and Coefficient of Variation in MS excel/any other software.
2. Presentation and analysis of data: scatter plot, histogram, bar chart, line plot, variability plot, box plot and table in MS excel/any other software.
3. Study and use of logical functions (If, AND, OR, XOR, NOT) in MS excel.
4. Application and use of significance test in MS excel.
5. Study and use of linear programming in MS excel.
6. Application and use of ANOVA in MS excel/any other software.

7. Study of curve fitting using regression equation.
8. Study of curve fitting with customized equation in MATLAB.
9. Finding area under curve in MATLAB.
10. Regression analysis of raw data using MATLAB.
11. Producing 3-D surface and contour plot in MATLAB/any other software.
12. Application and use of design of experiment using statistical software.

7th Semester

TTX- 401 Theory of Textile Structure [3 1 0 4]

Basic geometry of twisted yarns, The idealized helical yarn structure, Deviation from real yarn. Twist contraction and retraction, Packing of fibres in yarn. Forms of Twisting. Migration and its importance in yarn mechanics. Ideal migration, Parameters affecting migration, characterization of migration behavior, mechanism of migration in single and plied structure. 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 El-Sheikh. Blended yarn structure, Humburger's Theory. Structure property relationship of ring, rotor, air-jet, friction spun yarn.

Engineering approach to the analysis of fabric, Ashenhurst theory and its application. Fabric cover and fractional cover. Cover factor in SI unit. GSM and cover factor relationship. Concept of similar cloth. Design of similar cloth. Pierce geometrical model relationship between h, p, c, Crimp interchange, Jammed Structure. Minimum possible cover factor. Race track geometry, close limit of weaving concept of pierce elastic thread model, Geometry of plain knitted fabric. Knitted fabric tightness factor and GSM. An elementary idea about tensile, tear, bending, shear and drape behavior 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

TTX- 403 Statistical Quality Control in Textiles [3 1 0 4]

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 and 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.

8th Semester

TTX- 402 Technical Textiles [3 0 0 3]

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, Technomic Publishing Company, Inc., Pennsylvania, USA, 1995.
3. "Geosynthetics in civil engineering", Ed. R W Sarsby, Woodhead Textiles Series No. 57, 2006,UK.
4. "Modern Textile Characterization Methods", Ed. M Raheel, Marcel Dekker, Inc., 1996.
5. Mukhopadhyay S K and Partridge J F, "Automotive Textiles", Textile Progress, Vol. 29, No. ½, 1999, Textile Institute, Manchester, UK.
6. Ukponmwan J. O, Mukhopadhyay A. and Chatterjee K. N., "Sewing Threads", Textile Progress, Vol. 30, No. 3/4, 2000, Textile Institute, Manchester, UK.

TTX- 404 Mechanics of Textile Processes

Role of friction in textile processing: Elementary ideas of tuft opening; dust and foreign matter separation. Evaluation of Blow Room performance: Mechanisms of contaminant removal.

Theories of carding: Mechanics of fibre entanglement and hook formation during 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, evaluation of carding performance.

Role of draw frame on yarn quality and process parameters: Hook straightening in roller drafting, Theories of roller drafting, Evaluation of draw frame performance.

Theoretical aspects of combing: Fractionation in combing, Parameters affecting combing performance and quality, evaluation of combing performance.

Mechanism of package building and twisting in speed frame: Evaluation of roving frame performance, Yarn tension in ring spinning, Balloon theory in spinning.

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. 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.

HM-XXX Human Resource Management and Industrial Relations [3 0 0 3]

Introduction: Nature, importance, objectives, scope and principles of HRM; system approach of HRM; HRM functions and its relation with other managerial functions; changing environment of HRM; challenges and emerging horizon of HRM.

Procurement: Job analysis, job description, job specification; manpower planning, Demand and Supply Forecasting; Recruitment: Recruitment Policy and Methods; Selection procedure; Techniques and types of Psychological Tests; Interviews, Placement and Induction.

Development: Employee training and development; methods of training and development; performance appraisal: traditional and modern methods; career planning and advancement: career anchors, career development-Evan's model; career counseling and modern career problems.

Compensation: Factors affecting compensation policy, methods of payment; principles of wage and salary administration, methods of wage payment, various incentive wage plan, individual and group; supplementary compensation: fringe benefits; non wage incentives, current trends in compensation.

Integration: Human relations, industrial relations: importance, causes and effects of industrial disputes; machinery for settlement of disputes in India; trade unions, function, objectives and motivation, trade union in India, weakness of trade union, collective bargaining: concept, features, process, benefits, making trade union and collective bargaining effective.

Maintenance and Separation: Employees safety, health, welfare; provisions under factory act, 1948; turnover, retirement of employees, termination of contract, discharge, dismissal, suspension, layoff, retrenchment, exit interviews.

International HRM: Growth of HR challenges of international business, difference between domestic and international HRM, effect of inter-country differences on HRM, international staffing and compensation, international labor relations.

Books Recommended:

1. C. B. Mamoria, 'Personnel Management' Himalaya Publication House.
2. Edwin. B. Flippo, 'Personnel Management'. Sixth Edition. Tata Mc Graw Hill.
3. C. B. Mamoria, 'Dynamics of Industrial Relations' Himalaya Publication House.

4. C. S. Venkataratnam, 'Industrial Relations'. Oxford University Press (OUP).
5. P. Jyothi and D. N. Venkatesh, 'Human Resource Management' OUP.
6. Gary Dressler, 'Human Resource Management'. (8th Ed). Pearson Education.
7. Tanuja. Agarwala, 'Strategic Human Resource Management', Oxford University Press.
8. Snell, Bohlander, 'Human Resource Management', Thomson.
9. Mathis, Jackson, 'Human Resource Management', (10th Ed). Thomson.

Departmental Electives

5th and 6th semester

TTX-321 Characterization of Fibres and Polymers [3-0-0-3]

Molecular weight and dimensions: Number average, weight average and other expressions of molecular weight. Different approaches of determination of molecular weight. Methods of determination of molecular weight, viz., end group analysis, osmometry, light scattering, viscometry, GPC. Characterisation of structure (different structural elements), techniques for characterisation of structure, e.g., Electron microscopy, IR spectroscopy, NMR spectroscopy, X-ray scattering. Thermal characterization: DSC, TGA, TMA, DMA.

Books Recommended:

1. "Polymers; Polymer characterization and analysis", ED., J I Kroschwitz, John Wiley and Sons, 1990.
2. "Thermal characterization of polymeric materials", Ed., E A Turi, Vol I and II, Academic Press, 1997.
3. "Text book of polymer science", Billmeyer F W, John Wiley and Sons, 1984.

TTX-322 Post Spinning Operation [3 0 0 3]

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, draw 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 behavior 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.

TTX-323 MultifiberProcesses [3 0 0 3]

Survey of the established practices for spinning of man-made fibres, Present practices and assessment of available methods of contaminant removal. Fibre quality requirements for spinning. Humburger’s theory. Assessment of blending at different stages of a spinning line. Development in bending machines. Conventional spinning system. Detailed study of the changes required in processing short and long staple manmade fibres on cotton system. Spinning of dyed fibres. Aspects of Spinning of man- made fibres and wool on rotor spinning system. Spinning of micro fibres. Mellange and fancy yarn production. Processing of long fibres on woollen/worsted system. Silk reeling. Introduction and process sequence for jute spinning. Blending of jute. End use of jute and jute blended yarns and fabrics. End use of linen blended and linen yarn and fabrics. Production of manmade and their blends with modern spinning systems.

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.

TTX-324 Advances in Yarn Manufacturing [3 0 0 3]

Fibre characteristics requirements for different leading spinning technologies, Possibilities and limitations of different spinning technologies. Principle and raw material preparation for rotor spinning. Specifications of different organs and effect of each on the process and product quality. New developments

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. Principle and raw material preparation for friction spinning, Process and machine parameters affecting product quality. Assessment of DREF-II and DREF-III yarn structures and properties. Principle and raw material preparation for compact spinning. Comparative assessment of the structure and performance with respect to ring yarn. Principles of different converters. Self twist, twist less and warp spinning, Electrostatic spinning, Core spinning, Siro spinning, Bobtex yarn manufacture, solo spun yarn manufacture. Latest developments, 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

TTX- 325 Advances in Fabric Manufacturing [3 0 0 3]

Preparation of Yarn for shuttle-less weaving: Winding, warping, sizing and weft preparation and drawing of warp yarn.

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, selvage formation, Energy equation of torsion bar, velocity and acceleration of the projectile.

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. Fabric fractional cover.

Water-jet Weaving machine: Weft insertion mechanism, quality of warp required for water jet, selvage 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.

Techno-economics of shuttle-less weaving. Weft feeding in shuttle-less weaving.

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 and uses.

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

TTX-327 Textile Printing and Finishing [3 0 0 3]

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 softner for specific textiles, Evaluation of softner.

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, and 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.

TTX- 330 Marketing Management in Textiles [3 0 0 3]

Introduction: Need, want, demand, production, product, selling, marketing and societal concepts of marketing, types of goods. Various Textile Industry marketing practices in fibres, yarns, grey fabrics, finished fabrics and garments.

Marketing Process: Analyzing marketing opportunities, researching and selecting target markets, positioning the offer, designing marketing strategies, planning marketing program, organizing, implementing and controlling marketing efforts.

Consumer Behavior: Factors affecting consumer behavior, Buyer black box, stages in purchasing, buying roles

Marketing Research: Basic concepts, Marketing research process, market segmentation, target market selection, product research, Advertisement Research.

Organizational Buying: Salient features, factors affecting organizational purchase marketing mix, product, product levels, product hierarchy, product line, product mix, product life cycle, procedure for new product development, branding and packaging.

Price: Pricing objectives, price elasticity of demand, methods of pricing, discounts, discriminatory pricing.

Distribution: Need for middleman and their functions, vertical marketing system. Types of distributions, Channel management decisions, Frame work of Retailing in Textiles, career in retailing, types of retailers, and trends in retailing

Promotion Mix: Advertising, media selection, frequency and timing of advertisement, steps in developing effective communication, sales promotion, personal selling, publicity, Recruitment, training and motivating sales representatives, controlling and evaluating.

Books Recommended:

1. Kotler P, "Marketing Management", Prentice Hall of India, Delhi, 9th Edition, 2002.
2. Dudeja V D, "Management of Textile Industry", Textile Trade Press, Ahmedabad, 1981.
3. Barry Band Joel R.E. "Retail Management" Metmiam Publishing Co., New York 1989.
4. Winer Russel S, "Marketing Management", Prentice Hall of India, 1998.
5. Guilitinan Joseph P, Gordon W Paul and Thomas J Madaen, "Marketing Management: Strategies and Programs", Mc Graw Hill Publication, 1996.

TTX-331 Costing and its Application in Textiles [3 0 0 3]

Costing as an aid to management-Elements of cost, treatment of stock, Cost terms related to income measurement, profit planning and cost control for textile industry.

Material cost - Costing of materials, Methods of valuing materials : FIFO, LIFO, Average cost method, Inflated price method, identification method, base stock method, HIFO, Market price method, Techniques of material control: Economic order quantity, Just in Time inventory system, stock control through ABC Analysis, VED analysis,

Labour cost – Types of labour, control of labour cost, labour turnover and turnover cost, Time and motion study, job analysis and job evaluation, Remuneration and Incentives, time wage system, Piece wage system

Overheads – Importance and classification of overheads, Allocation and apportionment of overhead to cost centres

Methods of costing – Job, Batch and contract costing, Process costing; waste cost and its control in a textile mill, Joint and by-product costing, Unit cost; costs of yarns and fabrics, fabric processing cost.

Techniques of cost analysis and control - Absorption and marginal costing, cost-volume-profit-analysis, break-even point, contribution margin, margin of safety, standard costing, budgetary control, productivity and value analysis,

Books Recommended:

1. Jain S P, Narang K L and Dhingra T R, “Cost Accounting”, 6th Ed., Kalyani publishers, N Delhi, 2000.
2. Khan M Y and Jain P K, “Cost Accounting and Financial Management”, Tata McGrawhill, Delhi, 2008.

TTX- 332 Financial Management in Textiles [3 0 0 3]

Introduction: Scope of finance, finance functions, financial manager's role, financial goals and firm's objectives.

Financial Statements: Accounting system, financial statements, Profit and Loss A/c and Balance Sheet, Use and importance of financial statements, Limitations of Financial statements.

Ratio Analysis: Meaning and nature of Ratio Analysis, Use and significance of Ratio Analysis Limitations of Ratio Analysis, Classification of ratio, Test for short-term financial position: Current liquid and Absolute liquid ratios, Efficiency and Activity ratios: Stock turnover, Debtor turnover Ratio, Average collection period, creditors turnover ratio, Average Payment Period, Test of solvency: Debt-Equity ratio, Equity ratio, Solvency ratio, and Net Worth ratio, Profitability ratios: Gross profit, Operating Expense, Net profit And operating profit ratios, Return on Investment and Earnings Per Share.

Statements of changes in Financial Position: Fund flow statement, Cash flow statement.

Sources of Finance: Classification of sources of finance, Security financing, Ownership securities, Equity Shares, Preference Shares, Deferred Shares, Debentures and Retained Earnings, Depreciation as source of funds, factoring, commercial banks, public deposits, lease financing and mutual funds.

Working Capital Management: Meaning, concept and classification of working capital, Needs and objectives of working capital, Disadvantages of Inadequate and redundant working capital, Principles of working capital management, Estimation of working capital requirements, Financing of working capital.

Control of Capital Issues: Securities and Exchange Board of India (SEBI), SEBI Act 1992,

Capital Budgeting: Introduction to investment, types of investment decisions, Factors affecting investment decisions Traditional techniques of capital budgeting: Payback Period and Average Rate of return methods, Modern techniques of capital budgeting: Net Present Value and Internal Rate of Return methods Capital Rationing.

Books Recommended:

1. Pandey, I M, "Financial Management", 8th Ed., Vikas Publishing House, New Delhi.
2. Sharma R K, Gupta, Shashi K, "Management Accounting", 9th revised edition, Kalayani Publishers, New Delhi.
3. James C Van Horne, "Financial Management and Policy", 11th edition, Prentice Hall of India
4. Fred R Kren, "Corporate Finance: Concepts and Policies", Blackwell Business, Oxford (U K)

TTX-421 Chemical Processing of Manmade Fibres and Blended Textiles [3 0 0 3]

Introduction: Structural study of manmade fibres and their blends, Stability of manmade 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, Pretreatment machineries.

Dyeing of man made: Dye-fibre attachment, Role of fibre structure in dyeing of manmade fibres, 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 manmade fibres.

Dyeing of blends: Characterisation of blends, dyeing of primary, binary and ternary blends.

Blend dyeing methods: Single bath, 1-bath 2-step and 2-bath 2-step methods to produce different shades.

Blend dyeing shades: Reserve, cross, shadow and solid shades, Possibilities of producing various shades on different blends.

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

TTX- 431 Product Design [3 0 0 3]

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, and 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.

7th and 8th Semester

TTX-326 Advances in Knitting Technology [3 0 0 3]

Introduction to knitting, basic weft-knitted structures, Circular weft knitting machine and mechanism, Flat bed knitting, Warp knitting machines and knitting elements, Double needle bar warp knitting machine, Yarn and its selection for knitting, Knitting of textured yarns, Scope of lycra yarn in knitting, Scope of jute yarn in knitting, Yarn tension in knitting and its measurement, Quality aspects in knitting, Developments in flat bed weft knitting, Developments in circular bed weft knitting, Developments in warp knitting, Mechanics of loop formation in weft knitting, Mechanics and mechanism of warp loop formation, Production of spacer fabrics in knitting, Scope of knitting in garment manufacturing, Potential benefits of seamless garment knitting, Scope of knitting in the manufacture of medical textiles, Technical textiles – the new product range in knitting, Analysis and testing of knitted fabrics, Concept of green business in knitting and knitwear industries.

Books Recommended:

1. Ray S C, “Fundamentals and advances in knitting Technology”, Woodhead publishing limited, 2001.
2. Edited by K F Au, Hong Kong Polytechnic University, Hong Kong, “Advances in knitting technology”, Woodhead Publishing Series in Textiles No. 89.
3. Spencer D J, “Knitting Technology”, 2nd edition, Pergamon Press, 1989.
4. Ajgaonkar D B, “Knitting Technology”, Universal Publishing Corporation, 1998.
5. Booth J E, “Textile Mathematics”, Vol. 3, Textile Institute, Manchester, 1977

TTX-329 Advancement in Textile Testing [3 0 0 3]

Fiber, Yarn and Fabric Testing: New approaches to textile measurements, Innovations in yarn testing instruments (dynamic, continuous and on-line testing of yarn quality) and fabric testing, Assessment of comfort, Standard tests, analysis of data and test reports such as HVI, AFIS, Classimat, Colour maching, 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, Test for textiles for sports application, Test for Composites, Testing for sewing threads, industrial cords etc, Special tests for carpets and nonwoven fabrics.

Product Leveling and Standards: 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. Fabric Testing, Ed. J Hu, Woodhead Textiles Series No. 76, 2008, UK.
4. “Testing and Quality Management”, Ed. V. K. Kothari, IAFL Publications, New Delhi, 1999.

5. Mukhopadhyay A, "Process Characterization and Evaluation of Filter Media" in "Pulse-Jet Filtration: An Effective Way to Control Industrial Pollution -Part II", Textile Progress, 42 (1), Taylor and Francis, UK., 2010.

TTX-328 Advances in Chemical Processing [3 0 0 3]

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

Controlled application techniques: Concept of short liquor processing: advantages and limitations, Short liquor pretreatment and dyeing of various textiles, Performance assessment of each method.

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, Assessment 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, Reproduction of shade.

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.

TTX- 422 Production Management [3 0 0 3]

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

EnterpriseResource 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 Recommended:

1. Raymond R Mayer, "Production and Operations Management", Tata McGraw Hill, 3rd Edition, 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.

TTX-423 Textile Structural Composites [3-0-0-3]

Introduction to fibres for high performance composites: 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 behavior of composites, various techniques of composites design and fabrication, Composites for structural engineering, electrical, civil, aerospace, defense, automobile, Sporting goods and other applications, Basic 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.

TTX-424 Waste Management and Pollution Control in Textile Industry [3 0 0 3]

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.

TTX-425 Textiles and Fashion Designing [3 0 0 3]

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 and 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).

TTX-426 Apparel Marketing and Merchandising[3 0 0 3]

Marketing: Domestic and 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 and Bhardwaj S K, "Managing Quality", New Age International, New Delhi, 2001.
5. Rosenau J A and Wilson D L, "Apparel Merchandising", Amazon, USA, 2001.

TTX- 427 Mill Management and Maintenance [3 0 0 3]

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, ManchesterUK, 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.

TTX-428 Project Formulation and Appraisal [3 0 0 3]

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", 6thEd., Kalyani publishers, N Delhi, 2000.
2. Kerzner H, "Project Management" 1st Ed., CBS Publishers and distributors, Delhi, 1987.
3. Prasanna 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, ManchesterUK, 1992.

TTX-429 Textile Process Simulations and Modeling [3 0 0 3]

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

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

Yarn manufacturing: Simulation of fibre properties, carding process, drafting, yarn formation, package building, balloon theory.

Fabric manufacturing: Modeling of weaving and knitting and stitching process, monitoring of online process performance.

Fabric properties: Modelling of fabric low stress 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", Sijthoff 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.

TTX- 430 Woolen Technology [3 0 0 3]

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 of wool: Objectives. Carbonization of wool in 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 woolen 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

TTX-432 Intelligent and Functional Textile [3 0 0 3]

Definition of smart and intelligent textiles, Passive and active functionality, Textile with high protection and comfort properties, Extreme winter clothing with low heat transmission, heat absorbing, heat storing systems. Phase change materials, incorporation of PCMs in fibres and fabrics. Breathable textile. Multifunctional textiles with incorporated electronics for integrated communication, music, health monitoring, defence support functions, wearable computers. Environmentally sensitive textiles- photochromic and thermochromic (chameleonic) fabrics, camouflage (radar shielding) fabrics, variable heat absorption surfaces, stimuli sensitive polymers such as temperature, pH, ionic, magnetic sensitive materials, design and their applications to textile. Fibres as solar cells, Recent advances in multifunctional textiles.

Books Recommended:

1. X. Tao, Xiaoming Tao ,” Smart Fibres, Fabrics, And Clothing”, Woodhead publishing (2001).
2. Jinlian Hu , “Adaptive and Functi polymers, Textiles and Their Applications”, imperial college press (2011).

3. Tao Xiaoming, "Wearable Electronics And Photonics", Woodhead publishing limited (2005).
4. H. Mattila, H. Mattila, " Intelligent Textiles and Clothing", CRC press (2006).
5. Vincenzini, "Smart Textiles", Trans tech pub ltd (2009).

TTX- 433 Advancement of nonwoven Technology [3 0 0 3]

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

Web formation techniques: Fibre preparation, Dry laying, wet laying, Spunlaying, Melt blowing, SM, SMS fabrics.

Mechanical Bonding: Developments in needle punching technology, Factors affecting the tensile and bulk properties of needle punched fabrics, Spunlacing technology, factors affecting the properties of spunlaced fabric, Stitch bonding techniques.

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 and their properties.

Spunbonding and Meltblowing: Techniques, structure and properties of fabrics.

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

Applications: Medical and Hygiene, Apparel, Household and 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 and Kittelmann, "Nonwoven Fabrics", Wiley-VCH Weinheim, 2003.
3. Mrstina V and 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.

TTX-434 Quality Control in Textile Chemical Processing [3 0 0 3]

Reviewing various areas of chemical processing of textiles.

Pretreatment: Optimized process parameters imparted to textiles in pretreatment and quality of products obtained, viz. singeing, desizing, scouring, bleaching, mercerization, Assessment of quality of pretreated product after each stage.

Colouration: Optimized dyeing parameters for dyeing of natural, manmade and blended textiles and quality of dyed product, Quality printing in various styles and methods.

Finishing: Optimized finishing parameters to impart various finishes on different fibres. Process parameters / process modification / any other changes. Change in quality due to selection of impure chemicals / faulty fabric / machine handling. Methods to assess quality of processed

product after every stage of processing and that of final product. Standardization of instruments / machineries, analysis of colour to check impurity percentage, evaluation of chemicals to check their efficiencies.

Books Recommended

1. Gokhale S V and Modi J R, "*Process and Quality Control in Chemical Processing of Textiles*", ATIRA, Ahmedabad, 1992.
2. Doshi S M and Shah H A, "*Quality and Process Control*", Chemical Processing Tablet IX, The Textile Association Education System, Ed. P C Mehta, The Textile Association (India), 1984.
3. Karmakar S R, "*Chemical Technology in the pretreatment processes of Textiles*", Textile Science and Technology Series, Vol-12, 1st Edition, Elsevier (1999).
4. Peters R H, "*Textile Chemistry*", Vol- III, Elsevier Scientific Publishing Co., New York, 1975.
5. Datye K.V and Vaidye A.A, "*Chemical Processing of Synthetic Fibres and Blends*", John Wiley and Sons, New York, 1984.

TTX- 435 Advancement in Manmade Fibres [3 0 0 3]

Structural principles of fibre forming polymers. Development of fibre structure during man-made fibre spinning. Variables in melt spinning.

High speed melt spinning: One step and two step spinning. Recent developments in melt, dry and wet technology. Various types of spinneret profiles. Mechanism of crystallization during MMF spinning.

Melt spinning of Hollow, multicomponent, Ultra fine and Nano fibres.

Spin finish application: Composition of spin finish, various methods of spin finish application, spin finish for staple fibre and textured yarns.

Technology of drawing of synthetic fibres, detailed study of mechanism of heat setting of synthetic fibres. Study of property changes in synthetic fibres during heat setting.

Simulation in melt spinning for fibre production. Process control in man-made fibre spinning.

Books Recommended:

1. Vaidya A A, "Production of Synthetic Fibres", 1st Ed., Prentice Hall of India, New Delhi, 1988.
2. Gupta V B and Kothari V K, "Manufactured Fibre Technology", Chapman and Hall, London, 1999.
3. "Hand Book of Fibre Chemistry", Ed. M Lewin and E M Pearce, Mercel Dekker Inc., 1998.
4. Hearle J.W.S., High Performance Fibres, Textile Institute, Woodhead Publishing, 2001
5. Mukhopadyay. S.K, "High Performance Fibres", Textile progress Vol. 25, Textile Institute Manchester, 1993.

TTX-436 Application of Operations Research in Textiles [3 0 0 3]

Operation research - Introduction, historical development, phases of operation research study; Linear programming; simplex method; Application of LPP in yarn production; Transportation problem and its application in textile production; Methods of finding an initial solution,

degeneracy, optimum solution; Assignment problems, variation in assignment problems, queuing theory. Inventory management techniques- selective inventory control: ABC analysis, economics order quantity, ordering cost, acquisition cost, inventory carrying cost or holding cost, just in time, information systems for inventory management, store management and merchandising, make or buy decision, analysis of investment in inventory, value analysis and material management; Enterprise resource planning.

Books Recommended:

1. Heera D S and Gupta P K, "Operation research ", Ist Ed., S Chand and Co., Delhi, 1997.
2. Taha H, "Operation research ", 6th Ed., Prentice Hall of India, Delhi, 1997.
3. Verma A P, "Operation research ", Ist Edition, S K Kataria and Sons, Delhi, 1998.
4. Menon K S, "Purchasing and inventory control", 3rd Ed., Wheeler Publishing House, N. Delhi, 1997.
5. Ahuja K K, "Production management", Ist Ed., CBS Publishers and Distributors, Delhi, 1998.
6. Christopher M, "Logistics and supply chain management", Pitman Publishing, UK, 1992.

TTX - 437 Clothing Science [3 0 0 3]

Factors involved in the study of clothing: the balance needed for comfort; boarder aspects of comfort; nonthermal components of comfort; environmental ranges and corresponding clothing.

Heat and moisture relations in clothing: approaches for studying heat and moisture exchange in clothing systems; heat and moisture factors in clothing as worn; heat and moisture transmission properties of clothing materials.

Physical properties of clothing and clothing materials in relation to comfort : thermal transmission or resistance; water vapor diffusion resistance ;water transport in clothing materials; water holding properties ;thickness of clothing materials; surface properties of fabrics; porosity and permeability properties; flammability of clothing materials; stiffness and bending properties etc.

Current trends and new developments in the study of clothing: new materials and finishes; new techniques and new concepts.

Books Recommended:

1. Lyman Fourt and Norman R.S. Hollies, "Clothing Comfort and Function", Marcel Dekker, INC., New York, 1971
2. Kothari, V K, "Testing and Quality Management ", CBS Book Publishers, New Delhi, 2000.
3. Zhang Wei Yuan, "Clothing Comfort and Function",China Textile Press,2011
4. Saville B P, "Physical Testing of Textiles," The Textile Institute, Woodhead Publication Limited, Cambridge, 1999,

TTX-438 High performance fibres [3 0 0 3]

Basic concept of high performance fibres; Hi -Performance Gelspun Polyethylene fibres- Manufacture fibres characteristics, properties and applications; Aramids- Introduction, polymer preparation, Spinning, Structure and properties, applications.

Carbon Fibres- Introduction, production, Physical properties of Rayon based, PAN based and Pitch based Carbon fibres.

Applications: Glass Fibres- Fibre manufacture, fibre finish, fibre properties and application. Vectran (Melt spun wholly aromatic polyester fibre)Fibre production; properties and application, PBO (Polyphenylene benzobisoxazole) fibres- Fibre production, properties and application. PEEK Fibres -Fibre production, properties and application.

Books Recommended:

1. T. Hongu, New fibres, Ellis Horwood, New York 1990.
2. Lewis. E .M. Pearce, J .Preston, Hand book of fibre science and technology Vol-4, , Marcel Dekkar, New York 1989.
3. Donnet J. B. Bansol R .C Carbon fibres , Marcel Dekkar, New York 1990.
4. Hearle J.W.S., High Performance Fibres, Textile Institute, Woodhead Publishing, 2001.
5. Mukhopadyay. S.K, “High Performance Fibres”, Textile progress Vol. 25, Textile InstituteManchester, 1993

Open Electives

TTX- 451 Polymers and Fibre Science [3-0-0-3]

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

Structure of polymers: Specific features of polymer structure, i.e., regularity andIrregularity; molecular weight and size; Configuration and conformation of molecules;Determination of molecular weight and effect of molecular weight on the structure andproperties of polymer; Concept of rubbery state and rubber elasticity; Transition from glassy to rubbery state; Melting of polymers; Factors influencing Tg and Tm of polymers; Basic concept of methods of investigation of polymer structure.

Polymerisation: Different methods of polymerization; Basic concept of bulk, solution, suspension and emulsion polymerisation.

Fibre: Introduction about fibre, special features of fibre / fibre forming polymers. Different processes for conversion of polymer to fibre. Basic understanding about common synthetic fibres ,e.g, Polyester, Nylon, Acrylic; Concept of high performance fibre; Introduction and use of Aramids, Carbon, Glass etc.

Introduction about application of fibres in Mechanical (Composite); Civil (Geotextile), Electronics (E-textile) etc.

Books Recommended:

1. Billmeyer W, “Textbook of Polymer Science”, John Wiley and Sons, New York, 1994.
2. Gowariker V. R, Viswanathan N.V and and Sridhar J, “Polymer Science”, New AgeInternational Ltd. Publishers, New Delhi, 1996.
3. Hearle JWS, “Polymers and their properties”, Vol.I, John Wiley and Sons, NY, 1982.
4. Gupta V B and Kothari V K, “Manufactured Fibre Technology”, Chapman and Hall, London, 1999.
5. High Performance fibre Hand book of fibre science andTech.

TTX-452 Properties of Polymer and 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.

TTX-453 Textile Machines and processes [3 0 0 3]

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.
2. Klein W, "Manual of Textile Technology" Vol. I - V, 1st Ed., The Textile Institute, Manchester, 1995.
3. Talukdar M K, Sriramulu P K and Ajgaokar 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.

TTX-454 Textile design [3-0-0-3]

Introduction to textiles and textile designs from fibre to product purchase, textile numbering system, types of fibres, yarns and fabrics, and their production methods, diversity of textile design, principles and elements of textile design, weave and structure of woven textile design (point paper, graphical), knitwear design, Principles: Surface approaches to textile design (Surface design of textiles, printed textile design, Embroidered textile design, Designing through dyeing and finishing), design of technical textile, key issues affecting textile and fashion design, commercial aspects of design, computer aided textile designing, Designing future textiles: new developments in textile structures and surface treatments

Books Recommended:

1. Gohl E P G and Vilensky LD, "Textile Science", CBS Publishers, Delhi, 1983.
2. Bernard P. Corbman, "Textiles Fiber to Fabric", McGraw-Hill International Editions, Singapore, 1983.
3. "Handbook of Technical Textiles", Ed. A R Horrocks and S C Anand, Woodhead Publication Ltd., Cambridge, 2000.
4. Textile design: Principles, advances and applications, Edited by A Briggs-Goode and K Townsend, Woodhead Publishing Series in Textiles No. 112, 2011.
5. Handbook of nonwovens, Edited by S Russell, Woodhead Publishing Series in Textiles No. 58, 2006.
6. Handbook of Textile design: Principles, Processes and Practice, by Jacquie Wilson, Woodhead Publishing Ltd, Cambridge 2001.
7. Angappan P and Gopalakrishnan R, "Textile Testing", SSM Institute of Textile Technology, Komarapalayam, 2002.

TTX-455 Fashion and Textiles [3 0 0 3]

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 and 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.

Books Recommended:

1. Erwin Mabel (1994):- Clothing for Moderns, Macmillan Co. London.
2. Tate (1977) Sharon lee:- “Inside Fashion Design” Farnsico 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 Publishersand Distributors, New Delhi

TTX- 456 Fashion Designing [3 0 0 3]

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.

TTX-457 Geotextiles [3 0 0 3]

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 "Geosynthetics in civil engineering", Ed. R W Sarsby, Woodhead Textiles Series No. 57, 2006, UK.
- 2 ShuklaS K, YinJian-hua, Fundamentals of Geosynthetic Engineering, Taylor and Francis, 2006, UK.
- 3 John N W M, "Geotextiles", Blakie, Chapman and Hall, 1987, New York, USA,
- 4 Raj P Purushothama, "Soil Mechanics and Foundation Engineering", Pearson, 2007, India.
- 5 "Engineering with Geosynthetics", Ed. G V Rao and G V S Raju, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.

TTX-458 Designs of Experiments [3 1 0 4]

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.

TTX459 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.

TTX-460 Environmental Science and Management [3 0 0 3]

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

Environment pollution: Different types of pollution: Water, air, soil, noise, thermal, radiation, etc.

Air pollution: Definition and limits, 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.

Thermal pollution: Definition, sources and classification, its impact, and management.

Radiation pollution: Definition, sources and classification, its impact, 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.

TTX-461 Industrial Textiles [3 0 0 3]

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, Technomic Publishing Company, Inc., Pennsylvania, USA, 1995.
3. Shukla S K, Yin Jian-hua, Fundamentals of Geosynthetic Engineering, Taylor and Francis, 2006, UK.
4. "Modern Textile Characterization Methods", Ed. M Raheel, Marcel Dekker, Inc., 1996.

5. Nonwoven Fabrics; Ed. W. Albrecht, H. Fuchs, and W. Kittelmann, WILEY VCH Publication, 2003, UK.

TTX-462 Marketing and Merchandising of Products [3 0 0 3]

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.

TTX-463 Clothing Science [3 0 0 3]

Introduction: Factors involved in the study of clothing; clothing considered as a system interacting with the body

Dimensional Stability: Hygral expansion. Relaxation shrinkage. Swelling shrinkage. Felting shrinkage Shrinkage in knitted fabrics. Stretch and recovery properties.

Serviceability: Abrasion resistance. Tear strength. Colour fastness. Seam slippage. Seam strength. Snagging. Pilling.

Transmission properties: Air permeability. Water vapour permeability. Wetting. Longitudinal and transverse wicking. Water absorption. Thermal conductivity. Electrical conductivity.

Thermal Comfort: Thermal transfer processes – Dry heat transfer and Rapid heat transfer. Flammability – burning behaviour. Thermal degradation. Function of Textiles in enhancing thermal comfort.

Fabric Handle: Tensile properties. Shear properties. Bending properties. Compressional properties. Roughness and Frictional properties. Buckling behaviour and Formability. Low stress mechanical properties and tailor ability. Sewability of fabrics.

Books Recommended:

1. Lyman Fourt and Norman R.S. Hollies, "Clothing Comfort and Function" Marcel Dekker, INC., NEW YORK 1971
2. Kothari, V K, "Testing and Quality Management", CBS Book Publishers, New Delhi, 2000.
3. Zhang Wei Yuan, "Clothing Comfort and Function", China Textile Press, 2011
4. Saville B P, "Physical Testing of Textiles," The Textile Institute, Woodhead publication limited, Cambridge, 1999,
5. J.E. Booth, " Principles of Textile Testing, Butterworth Heinemann Ltd., U.K. , Indian Edition: 1996

TTX -464 High performance fibres [3-0-0-3]

Basic concepts of fibres. Factors influencing properties / performance of fibre. Necessity of high performance fibres. Different approaches for development of high performance fibres.

Hi -Performance Gelspun Polyethylene fibres- Manufacture, fibres characteristics, properties and applications.

Aramids- Introduction, polymer preparation, Spinning, Structure and properties, applications.

Carbon Fibres- Introduction, production, Physical properties of Rayon based, PAN based and Pitch based Carbon fibres. Applications.

Glass Fibres- Fibre manufacture, fibre finish, fibre properties and application.

Vectran (Melt spun wholly aromatic polyester fibre), Fibre production, properties and application,

PBO (Polyphenylene benzobisoxazole) fibres- Fibre production, properties and application.

Books Recommended:

1. T. Hongu, New fibres, Ellis Horwood, New York 1990.
2. Lewis. E .M. Pearce, J .Preston, Hand book of fibre science and technology Vol-4, Marcel Dekkar, New York 1989.
3. Donnet J. B. Bansol R .C, Carbon fibres, Marcel Dekkar, New York 1990.
4. Hearle J.W.S., High Performance Fibres, Textile Institute, Woodhead Publishing, 2001.
5. Mukhopadyay. S.K, "High Performance Fibres", Textile progress, Vol. 25, Textile InstituteManchester, 1993.