

# M Tech (Part time) Programme in Textile Technology

## Scheme and Syllabi



**Dr B R AMBEDKAR  
NATIONAL INSTITUTE OF TECHNOLOGY JALANDHAR – 144011  
Year 2008**

**M TECH (PART-TIME) PROGRAMME IN TEXTILE TECHNOLOGY TO BE STARTED FROM 2009-2010****Preamble**

The Department of Textile Technology is a pioneer in grooming textile engineers in India. It is worth to mention that the Department of Textile Technology is a unique department among twenty NITs of the country which provides textile education. Being strategically surrounded by densely populated textile industries of India, graduates of the department find ample opportunities in the textile industry, garment industry, marketing, servicing of textile machines and even in software industry of the region and beyond. It may be added that during the past decade there is a changing scenario in textile industry as competition has intensified in the marketplace for cost competitiveness along with the requirement of high level of product quality. Therefore, at present industry needs specifically developed manpower for servicing at R &D and at different managerial positions with analytical skill. In the above perspective, M Tech (part time) programme is aimed at improving skills of working personnel within the state of Punjab and around.

**Eligibility Criteria**

B.E./B.Tech. in Textile Technology, Textile Engineering, Textile Chemistry and Man-made Fibre Technology with minimum aggregate marks of 60% along with a minimum of 2 years of industrial/research experience. Also see the Institute norms for additional requirements.

**Duration:** Three and half years (7 Semesters)

**Total number of seats:** 20 [10 (GN), 3 (SC), 2 (ST), 5 (OBC)]

**Number of Courses:** 12(Theory); 4(Practical)

**Independent Study:** 01

**Dissertation:** 02 Semesters (Minimum)

**Total Credits:** 65

**Semester-wise breakup of courses**

Semester	Number of courses/ Seminar
I	2 to 3 Theory Courses and 1 Lab. Course
II	2 to 3 Theory Courses and 1 Lab. Course
III	2 to 3 Theory Courses and 1 Lab. Course
IV	2 to 3 Theory Courses and 1 Lab. Course
V	2 to 3 Theory Courses and Independent Study
VI	Dissertation
VII	Dissertation

1. A student will take and complete a total of 12 courses, 04 laboratory courses, 01 independent study and 01 dissertation.
2. The student can submit his/her dissertation at the end of 7<sup>th</sup> Semester.
3. The proposal for dissertation can be submitted preferably by the end of 5<sup>th</sup> semester but not later than 4 weeks from the start of 6<sup>th</sup> semester.

**Note:**

1. These regulations will be effective w.e.f. academic session 2009-2010 starting from January 2009 and there after.
2. Maximum duration for clearing the M Tech Program shall be 5 years. In exceptional cases the duration for completing the course can be extended by one year with the permission of the competent authority.
3. There can be maximum of two supervisors for the dissertation out of which one should be from the department of Textile Technology.
4. Classes will be held on Saturday and Sunday only.

### Course Structure and Scheme

Maximum Credits = 65

Course Code	Course Title	Hrs/week			Credits
		L	T	P	
TT XXX	Core Course 1	3	0	0	3
TT XXX	Core Course 2	3	0	0	3
TT XXX	Core Course 3	3	0	0	3
TT XXX	Core Course 4	3	0	0	3
TT XXX	Core Course 5	3	0	0	3
TT XXX	Core Course 6	3	0	0	3
TT XXX	Core Course 7	3	0	0	3
TT XXX	Elective 1	3	0	0	3
TT XXX	Elective 2	3	0	0	3
TT XXX	Elective 3	3	0	0	3
TT XXX	Elective 4	3	0	0	3
TT XXX	Elective 5	3	0	0	3
TT-515	Yarn Manufacturing Lab	0	0	3	2
TT-517	Fabric Manufacturing Lab	0	0	3	2
TT-512	Advanced Textile Testing Lab	0	0	3	2
TT-516	Garment Technology Lab	0	0	3	2
TT-603	Independent Study	0	0	0	3
TT-600	Dissertation	0	0	--	18
<b>Total</b>					<b>65</b>

**LIST OF CORE COURSES**

Course Code	Course Title	Hrs/week			Credits
		L	T	P	
TT-501	Technology of Fiber Production	3	0	0	3
TT-503	Technology of Yarn Production	3	0	0	3
TT-505	Technology of Fabric Production	3	0	0	3
TT-502	Theory of Yarn Structure and Properties	3	0	0	3
TT-504	Theory of Fabric Structure and Properties	3	0	0	3
TT-506	Statistical Methods and Design of Experiments	3	0	0	3
TT-601	Technical Textiles	3	0	0	3
TT-515	Yarn Manufacturing Lab	0	0	3	2
TT-517	Fabric Manufacturing Lab	0	0	3	2
TT-512	Advanced Textile Testing Lab	0	0	3	2
TT-516	Garment Technology Lab	0	0	3	2

**LIST OF ELECTIVES**

Course Code	Course Title	Hrs/week			Credits
		L	T	P	
TT-507	Colouration and Finishing Technology	3	0	0	3
TT-508	Costing, Project Formulation and Appraisal	3	0	0	3
TT-509	Production Management in Textiles	3	0	0	3
TT-510	Textile Marketing and Merchandising	3	0	0	3
TT-518	Quality Management	3	0	0	3
TT-519	Human Resource Management	3	0	0	3
TT-520	Product Design and Development	3	0	0	3
TT-521	Process Control	3	0	0	3
TT- 611	Characterization of Polymers and Fibres	3	0	0	3
TT- 613	Post Spinning Operation	3	0	0	3
TT- 615	Advanced Chemical Processing	3	0	0	3
TT- 617	Garment Manufacturing Technology	3	0	0	3
TT- 619	Geosynthetics	3	0	0	3
IC- 621	Instrumentation and Control Engineering	3	0	0	3
TT- 621	Operation Research and Logistic Management	3	0	0	3
TT- 623	Knitting and Non woven Technology	3	0	0	3
TT- 625	Textile Structural Composites	3	0	0	3
TT- 627	Simulation of Textile Processes	3	0	0	3
TT- 629	Physical Properties of Fibre	3	0	0	3
TT- 631	Environmental Practices in Textiles	3	0	0	3

## **Core Subjects**

### **TT 501 Technology of Fiber Production [3-0-0-3]**

General definition of man made or manufactured fibres, introduction to general principles of spinning and spinning processes. Basic principles of fluid flow during fiber spinning, factors affecting shear viscosity. Elongational flow, spinnability and flow instabilities. Extruder design, spin head, spinneret, quench chamber. Spin finish application, wind up mechanism.

Manufacture and specifications of raw materials and monomers. Types, methods of manufacture, mechanism of polymerisation and production techniques of viscose, nylon 6 and 66, PET, PAN and PP. Introduction to new developments. Other fibres including PU, PVA, PE, PVC and polyvinylidene chloride.

Primary and secondary variables and their effect on melt spinning. High speed spinning, spinning of microfibre, solution spinning process: Dry and wet spinning. Heat-setting of fibres.

#### **Books Recommended:**

1. Vaidya A A, "Production of Synthetic Fibres", 1<sup>st</sup> Ed., Prentice Hall of India, New Delhi, 1988.
2. Gupta V B and Kothari V K, "Manufactured Fibre Technology", 1<sup>st</sup> Ed., Chapman and Hall, London, 1997
3. Mark H F, Atlas S M and Cernia E, "Man Made Fibre Science and Technology", Vol. 1, 2, 3, 1<sup>st</sup> Ed., Wiley Inter Science Publishers, New York, 1967.
4. Macintyre J E, "Synthetic Fibres", Woodhead Fibre Science Series, UK, 2003.
5. Fourné F, "Synthetic Fibres: Machines and Equipment, Manufacture, Properties", Hanser Publisher, Munich, 1999.

### **TT 503 Technology of Yarn Production [3-0-0-3]**

Fiber quality requirements for different spinning technologies. Systems of yarn manufacture in cotton, worsted, woolen and semi worsted system. Comparative study of new spinning technologies. Concept of opening and cleaning. Aerodynamics and its role in blowroom. Theories of Carding. Drafting theories. Developments in comber. Quality aspect of roving. Balloon theory in spinning. Significance of modern developments in spinning process. Modern high speed draft spinning systems. Machine and process variables affecting the structure and properties of spun yarns. Introduction to core spinning, cover spinning, Siro-spinning and compact spinning. Processing of wool and man made fibres in new spinning systems. Non conventional methods of yarn manufacture. Air-vortex yarn. Quality standards of different yarns with emphasis on USTER standard. Production and properties of textured yarn with emphasis on BCF, false twist and air-jet textured yarns. Analysis of structure-property relationship of rotor, air-jet and friction spun yarns.

#### **Books Recommended:**

1. Grosberg P and Iype C, "Yarn Production-Theoretical Aspects", 1<sup>st</sup> Ed., The Textile Institute, UK, 1999.

2. Chattopadhyay R, "Advances in Technology of Yarn Production", 1<sup>st</sup> Ed., NCUTE, New Delhi, 2002.
3. Rao M V S and Talele A B, "A Guide to Crimping / Texturing Technology", 1<sup>st</sup> Ed., Nasnal Printers and its associates, Surat, 1992.
4. Klein W, "Manual of Textile Technology- New spinning Systems", Vol.5, 1<sup>st</sup> Ed., The Textile Institute, UK, 1993.

### **TT 505 Technology of Fabric Production [3-0-0-3]**

Development trends in winding, warping and sizing machines for improving quality of preparation and cost reduction. Loom development trends and objectives. Kinematics of sley and heald motion with reference to shuttle loom. Mechanism of shuttle checking. Analysis of warp tension during weaving. Theoretical analysis of weft insertion in shuttleless loom. Cloth fell position, beat-up force and pick spacing. Electronic control of different motions of loom. Techno-economics of different methods of fabric production.

Types of weft knitting machines and its cam profile. Quality control in weft and warp knitted fabrics. Mechanics of knitted loop formation. Designing nonwoven for engineering applications. Effect of machine, fiber and process variables on the properties of nonwoven fabrics. Developments in nonwoven machineries. Value loss of fabric. Stitching and garment making. Concept of smart textiles.

#### **Books Recommended:**

1. Marks R and Robinsons A T C, "Principles of weaving", Textile Institute, UK, 1986.
2. Ormerod A, "Modern preparations and weaving machinery", Butterworth and Co., UK, 1983.
3. Talavasek O and Svaty V, "Shuttleless weaving machine", Elsevier Scientific Publishing Co., Amsterdam, 1981.
4. Lunenschloss J and Albrecht W, "Non-Woven Bonded Fabric", Ellis and Horwood Ltd., UK, 1985.
5. Journals: Textile Research Journal, Princeton, USA and Journal of Textile Institute, Manchester, UK.

### **TT 502 Theory of Yarn Structure and Properties [2-1-0-3]**

Elements of yarn geometry. Geometry of helix and its application to yarn structure. Geometry of folded yarn. Yarn diameter and density. Theoretical analysis of effect of fiber properties and their geometrical configuration on the tensile and bending properties of yarn. Design of yarn structures for certain functional uses. Theories and analysis of yarn strength and irregularity. Fiber migration characteristics of continuous filament and spun yarns. Breakage of continuous filament and spun yarns. Effect of properties of constituent fibres and blend composition on behaviour of composite yarns. Effect of yarn structure on different properties of yarns. Structure and property relationship of ring, rotor, air-jet and friction spun yarns.

**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. Hearle J W S, Thwaites J J and Amirbayat J, “Mechanics of flexible fibre assemblies”, Sijthff and Noordhoff International Publishers BV, Alphen aan den Rijn, Netherlands, 1980.
4. Journals: Textile Research Journal, Princeton, USA and Journal of Textile Institute, Manchester, UK.

**TT 504 Theory of Fabric Structure and Properties [2-1-0-3]**

Engineering approach for fabric formation, cloth geometry, practical aspect of cloth geometry, jammed structure, racetrack section of yarn. Fabric cover factor and its significance. Graphical relationship in cloth geometry for plain, twill and sateen weaves. Theoretical investigation of weavability limit of yarns. Elastic thread model for fabric. Concept of fabric relaxation. Tensile and tearing behaviour of fabric. Bending deformation of fabric, bending hysteresis of woven fabric. Buckling, shear and drape behaviour of woven fabric. Geometrical and mechanical properties of warp and weft knitted fabrics. Mechanical properties of nonwoven needle punch and stitch bonded fabric. Formability, tailorability and hand of apparel fabric.

**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. Peirce F T and Womersley J R, “Cloth Geometry”, The Textile Institute, Manchester, 1978.
3. Hearle J W S, Thwaites J J and Amirbayat J, “Mechanics of Flexible Fibre Assemblies”, Sijthff and Noordhoff International Publishers BV, Alphen aan den Rijn, Netherlands, 1980.
4. Journals: Textile Research Journal, Princeton, USA and Journal of Textile Institute, Manchester, UK.

**TT 506 Statistical Methods and Design of Experiments [3-0-0-3]**

Various statistical tools and their usefulness. Measurement of dispersion, binomial, Poisson and normal distribution, analysis of discrete and ranking data, acceptance sampling, control charts, correlation and regression, principles of experimental design, typical application of experimental design, simple comparative experiments, experiment with single factor, analysis of variance, Various type of design, introduction to factorial designs,  $2^k$  factorial design, two level design, three level design, fitting regression models, multiple regression and correlation analysis, response surface methodology, test of significance and model lack of fit, use of replicates, use of computers and software package.

**Books Recommended:**

1. Cochran W G and Cox G M, “Experimental Designs”, Second Edition, John Wiley and Sons, Inc., New York, 1957.

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

### **TT 601 Technical Textiles [3-0-0-3]**

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: Brief idea about the important properties and requirements in automotive textiles, textiles components in tyre, tyre structure and design. General technical textile: Textiles in agriculture, 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. Roy T K, "Air Pollution Control in Textile Industry", Vol. I and II, Tech Book International, New Delhi, 2004.
3. "Modern Textile Characterization Methods", Ed. M Raheel, Marcel Dekker, Inc., 1996.
4. "Engineering with Geosynthetics", Ed. G V Rao and G V S Raju, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.
5. Journals: Textile Research Journal, Princeton, USA and Journal of Textile Institute, Manchester, UK.
6. Mukhopadhyay S K and Partridge J F, "Automotive Textiles", Vol. 29, No. ½, The Textile Institute, 1999.

### **TT 515 Yarn Manufacturing Laboratory**

- A. Exploration of product development possibilities in Spinning and Weaving laboratories.
- B. B. Product development by using the existing prototype machines.
  - 1. Friction spun Yarn
  - 2. ring Spun Yarn
  - 3. Air –jet Spun Yarn
- C. Measurement of properties of the yarns.

### **TT 517 Fabric Manufacturing Laboratory**

- A. Preparation of Fabric Samples in knitting machines and measurement of Fabric properties.
- B. Preparation of Fabric Samples in Weaving machines and measurement of Fabric Properties.

### **TT 512 Advanced Textile Testing Lab**

- 1. Evaluation of tensile and compressional characteristics of different woven and nonwoven fabric.
- 2. Evaluation of filtration efficiency of bag filters.
- 3. Assessment of yarn diameter, fabric pore size using image analysis method.
- 4. Evaluation and analysis of HVI data for differently graded cotton material.
- 5. Evaluation and analysis of bending behaviour of woven fabric using Shirley stiffness tester and through bending length measurement.
- 6. Evaluation and analysis of tearing strength of fabric using universal tester and Elmendorf tear tester.

### **TT 514 Garment Technology Lab**

Study of various stitches and seams

- 1. Calculation of seam strength and seam strength efficiency with various stitches and destiny.
- 2. Study and construction of some patterns for Kids wear, Men's wear and Women's wear.
- 3. Design and optimization of sewing parameters for knitted fabrics and elastomeric materials.
- 4. Study and assessment of seam puckering.
- 5. Study of various lay plans.
- 6. Study of various cutting tools and its applications.
- 7. Designing of T-shirts, Skirts, Pant and Shirt using Mannequins.

### **TT 603 Independent study [0-0-0-3]**

Student should undertake in depth study of a subject of outside the regular courses offered in the programme. The study should be carried out under the guidance of a faculty member. The subject area chosen by the student should be sufficiently different from the area of project being pursued by the student. Student must submit the detailed plan of work to the programme coordinator before approval of registration for the courses. The evaluation will be based on the report, seminar and viva-voce.

## **Electives**

### **TT 507 Colouration and Finishing Technology [3-0-0-3]**

Preparatory processes for synthetic textiles and their blends. Heat setting - Mechanism and effect on properties of textiles. Developments in dyeing of synthetic textiles and their blends. Dyeing of micro-fibres. Mass coloration of synthetic textiles. Printing of synthetic/blended textiles in direct, resist and discharge styles. Transfer printing of polyester, cotton, wool and their blends. Quality control in chemical processing. Anti-crease finishes and latest development in it. Controlled application techniques. Anti-stat, soil release and flame-retardant finishes. Garment processing. Energy conservation, minimization of wastage of energy during chemical processing of textiles, low temperature processing of textiles. Waste water load in various areas of chemical processing and ways to reduce it.

#### **Books Recommended:**

1. Peters R H, "Textile chemistry", Vol. – II and III, Elsevier Publishing Company, London, 1967.
2. Nunn D M, "The dyeing of synthetic polymer and acetate fibres", Dyers Company Publication Trust, London, 1979.
3. Miles L W C, "Textile printing", Dyers Company Publication Trust, Bradford, England, 1981.
4. Hall A J, "Textile finishing", Haywood Books, London, 1996.
5. Bird C L and Boston W S, "The theory of coloration of textiles", Dyers Company Publication Trust, Bradford, England, 1975.
6. Smethwurst G, "Basic water treatment", IBT Publications, Delhi, 1989.

### **TT 508 Costing, Project Formulation and Appraisal [3-0-0-3]**

Costing- elements of costs, expenses excluded from cost, cost sheet, cost concept, cost classification, treatment of stock. 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 –Cost of project, means of finance, projected financial statements, working capital requirement, estimate of sale and production, cost of production, cash flow, time value of money and cost of capital. 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", 6<sup>th</sup> Ed., Kalyani publishers, N Delhi, 2000.
2. Kerzner H, "Project Management" 1<sup>st</sup> Ed., CBS Publishers and distributors, Delhi, 1987.
3. Prasana C, "Projects- Planning, Analysis, Selection, Implementation and Review", 6<sup>th</sup> Ed., Tata Mc Grawhill Publishing Co. Ltd., N. Delhi, 1996.
4. Ormerod A, "Textile Project Management", The Textile Institute, Manchester UK, 1992.

**TT 509 Production Management in Textile [3-0-0-3]**

Operations management in corporate profitability and competitiveness, types and characteristics of manufacturing and service systems. Operations planning control: Planning production in aggregate terms, quality assurance. Plant layout: Features, basic principles, types of layout, merits and demerits, optimization of a product/line layout and process layout. Location of Facilities: Nature of location decision, situations that influence location decision, backward areas and industrial policy, behavioral aspects in location planning. Purchasing; Objectives, value engineering, vendor relations, selection of vendors. Material Requirement Planning: MRP Calculations, material handling. Job Evaluation: Incentive schemes, job redesign. Work measurement techniques.

**Books recommended:**

1. Raymond M R, "Production and operations management", Mcgraw-Hill international Edition, New York, 1993.
2. Buffa S E and Sarin R, "Modern Production/ Operations Management", John Willey and Sons, Delhi, 1995.
3. Collard R, "Total quality", Jaico Publishing House, Mumbai, 1988.
4. Sharma S K, Sharma S and Sharma T, "Industrial Engineering and Operations Management", S K Kataria and sons, Delhi, 1996.

**TT 510 Textile Marketing and Merchandising [3-0-0-3]**

Marketing management - Domestic marketing, international marketing, textile product development and marketing, product life cycle, pricing, marketing channels and promotion mix. Marketing research – Basic concepts, research process, identifying market segment, product research, advertising research, market and sales analysis. Merchandising - Merchandise buying and handling process, resident buying offices, merchandise pricing, merchandising forecasting and budgeting. Framework of retailing, developing and applying retail strategies, factors affecting retail price strategy, societal impact of retail merchandising, selling to retailers.

**Books Recommended:**

1. Kotler P, "Marketing Management", 9<sup>th</sup> Ed., Prentice Hall of India, N. Delhi, 1998.
2. Barry B and Joel R E, "Retail Management", McMillan Publishing Co., New York, 1989.
3. Ernest H R, "Retail Merchandising", McMillan Publishing Co., New York, 1991.

**TT 518 Quality Management [3-0-0-3]**

Introduction to Quality Management, concept of Modern Quality management, service quality and product quality. On-line quality control, Role of off-line and on-line quality control. Off-line quality control, Basic concept, pre-requisite steps of off-line Q.C., Z.D. on way to off-line quality control. Leadership for quality Management; Attitude and involvement of top management, communication. Strategic quality Planning, the process and strategic quality management, definition of quality control, Relationship with HRM. Management of process quality; Product and process control, statistical quality control and basic approach to it, 6 sigma limit, TPM, quality function deployment, just-in-time, just-in-case. Organizing for TQM. Cost of Quality . Universal standards of quality; ISO around the world, certification, quality manuals, documentation and implementation. Case studies.

**Books recommended:**

1. Ross E, "Total Quality Management", Kogan Page USA, 1989.
2. Raju S S M, "Total Quality Management", Tata Mcgraw Hill Publishing Co., 1985.
3. Fiegenbaum V A, "Total Quality Management", Mcgraw Hill International, 1990.
4. Tenner R A and Detoro J I, "Total Quality Management", Addison-Wesley Publishing Co., 1986.

**TT 519 Human Resource Management [3-0-0-3]**

Nature, scope, developments and operations of human resources management. The planning function, procurement function with an emphasis on the employment exchange act, labour regulation act, apprentice act. The compensation function with payment of wages act and minimum wages act. Maintenance functions with factory act, industrial dispute act, P.F. act, family pension scheme, gratuity act, maternity benefit act, integration function. Balancing of employee satisfaction with organization goals, moral and motivation. An overview of union - management relations. The role of line managers and personnel administrators in the development and application of personnel policies.

**Books recommended:**

1. Flippo B E, "Personnel Management", Mcgraw Hill Book Co., 1993.
2. Mamoria C B and Gankar S V, "Personnel Management", Himalaya Publishing House, Delhi, 1994.
3. Chhabra T N, "Human Resource Management", Dhanpat Rai and Co.Pvt. Ltd., Delhi, 1999.

### TT 520 Product Design and Development [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.

#### Books recommended:

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

### TT-521 Process Control [3-0-0-3]

Concept of process and control, What is the need of such process control? Basic knowledge of statistics for controlling the process. The general method of process control. On-line Process Control and Trouble shooting. The effect of Process control on product cost. The various shop floor case studies.

Uniform Textile Production: Definition of uniformity in terms of textile production. What is the need of Uniform Textile Production? Various sources of non-uniformity generation along the textile production line. Process parameters versus non-uniformity model. Preventive measures for arresting non-uniform textile production at every stage. Various Remedial measures for reducing / eliminating non-uniformity in textiles.

Processing of Stretched fabric: What is stretched fabric? Basic knowledge of stretch yarn, stretch fabric production. Various quality parameters of stretched fabric. Detail study of processing of stretched fabric.

Defects in Textile products & Customer complaints: Definition of defects in terms of textile products. Knowledge of various defects generally observed in textile products. Detail study of Standard Textile Inspection system. Maximum utilization of defective textile products. Various analysis tools for handling customer complaints. Customer Satisfaction Index. Value Addition in Textile Products: Scope of value addition in textile products. Intelligent / Smart Textiles. Various functional finishes.

#### Books recommended:

1. Garde A R and Subramanian T A, "Process Control in Cotton Spinning," ATIRA, Ahmedabad, 2<sup>nd</sup> Ed., 1978.
2. Paliwal M C and Kimothi P D, "Process Control in weaving", ATIRA, Ahmedabad 2<sup>nd</sup> 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.

- Salhotra K R, Chattopadhyay R and Ishtiaque S M, "Process control in spinning", IIT, Delhi, CD cell, 2001

### **TT 611 Characterisation of Polymers and Fibres [3-0-0-3]**

Molecular weight and dimension: Number and weight average 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 techniques of structure characterization, viz., IR Spectroscopy, NMR Spectroscopy, UV-VIS Spectroscopy, Raman Spectroscopy. X-ray scattering and analysis of structure. Thermal characterisation: Differential scanning calorimetry, Differential thermal Analysis, Thermo gravimetric analysis, Dynamic mechanical analysis. Microscopy: optical and electron microscopy. Determination of fiber density.

#### **Books recommended:**

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

### **TT 613 Post Spinning Operations [3-0-0-3]**

Drawing Process, neck drawing, initiation and propagation of neck, neck stabilization. natural draw ratio, effect of temperature and strain rate on neck drawing, prediction of neck formation, influence of drawing on structure and properties of filament, spin-draw process. Texturing and warping process. Material and process variables in texturing and their influence on yarn quality. Recent advances in texturing, testing and evaluation of textured yarn. Properties of fabrics made from textured yarn.

Heat Setting process, parameters for heat setting, equipment for heat setting and evaluation of degree of set. Post spinning operation on multifilament sewing threads.

#### **Books recommended:**

- Gupta V B and Kothari V K, "Manufactured fibre technology", 1<sup>st</sup> Ed., Chapman and Hall, London, 1997
- Mark H F, Atlas S M, Cernia E, "Man made fibre science and technology", 1<sup>st</sup> Ed., Vol. I, II, III, Willey Interscience Publishers, New York, 1967.
- Macintyre J E, "Synthetic fibres", Woodhead Fibre Science Series, UK, 2003.
- Fourne F, "Synthetic fibres: Machines and equipment, manufacture, properties", Hanser Publisher, Munich, 1999.

### TT 615 Advanced Chemical Processing [3-0-0-3]

Colour: definition, types of colouring materials, colour theories and colour measurement. Computer colour matching system. Recipe management. Theory of dyeing: Dye-fibre bonds, influence of fibre and dye structures in dyeing, diffusion and rates of dyeing, response of fibres to dyeing processes. Dyeing at super critical temperature. Kinetics of various dyeing processes: dyeing of cotton with direct and vat dye, dyeing of nylon and wool with acid dye. Overdyeing and tip dyeing of wool. Developments in printing: ink-jet printing, xerox printing. Development in finishing, finishing of micro fibres/fabrics, low liquor finishing and kiss-roll technique, foam finishing. Energy conservation. Water quality and waste water management.

#### Books Recommended:

1. Sule A D, "Computer colour analysis- Textile applications", New Age International (P) Ltd., New Delhi, 1997
2. Miles L W C, "Textile printing", Dyers Company Publication Trust, Bradford, England, 1981.
3. Hall A J, "Textile finishing", Haywood Books, London, 1996.
4. Shore J, "Colorants and auxiliaries", Vol-I and II, Society of Dyers and Colorists, Bradford, England, 1990.
5. Datye K V and Vaidye A A, "Chemical processing of synthetic fibres and blends", John Wiley and Sons, New York, 1981
6. Bird C L and Boston W S, "The theory of coloration of textiles", Dyers Company Publication Trust, Bradford, England, 1975.
7. Manivaskaram N, "Treatment of textile processing effluent", Sakthi Publications, Coimbatore, 1995.
8. Peters R H, "Textile chemistry", Vol- III, Elsevier Scientific Publishing Co., New York, 1975.
9. Smethwurst G, "Basic water treatment", IBT Publications, Delhi, 1989.

### TT 617 Garment Manufacturing Technology [3-0-0-3]

Introduction to garment manufacturing and Indian apparel industry. Pattern alteration techniques. Principles of fittings. Selection of fabrics, trims and accessories. Methods of fabric inspection. Interlining, trade pattern design and grading, types of seam and stitches. Sewing machinery and its special attachment. Apparel production system and practices. Production planning and control. Bundling techniques. Batch, piece and sectional assembling. Special finishes on garments such as stone wash. Labeling system. Checking, Pressing, folding and packing standards for domestic and export market. Checking and quality control. Ready to wear garment. Garment comfort. Kawabata and FAST evaluation system. Plant layout for a garment unit. Application of CAD and CAM in garment manufacturing.

Phasing of MFA and its implications and export documentations.

#### Books Recommended:

1. Cooklin Gerry, "Garment Technology for fashion Designers", Om Book Service Delhi, 1997.
2. Carr Harold and Barbara, "The Technology of clothing Manufacture", Om Book Service, Delhi, 1998

3. Mehta P V and Bhardwaj S K “ Managing Quality in Apparel Industry”, New Age International (P) Ltd., Delhi-2002
4. “Garment Technology NCUTE Series”, Ed.Bhattacharye A, NCUTE- IIT, Delhi,2003.
5. Aldrich W, “ Metric pattern cutting”, Om Book Service, Delhi-1998.
6. Wilson J, “ Hand book of Textile Design”, Woodhead publishing Ltd., UK, 2002.

### **TT 619 Geosynthetics [3-0-0-3]**

Fundamental of physical, chemical and mechanical 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 and functions, fibres used, material construction and manufacturing processes in case of geotextiles, composition of geomembrane and geogrids and their manufacturing, structure of geocomposites, testing of geocomposites with and without soil, evaluation of filtration and drainage functions, reinforcement, creep, moisture barrier characteristics, durability and ageing.

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

#### **Books Recommended**

1. John N W M, “Geotextiles”, Blakie, Chapman and Hall, New York, USA, 1987.
2. “Engineering with Geosynthetics”, Ed. G V Rao and G V S Suryanarayananana Raju, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1990.
3. Ranjan G and Rao A S R, “Basic and Applied Soil Mechanics”, International Publishers, New Delhi, 2000.
4. Koerner R M, “Designing with Geosynthetics” Prentice –Hall, N J, USA, 1986.

### **IC 621 Instrumentation and Control Engineering [3-0-0-3]**

Introduction to measurement and instrumentation, block diagram representation of instrument/instrumentation system ( functional elements), static performance characteristic of instrument-accuracy, true value, error, sensitivity resolution, linearity, repeatability, drift hysteresis, loading effect, study of different types of electromechanical instruments such as permanent magnet moving coil, moving iron electro-dynamometer, rectifier type. Definition and classification of different type of transducer. Construction, operating principle, interfacing circuit, salient features of resistive (RTD), potentiometer, strain gauge, inductive (LVDT), capacitive, thermocouple, optoelectronic and digital transducers. Representation of system (1<sup>st</sup>, 2<sup>nd</sup> and 0 order) system using transfer function. Time domain analysis of zero, first and second order systems to step-input. Frequency domain analysis of first order system, study of control system ( block diagram representation): open loop and closed loop, servo control system, linear and nonlinear systems, time variant and invariant, continuous and sampled data control system, feedback characteristics of control system, steady state analysis of control system – steady, state error for various inputs and systems’ frequency response of control systems (Bode Plot), stability of control system (Routh-stability criterion). Application of instrumentation and control engineering in textile industry.

**Books Recommended:**

1. Sahwney A K, "Electrical Electronics measurement and instrumentation", Danpat Rai and Co. Ltd., Delhi, 2001.
2. Bishop R H and Dorf R C, "Modern Control system" Replika Press Pvt. Ltd., Delhi, 1999.
3. Nakra B C and Chaudhary K K, "Instrumentation Measurement and Analysis", McGraw-Hill publishing company, Ltd., 2000.
4. Doellin E, "Measurement systems", Tata McGraw Hill, 1990.
5. Ogata K, "Modern control Engg.", PHI, EE edition, New Delhi, 1995

**TT 621 Operation Research and Logistic Management [3-0-0-3]**

Operation research - introduction, historical development, phases of operation research study, general linear programming, simplex method, sensitivity analysis. Transportation problem, methods of finding an initial solution, degeneracy, optimum solution, post optimality analysis, variation in transportation problems, assignment problems, variation in assignment problems, queuing, game theory, minimax and maximin strategies, decision theory, replacement decisions. 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", 1<sup>st</sup> Ed., S Chand and Co., Delhi, 1997.
2. Taha H, "Operation research", 6<sup>th</sup> Ed., Prentice Hall of India, Delhi, 1997.
3. Verma A P, "Operation research", 1<sup>st</sup> Edition, S K Kataria and Sons, Delhi, 1998.
4. Menon K S, "Purchasing and inventory control", 3<sup>rd</sup> Ed., Wheeler Publishing House, N. Delhi, 1997.
5. Ahuja K K, "Production management", 1<sup>st</sup> Ed., CBS Publishers and Distributors, Delhi, 1998.
6. Christopher M, "Logistics and supply chain management", Pitman Publishing, UK, 1992.

**TT 623 Knitting and Nonwoven Technology [3-0-0-3]**

Weft and warp knitting machines, Different forces acting on needle butt, dynamics of knitting process, mechanics of loop formation, different machines, process and yarn parameters affecting the yarn tension in knitting zone and loop length, development in knitting machines, design and performance of high speed knitting cam, yarn feeding devices on circular knitting machine, warp knitted fabric and its different industrial uses, geometry and properties of knitted fabrics, process control in knitting, classification and areas of application of nonwoven fabrics, different methods of production of nonwoven fabric, effect of machine, fiber and process variables on properties of non woven fabrics, failure mechanism in nonwoven fabrics, prediction of needle punch nonwoven fabric behaviour.

**Books Recommended:**

1. Spencer D J, "Knitting Technology", 2<sup>nd</sup> Ed., Pergamon Press, 1989.
2. Lunenschloss J and Albrecht W, "Non-Woven Bonded Fabric", Ellis and Horwood Ltd., UK, 1985.
3. Albrecht W, Fuchs H & Kittelmann, "Nonwoven Fabrics", Wiley-VCH Weinheim, 2003.
4. Mrstina V & Fejgal F, "Needle punching textile technology", Elsevier, 1990.
5. Krcma Radco, "Manual of nonwovens", Textile Trade Press, UK, 1971
6. Gulrajani M L, "Book of Papers of International Conference on Nonwovens", The Textile Institute, UK, 1992
7. Journals: Textile Research Journal, Princeton, USA and Journal of Textile Institute, Manchester, UK.

**TT 625 Textile Structural Composites [3-0-0-3]**

Defination of composite. General introduction to fibres and resins for composites. Composite fabrication techniques. Matrices and interphase.

Polyamide fibres: Aliphatic polyamide (N6 and 66) and their application in rubber tyre. Fully aromatic polyamides or aramid fibres (Nomex and Kevlar), their manufacture, structure, properties and applications.

Carbon fibres: Different precursors, preoxidation, carbonization, graphitization, structure and properties. application in composite.

Flexible chain high performance fibres, manufacture and application in composite.

Glass fiber, manufacture, properties and application in composite.

Nanocomposite: Introduction, advantages and different nanomaterials commonly used as fillers (Carbon nanotubes, carbon nanofibres and Nano clay).

**Books Recommended:**

1. Mc Crum N G, Buckley C P and Bucknall C B, "Principle of Polymer Engineering", Oxford University Press, New York, 1990.
2. "High Performance Fibres", Ed. J W Stteare, Woodhead Publishing Co.,England, 2001.
3. Hull D, "An introduction to composite materials", Cambridge University Press, UK, 1981.
4. Broody H, "Synthetic Fiber Materials", Longman Scientific and Technical, UK, 1994.

**TT 627 Simulation of Textile Processes [3-0-0-3]**

Concept of simulation, mathematical simulation, empirical model building, fuzzy logic, theory of artificial neural network and expert system, CAD system, usefulness of different simulation systems.

Application of different simulation techniques on cotton mixing, fiber blending, carding process, drafting, yarn formation, package building, simulation of weaving and knitting process, on line quality control, application of CAD in textile manufacturing, prediction of yarn tensile and bending properties, simulation of fabric low stress behaviour such as shearing, bending and tensile modulus. Prediction and simulation of fabric tensile and tearing strength.

**Books Recommended:**

1. “Computers in the World of Textiles”, Paper presented at the Annual World Conference, Hong Kong, September 26 – 29, 1984.
2. Journals: Textile Research Journal, Princeton, USA and Journal of Textile Institute, Manchester, UK.

**TT 629 Physical Properties of Fibre [3-0-0-3]**

Moisture absorption and desorption of fibres, sorption isotherms, heat of sorption and theory of sorption, swelling of fibres. Mechanism of deformation of fibres, principles of elasticity and visco-elasticity. Stress-strain behaviour of textile fibres. Creep and stress relaxation. Dynamic mechanical properties of fiber. Model theory. Time temperature superposition principle, thermodynamic analysis of deformation. Fiber friction, its nature, theory, application and measurement. Birefringence and its measurement. Thermal transition and its importance. Dielectric properties of fiber. Static electricity and measurement of static charge in fibres. Fiber micro structure, x-ray analysis, IR spectroscopy and SEM.

**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, 1<sup>st</sup> reprint, The Textile Institute, Manchester, 1986.
3. Gupta V B and Kothari V K, “Manufactured Fibre Technology” 1<sup>st</sup> Ed., Chapman and Hall, London, 1997.
4. Hearle JWS, Polymers and their properties, Vol. I, John Wiley and Sons, NY, 1982.

**TT 631 Environmental Practices in Textiles [3-0-0-3]**

Introduction to environment. The impact of human upon the environment. Improvement of environment quality. Role of environmental engineer. Different types of pollution : Water, air, solid waste, soil, noise, odours etc. Pollution caused by textile industries. Waste definition, characteristics and perspectives. Different types of waste. Waste water collection, treatment and disposal. Solid waste generation, collection and disposal. The textile effluents. Textile waste characteristics. Textile waste water problems. Chemicals used in textile industry. Treatment of textile effluents and its testing.

**Books Recommended:**

1. Asolekar S, “Environmental problems in chemical processing of textiles” 1<sup>st</sup> Ed. NCUTE, Department of Textile Technology, IIT-Delhi, 2000.
2. Padma V, “Textile Effluents” 1<sup>st</sup> Ed. NCUTE, Department of Textile Technology, IIT-Delhi, 2002.
3. Edmund B, “The Treatment of Industrial Wastes” 2<sup>nd</sup> Ed., Tata McGraw-Hill, New Delhi, 1976
4. Rao M N, “Environmental Engineering” 2<sup>nd</sup> Ed., Tata McGraw-Hill, New Delhi, 1993