

5th BoS Meeting held on February 27th, 2019

CURRICULUM

M. TECH. (Textile Engineering and Management)

July 2019 admission onwards

BOARD OF STUDIES (BOS)

5th MEETING, February 27th, 2019

M. TECH. (Textile Engineering and Management)

(Revised Teaching Scheme)



DEPARTMENT OF TEXTILE TECHNOLOGY

**Dr B R AMBEDKAR NATIONAL INSTITUTE OF TECHNOLOGY,
Jalandhar**

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**TEACHING SCHEME OF M TECH (FULL TIME) PROGRAMME IN
TEXTILE ENGINEERING AND MANAGEMENT**

Semester - I

Course Code	Subject	L	T	P	Contact hours	Credits
TT-501	Advances in Fibre Production	3	0	0	3	3
TT-503	Advances in Yarn Production	3	0	0	3	3
TT-505	Advances in Fabric Production	3	0	0	3	3
TT-507	Advances in Colouration and Finishing Technology	3	0	0	3	3
TT-509	Production Management in Textiles	3	0	0	3	3
TT-511	Mechanical Processing Lab	0	0	3	2	2
TT-513	Chemical Processing Lab	0	0	3	2	2
Total		15	0	6	19	19

Semester – II

Course Code	Subject	L	T	P	Contact hours	Credits
TT-502	Structural Mechanics of Yarns	3	0	0	3	3
TT-504	Structural Mechanics of Fabrics	3	0	0	3	3
TT-506	Statistical Methods and Design of Experiments	3	0	0	3	3
TT-508	Costing, Project Formulation and Appraisal	3	0	0	3	3
TT-510	Textile Marketing and Merchandising	3	0	0	3	3
TT-512	Advanced Textile Testing Lab	0	0	3	2	2
TT-514	Software Engineering Lab	0	0	3	2	2
Total		15	0	6	19	19

Semester - III

Course Code	Subject	L	T	P	Contact hours	Credits
TT-XXX	Department Elective -I	3	0	0	3	3
TT-XXX	Department Elective -II	3	0	0	3	3
TT-600	Project Part-I*	0	0	12	3	6
TT-601	Independent Study	0	3	0	3	3
Total		6	3	12	15	15

*The credits shall be consolidated on the completion of Project part – II

Semester – IV

Course Code	Subject	L	T	P	Contact hours	Credits
TT-600	Project Part-II	0	0	24	12	12
Total		0	0	24	12	12

Semester Wise Credits Distribution

Semester	No. of Credits
I	19
II	19
III	15
IV	12
Total	65

Departmental Electives:

S.No.	Name of Subject with Code	L-T-P-C
1	Characterization of Polymers and Fibres (TT-515)	3-0-0-3
2	Post Spinning Operation (TT-516)	3-0-0-3
3	Advanced Chemical Processing (TT-517)	3-0-0-3
4	Garment Manufacturing Technology(TT-518)	3-0-0-3
5	Geosynthetics (TT-519)	3-0-0-3
6	Operation Research and Logistic Management (TT-520)	3-0-0-3
7	Knitting and Nonwoven Technology (TT-521)	3-0-0-3
8	Textile Structural Composites (TT-522)	3-0-0-3
9	Simulations and Modelling of Textile Processes(TT-523)	3-0-0-3
10	Physical Properties of Fibre(TT-524)	3-0-0-3
11	Environment Management in Textile Industry(TT-525)	3-0-0-3
12	Medical Textiles(TT-526)	3-0-0-3
13	Textile Product Design(TT-527)	3-0-0-3
14	Heat and Mass Flow through Fibrous Material(TT-528)	3-0-0-3
15	Process Control in Mechanical Processing of Textiles(TT-529)	3-0-0-3
16	Application of OR in Textiles(TT-530)	3-0-0-3
17	Technical Textiles(TT-531)	3-0-0-3
18	Financial Management and Accounting(TT-532)	3-0-0-3
19	Advances in Apparel Technology(TT-533)	3-0-0-3
20	Bioprocessing of Textiles(TT-534)	3-0-0-3

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Core Subjects**TT-501 Advances in Fiber Production [3 0 0 3]****Course Outcomes**

CO1	Develop the concept of Man-made fibre production.
CO2	Understand the influence on various parameters / factors on the structure development of fibre
CO3	Discuss the different important fibres, their properties and applications
CO4	Discuss the advances in the manmade fibre production
CO5	Understand the necessity and Influence of post spinning operations on properties.

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.

Recommended Books:

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", 1st 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, 1st Ed., Wiley Inter Science Publishers, New York, 1967.
4. Macintyre J E, "Synthetic Fibres", Woodhead Fibre Science Series, UK, 2003.
5. Fourne F, "Synthetic Fibres: Machines and Equipment, Manufacture, Properties", Hanser Publisher, Munich, 1999.

TT-503 Advances in Yarn Production [3 0 0 3]**Course Outcomes**

CO1	be able to analyse the theory and design of textile machinery and their working
CO2	have an in depth knowledge of modern technologies available for yarn production
CO3	understand the changes necessary for the product for specific application.

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.

Recommended Books:

1. Grosberg P and Iype C, “Yarn Production-Theoretical Aspects”, 1st Ed., The Textile Institute, UK, 1999.
2. Chattopadhyay R, “Advances in Technology of Yarn Production”, 1st Ed., NCUTE, New Delhi, 2002.
3. Rao M V S and Talele A B, “A Guide to Crimping / Texturing Technology”, 1st Ed., Nasnal Printers and its associates, Surat, 1992.
4. Klein W, “Manual of Textile Technology- New spinning Systems”, Vol.5, 1st Ed., The Textile Institute, UK, 1993.

TT-505 Advances in Fabric Production [3 0 0 3]

Course Outcomes

CO1	Understand science based manufacturing
CO2	Learn mathematic Modelling of weaving process, example: Shedding, Beat-up, Let-off etc
CO3	Learn Modelling of unwinding process
CO4	Learn modelling of knitting process
CO5	Identify the parameters in Non-Woven Production

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. Concept of smart textiles.

Recommended Books:

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-507 Advances in Colouration and Finishing Technology [3 0 0 3]

Course Outcomes

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| CO1 | Explain various approaches to pre-treat manmade textiles and their blends |
| CO2 | Know modern approaches for dyeing of manmade fibres and blends |
| CO3 | Learn cost effective dyeing and finishing processes |
| CO4 | Suggest ways to reduce waste water load in chemical processing sectors. |
| CO5 | Will learn energy management in textile industries. |

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.

Recommended Books:

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

Course Outcomes

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| CO1 | Get the evolving concepts of Manufacturing, Operation and Production Management. |
| CO2 | Know Importance of Production Management in Textile fields. |
| CO3 | Identify the ways and means to finalise the option of location amongst many. |
| CO4 | Identify the methods to enhance quality and production through Product and Job design. |
| CO5 | Optimise the cost and movement of materials through Linear Progressive Progression techniques. |

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.

Recommended Books:

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 Wiley 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-511 Mechanical Processing Laboratories [0 0 3 2]

Course Outcomes

CO1	Build self-confidence to study the machine independently.
CO2	Learn to draw simplified diagrams of machine and its other components from their own observations
CO3	Develop skill to draw figures in Microsoft word
CO4	Acquire the presentation skill
CO5	Develop the idea to analysis the machine faults and their corresponding causes

- A. Exploration of product development possibilities in Spinning and Weaving laboratories.
- 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.
- D. Preparation of Fabric Samples in knitting machines and measurement of Fabric properties.
- E. Preparation of Fabric Samples in Weaving machines and measurement of Fabric properties.

TT-513 Chemical Processing Laboratories [0 0 3 2]

Course Outcomes

CO1	Carry out colourfastness tests on dyes textiles.
CO2	Identify the dye on a dyed textile.
CO3	Evaluate degree of finishing for anti-crease, flame retardant and water repellent finished textiles
CO4	Analyse dye uptake and dye strength on dyed textiles.
CO5	Carry out quality assurance tests for pre-treated and dyed textiles.

- 1. Identification of dye from given dyed sample and reproduction of the same
- 2. Assessment of fastness criteria of dyed samples.
- 3. Evaluation of Anti-crease finish
- 4. Evaluation of water repellent finish.
- 5. Evaluation of flame retardant finish.
- 6. Evaluation of dye yield and dye uptake on given sample.
- 7. Quality assessment of processed and finished samples.
- 8. Extrusion and drawing of mono-filament.
- 9. Influence of expression and drawing conditions on the mechanical properties of Mono-filament
- 10. Demonstration of various analytical equipments i.e. DSC, TGA, FTR etc.

TT-502 Structural Mechanics of Yarn [3 0 0 3]**Course Outcomes**

CO1	Know the Idea to analyse the yarn structure and measurements of various parameters as well as the fundamental research works in this area
CO2	Generate idea to develop mathematical models
CO3	Develop the idea to analysis the finding
CO4	Gain the ability to solve various problems mathematically
CO5	Acquire the presentation skill

Introduction to fibre to yarn engineering. Design related aspects of yarn structure. 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. Structural analysis of specialized yarns. Effect of yarn structure on different properties of yarns. Structure and property relationship of ring, rotor, air-jet and friction spun yarns.

Recommended Books:

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 Structural Mechanics of Fabrics [3 0 0 3]**Course Outcomes**

CO1	Develop the concept of Mechanics applicable to Textiles
CO2	Understand the anatomy of woven structure
CO3	Analyse relation with property and structure
CO4	Understand the mechanics of knitting process
CO5	Understand the mechanics of non-woven fabric

Engineering approach for fabric formation, Fabric cover factor and its significance, cloth geometry, practical aspect of cloth geometry, jammed structure, racetrack section of yarn. Graphical solution for the design of plain fabric, twill and sateen weaves. Theoretical investigation of weavability limit of yarns. Tightness factor. 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 weft knitted fabrics.

Mechanical properties of nonwoven needle punch and stitch bonded fabric. Formability, tailorability and hand of apparel fabric.

Recommended Books:

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.

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

Course Outcomes

- CO1 Apply basic statistical tools for data analysis
- CO2 Control process and process capability analysis
- CO3 Apply Design of Experiment for product and process improvement
- CO4 Utilize techniques for process optimization

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, 2k 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.

Recommended Books:

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, 1957.
3. Leaf G A V, “Practical Statistics for the Textile Industry”,(Part-I and II), The Textile Institute, UK, 1984.

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

CO1	Estimate & Calculate the cost of manufacturing the goods
CO2	Identify the expenditures which need to be controlled for economical production
CO3	Prepare the project report for setting up a plant
CO4	Evaluate various alternative investment options to select the best for investment

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.

Recommended Books:

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

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

CO1	Get the detail concepts of different concepts of Marketing Management.
CO2	Know Importance of Marketing and Retail Management in Textile fields.
CO3	Identify the ways and means to finalise the Pricing of a product in the Market.
CO4	Identify the methods to know the consumer behaviour in the market.
CO5	Ways to minimise the cost and movement of materials through Merchandising process.

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.

Recommended Books:

1. Kotler P, "Marketing Management", 9th 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-512 Advanced Textile Testing Lab [0 0 3 2]

Course Outcomes

CO1	Gain knowledge about the significance of quality and characterisation of textile products.
CO2	Know the details about the latest quality parameters of fibres and their assessment.
CO3	Know the details about the latest quality parameters of yarns and their assessment by the advance instruments.
CO4	Implement online quality control in yarn production.
CO5	Know the details about the latest quality parameters of fabrics and their evaluation with special reference to FAST and Kawabata tests.

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 Soft ware Engineering Lab [0 0 3 2]

Course Outcomes

CO1	Learn advance quality testing instruments of garments and on-line control in production.
CO2	Learn details about all modules and inputs of fashion/ apparel designing and merchandising software.
CO3	Optimise and perform processes like marker planning, spreading and lay planning using software.
CO4	Plan, balance and manage inventory by the software in cutting and sewing operations.
CO5	Use statistical methodology/ software for the quality and process control in apparel production.

- Learning of different statistical packages such as STATISTICA/ SYSTAT/MINITAB.
- Analysis of basic statistical tools along with design of experiment, multivariate analysis and neural networks.
- Detail study of various modules of software's use for surface/texture designing in

- fabric production.
- Detail study of various modules of garment/fashion designing software.
- Study of various stages/modules of CAD software of apparel production.
- Study of various stages/modules of Cut Planner software used in apparel production.
- Study of different tools and modules of merchandising software of apparels viz-
 - production/order/supply and its marketing.
- Use of MATLAB in textiles.

TT 601 Independent Study [0-3-0-3]

Student should undertake in depth study of a topic 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. The evaluation will be based on the report, seminar and viva-voce.

Departmental Electives (TT-XXX)**TT-515 Characterizations of Polymers and Fibres [3 0 0 3]****Course Outcomes**

CO1	Develop concept of Structure and structure property correlation
CO2	Understand the influence on various parameters / factors on the structure development of fibre
CO3	Discuss the different important techniques for physical structure characterisation
CO4	Discuss the different important techniques for thermal characterisation
CO5	Discuss the different important techniques for mechanical characterisation

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.

Recommended Books:

- 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. Billmeyer F W, "Text book of polymer science", John Wiley and Sons, 1984.

TT-516 Post Spinning Operations [3 0 0 3]**Course Outcomes**

CO1	Understand the significance of post spinning operation process
CO2	Understand the influence on various parameters / factors on drawing / stretching
CO3	Understand the influence on various parameters / factors on heat-setting
CO4	Learn Different texturing process for fibres
CO5	Understand the influence of various parameters / factors on textured yarn formation.

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.

Recommended Books:

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

TT-517 Advanced Chemical Processing [3 0 0 3]

Course Outcomes

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| CO1 | Carry out colour measurement and reproduction using computerised colour matching system. |
| CO2 | Identify various dye-fibre relationships with precision to improve dye uptake. |
| CO3 | Analyse various dyeing processes thermodynamically. |
| CO4 | Handle latest printing techniques, e.g. Ink-jet printing, Xerox printing etc. |
| CO5 | Carry out non-aqueous dyeing processes. |

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.

Recommended Books:

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-518 Garment Manufacturing Technology [3 0 0 3]

Course Outcomes

- CO1 Learn the basics of garment- production-sequence and management of garment manufacturing unit
- CO2 Acquire details about basic designing and pattern making.
- CO3 Discuss the process and machineries for the marker planning, spreading and lay planning.
- CO4 Explain the machineries and quality parameters cutting room operations.
- CO5 Explain the machineries and quality parameters sewing room operations
- CO6 Implement quality and process control in garment production.
- CO7 Conduct Quality testing of garments and on-line quality control in production.

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.

Recommended Books:

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-519 Geosynthetics [3 0 0 3]

Course Outcomes

- CO1 Identify the properties affecting engineering behaviour of soil
- CO2 Develop an idea about the criteria of filter design as per soil properties.
- CO3 Learn about the raw materials, manufacturing techniques of different types of geo-synthetics
- CO4 Testing and evaluation of geo-composites’ performance and characteristics
- CO5 Use the geo-synthetics in myriad applications like roads, railways, environmental control

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.

Recommended Books :

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 Suryanarayana 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

TT-520 Operation Research and Logistic Management [3 0 0 3]

Course Outcomes

CO1	Identify and develop operational research models from the verbal description of the real system
CO2	Understand the mathematical tools that are needed to solve optimisation problems
CO3	Use mathematical software to solve the proposed models
CO4	Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering
CO5	Able to do store management and merchandising, make or buy decision, analyse investment in inventory and make an Enterprise Resource Planning

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.

Recommended Books:

1. Heera D S and Gupta P K, "Operation research", 1st 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", 1st 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", 1st Ed., CBS Publishers and Distributors, Delhi, 1998.
6. Christopher M, "Logistics and supply chain management", Pitman Publishing, UK, 1992.

TT-521 Knitting and Nonwoven Technology [3 0 0 3]

Course Outcomes

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|-----|--|
| CO1 | Understand the dynamics of knitting process and mechanics of loop formation |
| CO2 | Understand the design and performance of high speed knitting cam |
| CO3 | Analyse the geometry and properties of knitted fabrics |
| CO4 | Understand effect of machine, fibre and process variables on properties of non-woven fabrics |
| CO5 | Analyse the failure mechanism in nonwoven fabrics |

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.

Recommended Books:

1. Spencer D J, "Knitting Technology", 2nd Ed., Pergamon Press, 1989.
2. Russell, S J, "Handbook of Nonwovens", Woodhead Publishing Limited, Cambridge, UK, 2007
3. Lunenschloss J and Albrecht W, "Non-Woven Bonded Fabric", Ellis and Horwood Ltd., UK, 1985
4. Albrecht W, Fuchs H and Kittelmann, "Nonwoven Fabrics", Wiley-VCH Weinheim, 2003.
5. Journals: Textile Research Journal, Princeton, USA and Journal of Textile Institute, Manchester, UK.

TT-522 Textile Structural Composites [3 0 0 3]

Course Outcomes

CO1	Understand the various techniques for development/fabrication of composite structure
CO2	Understand the influence of filler and matrix properties and arrangement on the properties of composite
CO3	Learn the details about the fibres used for composite
CO4	Understand the properties and applications of composite

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).

Recommended Books:

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-523 Simulations of Textile Processes [3 0 0 3]

Course Outcomes

CO1	Define, explain, and discuss the fundamental elements of discrete-event simulation including analytical elements, random processes, random varieties, and inputs to simulation regarding textile materials and processes.
CO2	Analyse a real world problem of textile industry, and apply modelling methodologies to develop a discrete-event simulation model.
CO3	Recognise the cost/benefits of computer simulation, the generation of meaningful results, decision making, and risks involved while dealing with textile materials.
CO4	Interpret and contrast discrete-event techniques (including parallel and distributed) for implementing a solution to a simulation problem.
CO5	Formulate judgements and synthesise conclusions through research of a simulation topic.

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.

Recommended Books:

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-524 Physical Properties of Fibre [3 0 0 3]

Course Outcomes

CO1	Develop the concept of fibre structure and basic structure analysis techniques
CO2	Understand the significance and influences of moisture on fibre properties
CO3	Identify the factors influencing mechanical properties and analysis of test data
CO4	Learn about the time dependent properties, significance and analysis
CO5	Learn about the thermal and electrical properties of fibre and its influences on processing and application

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.

Recommended Books:

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.

TT-525 Environment Management in Textile Industry [3 0 0 3]**Course Outcomes**

CO1	Understand the significance of environmental issues in textiles and related areas
CO2	Understanding the use of sustainable technologies for environment protection
CO3	Discuss the various process of control of pollution in textiles.
CO4	Explain the design and machineries/equipments of control unit.
CO5	Explain the quality parameters and monitoring machineries of the environmental impact in textiles.
CO6	Discuss about the uses of fabric filter in environmental protection in textiles production.

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.

Recommended Books:

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

TT-526 Medical Textiles [3 0 0 3]**Course Outcomes**

CO1	Understand and improve the design and production techniques of hygiene and healthcare products
CO2	Analyse the application of textiles to wound healing covering minor wounds, burns, ulcers and other deep skin wounds
CO3	Understand the application of nanotechnology in hygiene textiles, knitted spacer fabrics, innovative and sustainable packaging and biodegradable hygiene products
CO4	Understand the use of smart textiles for wound care including drug delivery dressings and textile-based scaffolds for tissue engineering as well as future
CO5	Know about the range of applications and case studies, including improvements in medical occupational clothing, medical filters and superabsorbent fibres.

Introduction to healthcare and medical textile devices, role of textile structures and biomaterials in healthcare, Types of textiles and biomaterials for medical applications, Key properties of medical textile products, Healthcare and hygiene products. Wound care products and bandaging Hi-tech textiles for interactive wound therapies, Surgical Textiles; Suture threads. Application of implantable biomedical devices: Vascular textiles, Knitted cardiac biological valves, hollow fibres as dialysis membrane, Tissue culture engineering. The role of reusable medical textiles, Advantages of reusable textiles, Types of reusable textiles used for medical applications, Nonwoven materials and technologies for medical applications, Textiles with cosmetic effects, Drug-releasing textiles, Bio-functional textiles, Textiles for medical filters, Super absorbents and their medical applications, Nanofibrous textiles in medical applications, Evaluation of medical textile products. Fundamental aspects of legal and ethical issues involved within the medical textiles supply chain, Future of medical textiles and products

Recommended Books:

1. “Handbook of Technical Textiles”, Ed. A R Horrocks and S C Anand, Woodhead Publication Ltd., Cambridge, 2000
2. “Handbook of medical textiles” Edited by V Bartels, Bartels Scientific Consulting GmbH, Germany, Woodhead Publishing Series in Textiles No. 100

TT-527 Product Design [3 0 0 3]

Course Outcomes

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| CO1 | develop an idea for creating a new product and the basic theory behind it. |
| CO2 | get an idea for utilization of fibrous material in different applications. |
| CO3 | develop fibrous products to advanced function focus products that touch every aspect of human life. |
| CO4 | learn about development and design of various products, particularly those involving fibrous materials. |

Concepts of engineering, product development and design, Characteristics of successful product design, Product development process tools. Product architecture. Evolution of engineering. Engineering attributes and concepts, Basic concepts and critical factors for product development Simplified view of product development The product development cycle, Business and marketing aspects related to product development Product-focus versus user-focus product development Role of research in product development The core task in product development The product design cycle, Design conceptualization Design analysis. Basic differences between design conceptualization and design analysis. General guidelines for design conceptualization Basic tools of design conceptualization Purpose of design analysis Optimization analysis: linear programming. Product design economics.

Recommended Books:

1. Otto Kevin, & Wood Kristin, Product Design Techniques in Reverse Engineering and New product Development Pearson Education publication, 1st Ed, 2006.

TT-528 Heat and Mass flow through Fibrous Materials [3 0 0 3]**Course Outcomes**

- CO1 explain how momentum, heat and mass is transported and how transport of these interact in heterogeneous fibrous systems with reaction and separation.
- CO2 explain how flow fields and transport of momentum affect the transport of heat and mass in fibrous systems.
- CO3 formulate mathematically advanced models for transport of momentum, heat and mass
- CO4 analyse engineering mass transport and flow problems using theory and computational means
- CO5 judge and evaluate how advanced theory on transport phenomena can be applied to fibrous systems and the degree of usefulness of the same.

Unit operations, Newtonian and non-Newtonian fluid, viscosity, Reynold number, Fluid flow through pipe and its applications in absorbent textiles. Basic law of heat conduction- Fourier's law, thermal conductivity, steady state heat conduction through different insulating materials and their applications for process equipment and pipelines. Transitional heat transfer, Textile as insulating materials. Convective 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. Heat transfer coefficient of a heat exchanger. Fouling factor. Basic principle of radiation from a surface, blackbody radiation, Planck's law Wein's displacement law, the Stefan Boltzmann law, Kirchoffs law, grey body, radiation exchange between black bodies & gray bodies. Heat transfer equation. Heat loss due to radiation from human body. Filtration, cake filter, Pressure drop in filtration, Kozeny-Carman equation, media resistance and cake resistance in filtration. Classification of mass transfer operation, choice of separation methods. Fick's law of diffusion, Mass transfer coefficients. Mass transfer in textiles. Equilibrium in drying, batch drying, time of drying, continuous drying, and equipment of drying.

Recommended Books:

1. Geankopolis C J, "Transport Processes and Separation Process Principles", Prentice Hall of india, 4th Edition, Eastern Economy Edition (2004)
2. Pan N and P Gibson, Thermal & moisture transport in Textile Materials, CRC(2006)
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)

TT-529 Process Control in Mechanical Processing of Textiles [3 0 0 3]

Course Outcomes

CO1	Understand the significance of the process and quality controls in textile production.
CO2	Know the details of optimisation of quality and cost of fibres in mixing/blending.
CO3	Explain about optimisation of process and quality controls in yarn production.
CO4	Discuss about process and quality controls in fabric production.
CO5	Discuss about process and quality controls during the chemical processing of textile products.
CO6	Details about latest process/quality parameters and material realisation of fibres, yarns and fabrics in production.
CO7	Gain knowledge about software/instruments for the process/quality optimisation in textile production.

The basic aspects of process control programme, relevance of modern testing instruments in optimization of yarn quality and process performance, bale management in spinning mills, waste management in spinning mills, fibre friction and process performance, control of yarn blemishes leading to fabric faults; Optimum realization of yarn tenacity and elongation, controlling mass variation in yarn, yarn faults and hairiness, technological considerations: productivity and quality of yarns obtained from new spinning systems (rotor, friction, airjet). Winding - quality of knots and splices, quality of package, control of hard waste, yarn quality requirements for shuttle and shuttleless looms. warping and sectional warping – performance, process parameters and productivity. Minimizing end breaks, quality of warper's beam, control of hard waste, : choice of size recipe, control of size pick up, quality of sized beam. Quality of weaver's beam. Control of cross, extra, missing and buried ends, loom efficiency, factors influencing loom efficiency, hard waste, productivity. Fabric defects and their control.

Recommended Books:

1. Process Control in Spinning, A.R. Grade, & T.A. Subramanian, 1987.
2. C.A. Lawrence, Fundamentals of Spun Yarn Technology, 2003, CRC Press LLC, USA
3. Lord P R, "Handbook of Yarn Production", The Textile Institute, Woodhead Publication Limited, Cambridge, 2003.
4. Paliwal M C and Kimothi.P D, "Process Control in Weaving ", ATIRA Publication, Ahmedabad, 1983.
5. Loom shed, BTRA Publication, Mumbai, 1986.
6. Warping and Sizing, BTRA Publication, Mumbai, 1983.
7. Winding, BTRA Publication, Mumbai, 1986.

TT-530 Application of Operation Research in Textiles [3 0 0 3]

Course Outcomes

CO1	Identify and develop operational research models from the verbal description of the real system.
CO2	Understand the mathematical tools that are needed to solve optimisation problems suitable to Textile Production.
CO3	Use mathematical software to solve the proposed models suitable to Textile Production.
CO4	Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Textile and Management Engineering.
CO5	Able to do store management and merchandising, make or buy decision, analyse investment in inventory and make an Enterprise Resource Planning.

Operations 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. Application of Transportation problems, Assignment problems, Queuing theory, Sequencing models in textile production. Game theory and its suitability in textile production. 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.

Recommended Books:

1. Heera D S and Gupta P K, "Operation research", 1st 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", 1st 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", 1st Ed., CBS Publishers and Distributors, Delhi, 1998.
6. Christopher M, "Logistics and supply chain management", Pitman Publishing, UK, 1992.

TT-531 Technical Textiles [3 0 0 3]**Course Outcomes**

CO1	Identify diversified fields of application of Technical Textiles
CO2	Design a Product as per the requirements specific to end use
CO3	Learn Product design specific to fabric filter, geo-textiles, medical textiles and textiles in sports
CO4	Characterize products and their performance

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.

Recommended Books:

1. "Handbook of Technical Textiles", Ed. A R Horrocks and S C Anand, Woodhead Publication Ltd., Cambridge, 2000.
2. "Wellington Sears Handbook of Industrial Textiles", Ed. Sabit Adanaur, Technimic Publishing Company, Inc., Pennsylvania, USA, 1995.
3. Shukla S K, Yin Jian-hua, Fundamentals of Geosynthetic Engineering, Taylor & 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.

TT-532 Financial Management and Accounting [3 0 0 3]

Course Outcomes

CO1	Understand the accounting concepts used in the recording of financial information
CO2	Prepare and Analyse the Financial Statements of any company
CO3	Evaluate the liquidity and solvency position of a company
CO4	Evaluate the profitability of a company

Nature and Scope of Financial Accounting: Meaning and Development of Accounting, Functions of Financial Accounting, Accounting Principles, Concepts and Conventions, Limitations of Financial Accounting, Making Financial Accounts useful to Management.

Financial Statements: Accounting Cycle: Journal, Ledger, Cash book, Trial balance, Trading and 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.

Corporate Finance: Meaning, Evolution and importance of corporate finance, Approaches of finance function, contents of finance function, Relationship of finance with other business functions, financial divisions, and functions of Finance Manager.

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, Purpose of SEBI Act, Powers and functions of SEBI, Guidelines issued by SEBI (inclusive of recent modifications), Evaluation of SEBI, limitations of SEBI.

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.

Recommended Books:

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, Kalyani 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)

TT-533 Advances in Apparel Technology [3 0 0 3]

Course Outcomes

CO1	Understanding different manufacturing processes of apparel such as pattern making, lay plan, spreading, cuttings bundling and ticketing
CO2	Understanding of detail of sewing room processes
CO3	Understanding of finishing processes of apparel.
CO4	Knowledge of production, planning and control in apparel production.
CO5	Understanding of the property of the fabric with comfort to the clothing wearer

Introduction:- Introduction to garment manufacturing and Indian apparel industry. Latest developments in apparel manufacturing and machinery.

Pattern Formation and Cutting - Pattern making – Draft construction – marker planning – fabric spreading - laying methods - fabric cutting. Advanced Pattern making, Spreading & cutting – Factors affecting spreading – Automatic systems - Marker planning - 3D body scanner for measurements.

Computerized cutting machines – easymatch system - automatic ticketing and bundling Automatic pattern notcher.

Sewing Machine Mechanisms & Accessories – Introduction to sewing m/c and its parts and working details, types of sewing m/c, Attachment of sewing m/c, Automation in industrial sewing machines, automatic placket feeder, Automatic pocket maker, auto button sewer, Electronic Sewing machines Application of robotics in sewing, LAN in Sewing machines, high speed stitching. Preparation of seamless garments and its applications, sewing room planning.

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

Seams & Stitches – Seams, Different types, Superimposed, lapped, bound, flat, decorative, edge neatening, addition to Garment edges, single piece addition, Stitches – lock stitch, chain stitch, hand stitch type, multi-thread chain stitch, over edge chain stitch and covering chain stitches.

Stitch formation Mechanics: - Mechanism of lock stitch formation, Factors affecting yarn tension and stitch length of a seam during stitching, Mathematical model of lock stitch, Development of yarn tension during lock stitching, Modeling of take-up arm displacement

Components and Trims - Labels – linings, interlinings, wadding, lace, braid, elastic, hock and loop fastening shoulder pads, eyelets and laces, Zip fasteners and buttons.

Garment finishing & Packing machines - CNC pressing machines, Quality control in apparel production.

Apparel Production parameters – control parameters, Product Development, Time management. Breakdown of operation sequence, Development of Flow process, Grid chart for operation sequence.

Manufacturing systems & Planning – Lay out planning, Bundling and ticketing, Evaluation of production systems Capacity planning & line balancing, Capacity calculation for cutting, sewing & finishing, Machine requirements – Line Balancing techniques. Work study method, motion & time study - computer Integrated production planning & management systems.

Recommended Books:

1. Jackb Solinger, “Apparel Manufacturing Handbook”, Van Nostrand Reinhold company” 1980
2. Cooklin. G. “Introduction to clothing manufactures” Blackwell science . 1995.

3. Harold Carr & B. Latham, "The Technology of clothing manufacture - Blackwell sciences 1998
4. Churter. A.J, "Introduction to clothing production management", Oseney Mead.1995.
5. Mehta P V and Bhardwaj S K " Managing Quality in Apparel Industry", New Age International (P) Ltd., Delhi-2002
6. "Garment Technology NCUTE Series", Ed. Bhattacharya A, NCUTE- IIT, Delhi,2003.
7. Aldrich W, " Metric pattern cutting", Om Book Service, Delhi-1998.

TT-534 **Bioprocessing of Textiles [3 0 0 3]**

Course Outcomes

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| CO1 | Ecological issues associated with chemical processing of textiles |
| CO2 | Chemical properties and characterization of enzymes |
| CO3 | Classification and selection of enzymes for specific textile use |
| CO4 | Performance of an enzyme or enzyme combination in textile processing |
| CO5 | Immobilization of enzyme and its performance over conventional application |

Introduction: Environmental problems caused by conventional processing of textiles, viz. singeing, desizing, scouring, bleaching, dyeing and finishing.

Chemistry of Enzymes: Concept and classification of enzymes. Chemistry of different enzymes, viz. lipase, catalase, protease. Cellulase, pectinase, trans-glutaminase etc and their mechanism of working in textile processes and fibres.

Biopolishing of textiles: Significance, process and influencing parameters. Bio-processing of cotton fabric using different varieties of cellulases and their comparative performance. Bio-washing of denim, related problems of backsaining and precautionary measures to reduce it. Biopolishing of wool using proteolytic enzymes/

Bio-desizing: Enzymatic desizing with amylase. Mechanism of removal of starch with amylase, enzyme inactivation

Bio-scouring: Application of different enzymes in scouring, viz. lipase, pectinase, protease and their working on various impurities during scouring. Assessment of bio-souring efficiency, viz. absorption, copper number, methylene blue absorption, fluidity etc.

Bio-bleaching: A review of peroxide and peracetic acid bleaching. Application of glucose-oxidase for bleaching of cotton and protein fibres. Influence of catalase on peroxide stability. Bleaching with laccase. Evaluation of bleaching efficiency.

Colouration with enzymes: Properties of enzymes towards influencing dyebath activity. Enzymatic reduction of vat and sulphur dyes. Concept of reduction potential of bath and its influence on reduction of dye and dye uptake. Dyeing of denim with indigo using enzyme as reduction catalyst. Acid dyeing of wool with protease, problem of degradation and recovery using trans-glutaminase. Simultaneous dyeing and bio-polishing of textiles. Dyeing with natural colours.

Bio-Finish: Finishing of textiles with natural herbs, materials and products. Aloevera, neem etc extract finishing.

Anti-shrink finish on wool: Action of proteolytic enzymes on anti-felting property of wool, degradation of wool and recovery using transglutaminase.

Application techniques of enzymes: Performance gap in free and immobilised enzyme application and the reason thereof. Technology of immobilisation of enzymes and suitability of different support systems for efficient applications

Recommended Books:

1. Cavaco-Paulo A and Gubitz G M, *Textile processing with enzymes*, Woodhead Publishing, Cambridge, UK. (2003),
2. Nierstrasz V A and Cavaco-Paulo, *Advances in textile Bio-technology*, Woodhead Publishing, Cambridge, UK (2010)