

# **Curriculum**

## **Masters of Science (MSc) in Textile Engineering**

**National Institute of Textile Engineering and Research (NITER)**

**A Constituent Institute of the UNIVERSITY OF DHAKA**

**(Faculty of Engineering and Technology)**

### **Vision of the program**

The Post Graduate Program M.Sc. in Textiles Engineering is a three semester program which employs the best methods to equip the students with latest technologies to be in equilibrium with the theoretical aspects in the field of Textiles and Fashion Designing, Management, etc, focused on high tech areas addressing to national and global issues of significance and also being interdisciplinary, the course offers diverse platform for research.

### **Mission of the program**

The Master's program in Textiles Engineering enables the students to develop a high level of understanding of the advanced Textiles sector, preparing the students for a career in the textile or related industries as a manager or researcher, or for an academic career. After successfully completing the program, you will have gained a thorough grounding and understanding of the modern textile processing and the processing of green textiles. This successful delivery to the Textiles sector involves production, quality, and merchandizing. It will also provide knowledge on materials performance, Computer aided design (CAD), 2D/3D product design and specification, sustainability, effective supply chains and an understanding of diverse product sectors such as textile composites, protective wear, filtration, sportswear, medical textiles and the integration of electronics into textile structures.

### **Program educational objectives**

- To elicit the curiosity and creativity of students.
- To integrate theory and practical so as to develop the aesthetic, intellectual and technological know-how of the students.
- To blend useful practices with modern technology in Textiles and Fashion.
- To offer students On-the-Job training and exposure taking up entrepreneurial ventures in the campus.
- To promote consultancy with Textile or Fashion Industry.
- To enhance course work with active tie ups with highly reputed Textile or Fashion Research Centers or Industries for on-hand experiences.

### **Program Outcomes:**

- Able to develop new process or product at the textile industry or textile research organizations and
- Qualified to effectively carryout fundamental and applied research.
- Uphold social values, responsibilities, ethics, justice and respect to law and environment

**Entry Qualification:**

A Bachelor Degree (BSc) in Textile Engineering/ Technology, Fashion Design, Fashion Technology, Apparel Manufacturing, Knitting Technology or any other Textile related bachelor programs.

**Academic Regulations for the Graduate Students:**

M.Sc. in Textile Engineering program in NITER of the **University of Dhaka** will be started from the session 2018-2019 and onward.

**Graduation Criteria:**

- **Name of the Degree:** M.Sc. in Textile Engineering
- **Total Credits:** A total of 36 credits which will consist of 26 credits of theoretical courses; 8 credits of thesis and 2 credits for viva-voce. A student has to complete all credits for graduation.

**Duration of the Program:**

The duration of Master's Degree program shall be 03 Semesters of six months each.

**Minimum Credit Point**

The student must finish all 36 credits hours to obtain MSc in Textile Engineering degree with a minimum CGPA of 2.50.

**Credits & Contact Hour****Theoretical Courses**

1 (one) hour lecture per week will be equivalent to one credit (1.0). There shall be at least 15 contact hours for each theoretical credit point in each semester.

**Thesis**

The 3<sup>rd</sup> semester is exclusively dedicated for the Thesis Work. Credit for Thesis will be 8.00.

**Comprehensive Viva**

Credit for Comprehensive Viva will be 2.00.

**Time Limits for Completion of Master's Degree**

For the degree of M. Sc. in Textile Engineering maximum allowable number of semester would be 8 of 6 months. But an additional Semester may be granted after judging the merit of individual case according to the recommendation of Academic Committee of the Institute/DU.

**Syllabus & Curriculum Development**

The Curriculum of the M. Sc. in Textile Engineering degree shall be as proposed by the Academic Council of the University of Dhaka lead by Dean, Faculty of Engineering and Technology.

**Grading System :**

For evaluation purpose all courses will be equivalent to 100 Marks.

**Grades and Grade Points:**

Grades and Grade Point will be awarded on the basis of marks obtained in the Written, Oral and thesis work according to the following scheme:

Marks obtained (%)	Grade	Grade point
80 to 100	A+	4.00
75 to 79	A	3.75
70 to 74	A-	3.50
65 to 69	B+	3.25
60 to 64	B	3.00
55 to 59	B-	2.75
50 to 54	C+	2.50
45 to 49	C	2.25
40 to 44	D	2.00
Less than 40	F	0.00
	I	Incomplete

### Calculation of GPA/CGPA

The GPA (grade point average) will be calculated according to the following formula:

$$\text{GPA} = \frac{\sum(\text{Grade points earned in a course} \times \text{Credits for the course})}{\text{Total Credits}}$$

CGPA = Cumulative GPA for different semester

- The overall or Cumulative GPA gives the cumulative performance of the student from Semester-I up to any other Semester to which it refers and is computed by dividing the total grade points accumulated up to the date by the total credit hours.
- Both GPA and CGPA will be rounded off to the second place of decimal for reporting.

### Distribution of Marks

#### Theory

- (a) Class Attendance : 10%
  - (b) Incourse Assessment : 30%
  - (c) Semester Final Exam. : 60%
- Total : 100%**

#### Thesis

- (a) Thesis Report : 60%
  - (b) Presentation (Defense) : 40%
- Total : 100%**

### Evaluation System

Basis for awarding marks for class participation and attendance will be as follows:

<b>Attendance</b>	<b>Marks</b>
90% and Above	10
85% to 89%	9
80% to 84%	8
75% to 79%	7
70% to 74%	6
65% to 69%	5
60% to 64%	4
Less than 60%	0

A student is required to attend at least 60% of all classes held in every course.

### **In course Assessment**

- The number of in course exam of a course shall be 2 (Two). Evaluation of the performance in the class test will be on the basis of the average of the two exams.
- Incourse exam should hold regularly in every 3 to 4 weeks after starting of class.
- Duration of each incourse exam shall be 50 minutes.
- For convenience of conducting the incourse exam 50 minutes slot should be kept at the beginning of at least 4 working days in a week.
- The dates for the incourse exam shall be fixed by the course coordinator/chief course coordinator and shall be announced accordingly.
- All incourse exam shall be of equal value. The result of each individual class test shall be posted to display board for information of the students before the next incourse exam is held.
- The final computed marks sheet of the incourse exam and Class Attendance shall be submitted in 2 (two) separate sealed envelope by the course teacher to Chairman of concerned Examination Committee before preparatory leave for Semester final exam starts. The third copy of mark sheet along with answer scripts of all the incourse exam should be sent to the Controller of Examinations.

### **Thesis**

60% marks for thesis report and 40% for final presentation (defense) to be evaluated by the evaluation committee formed by Examination Committee.

### **Semester Final Examination**

#### **Duration of Semester final Examination**

There shall be 2 (two) hours examination for 2 (two) credit and 3 (three) hours examination for 3 (three) credit theory courses.

#### **Promotion Rules**

The minimum passing grade in a theory course shall be 2.00 and for Thesis 2.25.

### **Improvement of Grade**

If a student obtains a grade lower than 'B' in a course, he/she will be allowed to repeat the course only once for the purpose of grade improvement by forgoing his/her earlier grade, but he/she will not be eligible to get a grade better than 'B+' in such a course.

No improvement shall be allowed in Incourse Assessment, Thesis and Viva courses.

### **Re-admission**

A student of Semester 1, failing to appear in the semester final examination, unless rules of drop-out is applicable, may be allowed to get Re-admission with the Semester-I, of the immediate next batch. A re-admitted student however, shall always be assigned by the original registration number.

If a student fails to appear at any semester final examination due to shortage of required percentage of attendance, or failure to pay the dues or expulsion for the **institute/university** or any other reason as the case may be, she/he shall have to get herself/himself re-admitted to the same semester of the subsequently available batch.

If a student fails to full-fill the conditions for promotion from any Semester to the next may seek Re-admission with the same Semester of the subsequent available batch.

On Re-admission, grades earned earlier by a student in any Semester shall be cancelled automatically and the student shall have to retake all the course-works (such as incourse assessment, attendance, and thesis, viva voce and final examination).

## MSc in Textile Engineering Curriculum

Session: 2018-19 onward

### Semester-I

Course No.	Course Title	Credits
MTE-5101	DEVELOPMENTS IN SPECIALITY YARNS AND TEXTURING	3.00
MTE-5102	ADVANCED FABRIC STRUCTURE AND PRODUCTION	3.00
MTE-5103	ADVANCED COLORATION AND FINISHING	3.00
MTE-5104	ADVANCED APPAREL DESIGN AND PRODUCTION	3.00
<b>Total</b>		<b>12.00</b>

### Semester-II

Course No.	Course Title	Credits
MTE-5201	FUNCTIONAL AND SMART TEXTILES	3.00
MTE-5202	POLLUTION CONTROL AND ENVIRONMENT MANAGEMENT IN TEXTILES	3.00
MTE-5203	PRODUCT DESIGN AND DEVELOPMENT IN TEXTILES	3.00
MTE-5204	QUALITY ASSURANCE AND MANAGEMENT IN TEXTILES	3.00
MTE-5205	RESEARCH METHODOLOGY AND ACADEMIC WRITING	2.00
<b>Total</b>		<b>14.0</b>

### Semester-III

Course No.	Course Title	Credits
MTE-5301	THESIS	8.00
MTE-5302	COMPREHENSIVE VIVA	2.00
<b>Total</b>		<b>10.00</b>

## DETAIL COURSE CONTENTS

### Semester-I

#### MTE-5101: DEVELOPMENTS IN SPECIALITY YARNS AND TEXTURING (3.00 CREDITS)

**Learning Outcomes:** After successful completion of this course, the students should be able to

- Define science and technology of texturing
- Explain testing and application of textured yarns and fabrics made from them
- Describe setting and adjustments in various texturing process
- Select process parameters to process various special fibers
- Discuss the developments in Texturization

#### Course Contents:

- Types of specialty yarns: - Novelty yarns, Grindle yarns, core-spun yarns, Chennile yarns, Corded yarns, Bulky yarns and other types of specialty yarns. Methods of production of novelty yarns, their properties and applications
- Special Yarns on Unconventional Spinning Technologies: - Manufacture Properties & end uses of, Siro, Bobtex, Self-twist, Twistless, etc. Concepts of composite yarns
- Manufacture of some special purpose yarns:– Slub, double twist, Knop yarn, Chenille yarn, Diamond yarn, Eccentric yarn, Boucle yarn, Thick 'n' Thin Yarns.
- Comparative study of new spinning technologies: Break spinning assemblies. Comparison and properties of yarn made with different assemblies. Internal structure of break spun yarn. Production and properties of self-twist, twist-less core-spun, core-ply textured electrometric, Bobtex, fascinated & friction spun yarn. Cover spinning, siro spinning and compact spinning.
- Principles of texturing and modern classification: False twist texturing process-mechanisms and machinery, optimization of texturing parameters, barre', structure property correlation of textured yarns; Draw-texturing- the need and fundamental approaches; Friction texturing- the need and development, mechanics of friction texturing, latest development in twisting devices, optimization of quality parameters. Noise control in texturing.
- Air jet texturing- Principle, mechanisms, development of jets and machinery, process optimization and characterization, air jet texturing of spun yarns. Air interlacement-Principle and mechanism, jet development and characterization. Bulked continuous filament yarns- Need, principle, technology development. Hi-bulk yarns- Acrylic Hibulk yarn production, mechanism and machines involved, other such products. Solvent and chemical texturing- Need, texturing of synthetic and natural fibers.

**Reference Books:**

1. J W S Hearle, L Hollick and D K Wilson, Yarn texturing technology, Woodhead Publishing, 2001
2. G.D, Wilkinson; Draw-Textured Yarn Technology, Published by Monsanto Textiles Company, 1974
3. Ali Demir, Hassan M. Behery, Synthetic Filament Yarn: Texturing Technology, Prentice Hall, 1997
4. Bohumil Piller Bulked yarns: production, processing and applications; Textile Trade Press, 1973.
5. Modern Yarns for Modern Fabrics Seminar' Conference proceedings. By TTI, The Textile Inst. Publisher. 25
6. Woollen – Yarn manufacture' Textile progress, vol.15, no.1/2 by D.A. ROSS, The Textile Inst. Publisher.
7. The production of textured yarn by methods other than the false – twist technique, The Textile progress vol.16, No.3, By D.K. Wilson and T Kollu, The textile Inst. Publisher.

**MTE-5102: ADVANCED FABRIC STRUCTURE AND PRODUCTION (3.00 CREDITS)**

**Learning Outcomes:** After successful completion of this course, the students should be able to

- Design various weave structures
- Analyze colour and weave effects
- Illustrate special weaves
- Explain different Needle Selection Techniques in weft knitting
- Discuss the yarn quality requirements for weft knitting
- Summarize the dimensional properties of knitted fabric
- Compare Tricot & Rachel knitting machine
- Illustrate specialty warp knit structure

**Course Contents:**

- Woven fabric properties after structural modifications: Introduction, Crimp interchange phenomena, Maximum fabric extension, other structural changes, Structural design of woven fabrics using soft computing, Calculating fabric properties: numerical examples
- Design and engineering of woven fabrics: Textile product design methods: Introduction, The design process for textiles, Traditional design methods, Key issues in the design of textile products, Computer-assisted design (CAD) of woven fabrics, Design engineering using modeling, Reverse engineering, Expert systems in textile product design
- Modeling for woven fabric design: Introduction, Types of computer modeling in fabric design and manufacture, The application of modeling to woven fabric design, Modeling



structure–property relationships: elongation and bending, Modeling of woven fabric texture, Limitations of modeling

- Modeling three-dimensional (3-D) woven fabric structures: Introduction: 3-D fabrics, 2D and 3-D fabric weaving, Classifying 3-D woven fabrics, Modeling equations for weaving 2-D and 3-D fabrics, The use of 2-D and 3-D textiles in composites, The tensile properties of 3-D textile composites, non-crimped fabrics( NCF)
- Advances in knitting: Intelligent yarn delivery systems in weft knitting: Introduction, Theory of yarn delivery, Yarn storage and delivery systems on circular knitting machines, Yarn storage and delivery systems on flat knitting machines
- Advances in warp knitted fabric production: Introduction, Commercial warp knit machines, Delaware stitch and modified Delaware stitch tricot fabrics, Tricot and Raschel containing spandex, Key Raschel fabrics containing spandex, Newly developed constructions with spandex, Americana and modified Americana tricots, Surface interest fabrics, Milanese fabrics, Spacer fabric production and properties
- Knitted fabric composites: Introduction, Types of fibre and yarn used in knitted fabric composites, Composite performs, Knit structures for fabric composites, Types of matrix materials, Developments in manufacturing methods for knitted fabric composites, Mechanical properties, Applications

#### **Reference Books:**

1. Woven textile structure: Theory and applications, B. K. Behera and P. K. Hari
2. Advances in knitting technology, Edited by K. F. Au
3. Woven Fabric Structure : Design and Product Planning, J. Hayavadana
4. M. Text. Revised Syllabus (Technical Textiles) w.e.f. July, 2016
5. Soft computing in textile engineering, Edited by A. Majumdar

#### **MTE-5103: ADVANCED COLORATION AND FINISHING (3.00 CREDITS)**

**Learning Outcomes:** After completion of the course the students are able to

- Demonstrate understanding of the smart dyeing processes and how ‘smart textiles’ concept can be exploited using novel coloration techniques.
- Demonstrate knowledge and understanding of ‘surface engineering’ with the aid of advanced finishes.
- Appreciate how to measure and communicate colour to a global audience.
- Show competence to measure and communicate complex aspects of textile performance, such as ‘thermo-physiological comfort’ and ‘serviceability

#### **Course Contents:**

- Color specification and measurement
- Color theory, color strength, optical density, K/S,  $L^*a^*b^*$ ,  $L^*c^*h^*$  values, metamerism, Computer color matching system, Commercial formulation of dyes
- Sample preparation for CCM Application to textile processing, Advantages & limitations of CCM, Colour difference, shade sorting, relative dye strength and tone

analysis, Assessment of whiteness, yellowness and brightness, Computing and analyzing CCM results, Recipe formulation, batch correction, shade library.

- Application of chemical finishes, Drying of wet textiles, Curing of chemical finishes, Coating and laminating, Various Low liquor and minimum application techniques in textile finishing, their advantages and limitations
- Finishing with enzymes: bio-finishes for cellulose: Action of cellulose enzymes on cellulose, Chemistry of enzyme finishing, Evaluation of bio-finishing, Troubleshooting for bio-finishing
- Ultraviolet protection finishes: Mechanism of UV protection, Chemistry of UV protection finishes, Evaluation of UV protection finishes, Troubleshooting for UV protection finishes and combinability
- Functional Finishes: Wrinkle free finishing, concept of wet and moist cross linking, various ecofriendly resin finishes, antimicrobial finishes, Flame retardant finishes, eco-friendly flame retardant finishes
- Digital Printing: Concept, methods of inkjet printing, techno-economical features
- Dyeing machinery: Advances in fiber dyeing machine, Advances in Beam dyeing - Advances in soft flow dyeing machines, Advances in jet dyeing machines, Developments in jiggers, Continuous dyeing machineries & its developments, Various dyeing defects caused by the above machineries
- Printing machines: Advances in flat bed machines, rotary printing machines.
- Drying and finishing machines: Advances in drying and finishing machines

#### **References Books:**

1. Physical chemistry of dyeing by Thomas Vickerstaff
2. Theory of Coloration of Textiles by Alan Johnson, Society of Dyers and Colourists
3. Computer colour analysis: Textile applications by Dr. A.D. Sule
4. Instrumental colour measurements and computer aided colour matching for textiles b Dr. H. S. Shah & Dr. R. S. Gandhi
5. Colour Physics for industry by Roderick Mc Donald Chemical Processing of Synthetic fibres by Dr. K. V. Datye & A. A. Vaidya
6. Chemical Finishing of Textiles by W. D. Schindler and P. J. Hauser
7. Textile Finishing by Derek Heywood 4 Nanosols and textiles by B. Mahltig, T. Textor
8. Chemistry and technology of fabric preparation and finishing by Dr. C. Tomasino, NCSU, USA.
9. Dyeing of polyester & its blends by Prof. M. L. Gulrajani
10. Engineering in Textile coloration by C. Duckworth
11. Technology of finishing by J.T. Marsh

## **MTE-5104: ADVANCED APPAREL DESIGN AND PRODUCTION (3.00 CREDITS)**

**Learning Outcomes:** After successful completion of this course, the students should be able to

- Outline the process flow for garment processing machines
- Explain the various dyeing, printing and finishing methods involved in garment processing Prepare the garment with different style using advanced finishing machine
- Explain the working principle of garment processing machines
- Schedule the routine maintenance of the garment machines
- Design, sketch, cost and select appropriate fabric and trims for several outfits in various garment and price categories.
- Analyze critically the rationale used in applying basic drafting principles, methods and techniques learned in class to the solving of new concepts and ideas.
- Develop a portfolio for an original clothing collection

### **Course Contents:**

- Apparel designing: Definition, Tools and equipment used, Principles & elements of design, Structural and applied designs, Use of trimmings and decorative features, Factors influencing selection of fabric, Special consideration in designing and layout of the garment for prints, stripes, checks, pile fabric. Handling of special fabric while cutting and stitching. (Deep pile, lace, velvet, chiffon, knits, leather)
- Dobby designing; Introduction, scope and uses, principle of operation, extra warp and weft designs, method of representation of designs.
- Jacquard designing, Principles of operation, harness and design calculations, size of repeat, counts of design, paper construction and development of designs, prevention of long floats, insertion of weaves, conditions to observe while designing.
- Overview of the garment industry: Main sectors of the garment industry • Standards and Specifications: parts, types and preparation of specification sheet • assembling a garment in the industry: 4 P's- parts, panels, pieces and products • Production capacity
- Pre-production: Markers- planning, production, efficiency, methods of making • Spreading of fabric- requirements, methods, nature of fabric packages • Cutting – objectives, methods, Preparation before cutting-Fusing, ticketing and bundling- purposes and types • Fusing- advantages, requirements, processes, equipment, methods and quality control • Alternative methods of joining material: welding and molding technology.

### **References Books:**

1. Allen Anne Seaman Julian Fashion Drawing, The Basic Principles B.T. Batsford Ltd. London.
2. William Watson: Advanced Textiles Design, London, Longmans Green and Co. Bombay.
3. Nisbet, H : Grammar of Textile Design, Tarapoprewale Sons and Co. Bomaby

4. Engineering apparel fabrics and garments, J. Fan and L. Hunter, Woodhead Publishing Limited, 2009
5. Engineering textiles: Integrating the design and manufacture of textile product, Y. E. El Mogahzy, Woodhead Publishing Limited, 2000.
6. The Apparel Industry, Richard M Jones Ergonomics in the garment industry, Dr Gordana Colovic, Woodhead Publishing India Pvt. Ltd., 2014.
7. Brown, Patty and Rice Janett (1998) Ready to Wear Apparel Analysis (2nd Edition), Prentice Hall
8. Cooklin. G. (2000) Introduction to Clothing Manufacture, Blockwell Scientific Publication

## Semester-II

### MTE-5201: FUNCTIONAL AND SMART TEXTILES (3.00 CREDITS)

**Learning Outcomes:** After completion of the course students are able to demonstrate

- Assess technologies involved in smart textile and wearable electronic products and manufacturing processes, their advantages and disadvantages;
- Describe the development trends in technologies for smart textile and wearable electronics and their potentials in industrial applications.
- Develop the ability to adapt new technologies and update her/his knowledge;

#### Course Contents:

- Definition and Classification of Functional and Smart textiles.
- Modelling of intelligent materials: Background, underpinnings of interdisciplinary, scientific practices and research strategies for intelligent garments
- Phase change materials: Heat balance and thermo-physiological comfort, Phase change technology, PCM in textiles, Future prospects of PCM in textiles and clothing
- Study of shape memory polymer films for breathable textiles: Breathability and clothing comfort, Breathable fabrics, Water vapor permeability (WVP) through shape memory polyurethane Chromic and conductive materials: Photo chromic materials, Thermochromic materials, Colour changing, Electro chromic materials.
- Introduction to conductive materials: Electric conductivity, Metal conductors, Ionic conductors, inherently conducting polymers, Application technologies for conducting fibre materials Multipurpose textile based sensors: Introduction, Conductive polymer textile sensors, Conductive polymer composites (CPCs) textile sensors Textile micro system technology: Textile micro system technology, Textiles are inherent microstructures, Textile-based compliant mechanisms in micro-engineering and mechatronics.
- Wound: types and healing mechanism- textile materials for wound dressing – bio active dressing – anti microbial textiles dressing – composite dressing – testing of wound care

materials; Wound compression textiles; Reusable medical textiles: types, advantages, physical properties and performance — reusable processing methods.

- Bandages-types, properties and applications; compression garments-types, properties and applications; sutures: types and properties; implantable textiles: hernia mesh – vascular prostheses – stents; Extra corporeal materials: Cartilage nerves – liver ligaments, kidney, tendons, cornea; Drug delivery textiles: classification – mechanism various fabrication methods – characterization – applications.
- Smart textiles – types, characteristics – smart textiles in wound care; applications of phase change and shape memory materials – monitoring pregnancy, children and cardio patients – mobile health monitoring ; electronics in medical textiles; Smart textiles in rehabilitation and applications; textile sensors for healthcare ;legal and ethical values involved in the medical textile materials.

### **Reference Books:**

1. Wellington Sears Handbook of Industrial Textiles – Sabit Adanur
2. Protective Clothing – Textile Progress(Vol 22,no.2/3/4), 1992, Textile Institute
3. Hand book of Technical Textiles- A R Horrocks and S C Anand, Woodhead Publishing Ltd., 2000
4. Smart Fibers, Fabrics and Clothing- X Tao, Woodhead Publishing Ltd. 2001
5. D Hull An Introduction to composite materials, Cambridge university press, 1998
6. Hearle. J.W.S “High performance fibres composites and engineering textile structures” JTI (special issue) 1990.
7. Smart fibres, fabrics and clothing edited by Xiaoming Tao, Wood head publishing Ltd., England.
8. Intelligent Textile and clothing edited by H. R. Mattila, Wood head Publishing, England.

## **MTE-5202: POLLUTION CONTROL AND ENVIRONMENT MANAGEMENT IN TEXTILES (3.00 Credits)**

**Learning Outcomes:** After successful completion of this course, the students should be able to

- Play an important role in transferring a healthy environment for future generations
- Analyze the impact of engineering solutions in a global and societal context
- Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems
- Ability to consider issues of environment and sustainable development in his personal and professional undertakings
- Highlight the importance of ecosystem and biodiversity Paraphrase the importance of conservation of resources

## **Course Contents:**

- Introduction to Eco System & Environment Management: Environmental problems and human health, Risk assessment and risk management, ecology and textiles, Toxicological considerations of textile processing. Definitions of environment, ecology, pollution, Types of pollution and effects on environment, general waste categorization, effective pollution prevention program.
- Environmental Management Systems: Development of EMS, EMS tools, Importance of ISO - 14000 standards, environmental policy, EMS planning, Implementation, Checking of corrective action, Concept of Okötex, GOTS.
- Air Pollution in Textile Industry: Classification and properties of air pollutants, Sources of emission, Greenhouse gases, Behavior and fate of air pollutants, Effects of air pollution on human health, vegetation, animals, machinery and building. Sources of air pollution in wet processing, their levels, toxicity and effects on atmosphere. Air pollution laws and norms, Plume behavior, Analysis of air pollutants, Measures to control air pollution.
- Water Pollution in Textile Industry: Sources of water, their nature and use pattern, General types of water pollutants and their effects, Factors polluting water in textile wet processing in each unit operations. The volume of waste generated and nature of the wastewater, Effects of wet processing effluent parameters on the environment.
- Effluent Treatments: Basic processes of wastewater treatment, Basic factors to be considered for waste water or effluent treatment. Methods of Treatment of Textile effluent, preliminary, primary, secondary and tertiary treatments. Advancement in the effluent treatment like reverse osmosis, plasma technology, removal of dissolved solids, removal of heavy metals. Sludge disposal, Reuse of water and cost of effluent treatment, Norms of treated effluent. A typical design for effluent treatment plant to meet the norms laid down by Pollution Control Board Measures to be taken into consideration to improve the quality of the effluent generated either by chemical substitution, eco-friendly processing, process modification, etc

## **Reference Books:**

1. Environmental pollution control engineering – C.S. Rao.
2. Best management practices for pollution prevention in the textile industry – Textiles committee, 1997
3. Environmental issues – technology options for textile industry – Book of papers published by R.B. Chavan et.al of IIT, New Delhi.
4. Fundamentals of air pollution – Richard W. Boubel, D. Fox etal.
5. Treatment of textile processing effluents – N. Manivaskan.
6. Textiles energy and waste seminar – proceedings from textile institute, 1997.
7. Environmental Issues – Technology option for Textile Industry Edited by R. B. Chavan, Indian Journal of Fibre & Textile Research Special Issue - March, 2001
8. The Management Systems – Quality, Environment, Health & Safety ISO 9001 : 2000, ISO 14001, OHSAS 18001 BY Pranab Kr. Nag, International Certification Services

## **MTE-5203: PRODUCT DESIGN AND DEVELOPMENT IN TEXTILES (3.00 CREDITS)**

**Learning Outcomes:** After completing the course the student will be able to

- Describe the various stages in the product development process
- Understand the relationship between user needs and product requirements
- Explain the different product concepts Skills and Abilities
- Develop a new textile product concepts focusing on a specific user categori
- Collaborate in group in a product development project evaluation ability and approach
- Critically analyze and argue for a selected product from the viewpoint of economy, ecology, aesthetics, ergonomics and ethics
- Select and argue for the chosen concept in connection with concept development

### **Course Contents:**

- Practical aspects of innovation in the textile industry: Introduction and practical aspects of innovation, Meeting the needs of customers better than the competition, Innovation as a driver of new strategic issues in the apparel industry, Future trends in innovation
- New product developments in knitted textiles: Introduction, Seamless knitwear, Printing on knitwear, Computer aided knitwear design (CAD) and virtual knitwear
- Fabrics and new product development: Introduction, Market demand, Functionality responses, Environmental sustainability responses, sensing textiles responses,
- New product development in automotive upholstery: Introduction, The automotive textile market, key drivers and supply chain, new product development process for automotive upholstery, Novel materials and processes in automotive upholstery, Future developments in automotive upholstery
- New product development in interior textiles: Introduction, New product development of interior textiles, basics and general procedures, Case studies, learning experiences for successful new product developments of interior textiles, Future trends in interior textiles
- New product development for e-textiles: Introduction, Integration of electronics and fabrics, E-textiles product development challenges
- Customer co-creation: moving beyond market research to reduce the risk in new product development, Introduction, Challenges of identifying customer needs in the product development process
- Product Engineering: Objectives and Scope of product development in textiles and clothing. Performance and serviceability concepts in textiles. Effect of changes in fibre, yarn type and fabric construction and finishing on performance and serviceability of textile products.
- Consideration of a good product design. Product development procedure –Selection of product, Product analysis, Product design procedure- Preliminary design, Maintainability, Reliability and Redundancy, Final design.
- Product life cycle.
- Market Research, Material Research, Equipment and process research

### **Reference Books:**

1. New product development in textiles: Innovation and production, Edited by L. Horne, Published by Woodhead Publishing Limited in association with The Textile Institute, 2012
2. Hand book of Textile Design Principles, Process and Practice by Jacquie Wilson, Textile Institute Publication.
3. The Design Logic of Textile Products, Textile progress vol. 27, No. 3, T Matuo and M. N. Suresh. The Textile Institute Publication.
4. Engineering Design by George Dieter.
5. Proceedings of the Seminar – Non woven Technology, Market and Product Potential, IIT, New Delhi, December 2006

### **MTE-5204: QUALITY ASSURANCE AND MANAGEMENT IN TEXTILES (3.00 Credits)**

**Learning Outcomes:** After successful completion of this course, the students should be able to

- Describe the concepts of quality and statistical application in textiles
- Explain the sampling methods carried out in testing
- Calculation of maturity, fineness, crimp, yarn numbering system, evenness, hairiness  
Summarize the working
- Principle of all testing instruments of fibre, yarn & fabric
- Generalize the advanced testing instruments

### **Course Contents:**

- Introduction to Quality Standards: importance of Quality - British standards and ISO Standards for the Apparel Industry - Brief study about ISO 9000 Standards and ISO 14000 Standards - Total Quality management systems.
- Statistical Description of Quality: Population and sample, techniques of sampling, simple random sample, analysis of sample data, representation of sample data, practical examples. Statistical Inferences on Quality: Population and sample distributions, estimation of population parameters, statistical hypothetical test, practical examples.
- Quality and consistency among textile products- TQM, Target markets, Product attributes. Quality and consumer safety.
- **Quality control organizations, standards and regulations**
- AATCC, ASTM, ISO, BIS, INDA, GINETEX, etc.
- Eco-labels, silk mark, wool mark, other international labels □ Regulations on Apparel Labeling- Care labels, Fibre ID labels.
- Regulations on Apparel Industry Practices.
- Eco specification and restriction in apparel and textiles: Dry cleaning using Ozone depleting chemicals- pH values, Formaldehyde contents - Heavy metal contents -



Pesticides and Herbicides - Azo dye stuffs -Nickel – Penta-chloro phenols – color fastness - brighteners and Softening agents.

- Garment defects: Quality followed in cutting department - sewing department - Finishing and Packing Departments - Testing of Garments - Seam strength – Seam properties of Knitted fabrics -Bow & Skewness in woven & Knitted fabrics - Soil/Stain release testing -Testing of Sewing Threads.
- Introduction to care label - importance of care labels - Different systems of care labelling American - British and International Labelling - Eco-labelling.
- Starting a quality control program - implementation of quality systems in production line, product specifications and analysis using analytical tools - Quality Control Aspects for Garment Exports - Nature of Quality Costs and Customer Returns -Functions of Quality Assurance and Quality Control.

### Reference Books:

1. PV Mehta Management Quality in Apparel Industry.
2. Gopala Krishnan, P.A. Textile Testing, JK. Publications.
3. Jacob, S. Apparel manufacturing hand book, analysis principles and Practice, Columbia media corp, 1988.
4. Tomory, Edith, —A History of Fine Arts in India and the West – Orient Longman, Publishers Reprinted 1999
5. Bhardwaj, S.K. and Mehta, P.V. (1998) *Managing Quality in the Apparel Industry*, New Delhi, New Age International.
6. Kothari, V.K., Behera, B.K., (1996) *Quality Control in Textiles and Apparel Industry- A& B*, Delhi, Department of Textile Technology, IIT – Proceedings of Workshop- 3-5 October.
7. Kudolph Sara J., (1998) *Quality Assurance of Textiles and Apparel*, Fairchild publication.
8. Saville, B.P., (2000) *Physical Testing of Textiles*, Textiles Institute.
9. Stamper, Anita A., (2005) Linda B Donnell, *Evaluating Apparel Quality* (2<sup>nd</sup> ed.), Fairchild Publication.

### MTE-5205: RESEARCH METHODOLOGY AND ACADEMIC WRITING (2.00 CREDITS)

**Learning Outcomes:** At the end of this course, the students should be able to:

- Understand some basic concepts of research and its methodologies
- Identify appropriate research topics
- Select and define appropriate research problem and parameters
- Prepare a project proposal (to undertake a project)
- Organize and conduct research (advanced project) in a more appropriate manner
- Write a research report and thesis
- Write a research proposal (grants)

### **Course Contents:**

- Fundamental Concepts of Research: Meaning, definition, types of research – significance of research – research process, Defining the research problem, Sources, Identification, Selection and statement, Review of Literature.
- Research Design/Proposal: Research Design – Meaning, Types of Research Design, Basic principles of experimental designs, developing a research Plan. Sampling –Census and sample survey, steps in sampling design, criteria for selecting a sampling procedure, characteristics of a good sample design, different types of sample design.
- Research Methods And Tools: Methods of data collection – observation, questionnaire, Interview. Data Processing – Collection, Classification, Tabulation, Graphical representation and data analysis.
- Report Writing - Research Report – Format of research report, main body of the report, references and appendices, style of writing, typing the report, pagination, tables and figures, bibliography, footnotes, margins, quotations, evaluating the report.
- Statistics: Meaning and scope of statistics, role of statistics in research, measures of central tendency and dispersion. Co- efficient of Correlation and its Interpretation, Rank Correlation, Regression equation, Application of Chi – Square test, T-test, ANOVA test.

### **References Books:**

1. C R Kothari Research Methodology, Methods and Techniques ,New Age International (P) Ltd, Delhi, 2011.
2. J. Medo Statistical Method- An Introductory text,New Age publishers, Delhi, 2005.
3. Santosh Gupta Research Methodology and Statistical Techniques, Deep and Deep Publications, 1999.
4. S P Gupta An Introduction to Statistical Methods, Vikas publishing House, Delhi, 2009.
5. Lucy Jacobs, D.A. Introduction to Research in Education,Christine Sorensen, Cengage Learning, 2009.
6. Stuart Melville, W.G. Research Methodology, an Introduction, Jut and Company Ltd, 2004.

### **Semester-III**

<b>Course No.</b>	<b>Course Title</b>	<b>Credits</b>
5301	Thesis	8.00
	Comprehensive Viva	2.00
<b>Total</b>		<b>10.00 Credits</b>

**TOTAL CREDITS: 36**