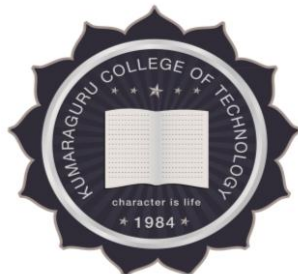


# **KUMARAGURU COLLEGE OF TECHNOLOGY**

(Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE – 641049



## **CURRICULUM & SYLLABUS CHOICE BASED CREDIT SYSTEM (REGULATIONS 2015)**

**I to IV Semester**

**M.Tech Apparel Technology**

**Department of Fashion Technology**

## **VISION**

Achieve excellence in academics and research by bestowing technological prowess and managerial acumen to our students to face the global challenges of the clothing industry within the context of professional and social responsibility.

## **MISSION**

- ❖ Disseminate core competencies with a comprehensive curriculum encompassing apparel design, manufacture and management.
- ❖ Stimulate analytical and creative thinking to transform the students as competent professionals and researchers.
- ❖ Promote collaborations with industry to comprehend global practices leading to excellence.
- ❖ Mould the students as socially responsible technocrats and entrepreneurs to develop products and offer services useful for society.

**Department of Fashion Technology**  
**Kumaraguru College of Technology**  
**Coimbatore – 641 049**  
**Regulations 2015**

| <b>CBCS – PG Curriculum</b>                                |             |   |                      |   |   |   |                    |  |
|--|-------------|---|----------------------|---|---|---|--------------------|--|
| <b>Name of the PG Programme: M.Tech Apparel Technology</b> |             |   |                      |   |   |   |                    |  |
| <b><u>Foundation Courses (FC)</u></b>                      |             |   |                      |   |   |   |                    |  |
| S.No   | Course Code | Course Title  | Periods/Wk & Credits |   |   |   | Preferred Semester |  |
|  |             |   | L                    | T | P | C |                    |  |
| 1  | P15ATT301   | Research Methodology                                      | 3                    | 0 | 0 | 3 | III                |  |
| 2  | P15ATP201   | Statistical Analysis and Design of Experiments Laboratory | 3                    | 0 | 0 | 3 | II                 |  |
| <b><u>Professional Core (PC)</u></b>                       |             |   |                      |   |   |   |                    |  |
| S.No   | Course Code | Course Title  | Periods/Wk & Credits |   |   |   | Preferred Semester |  |
|  |             |   | L                    | T | P | C |                    |  |
| 1.   | P15ATT7101  | Automation in Apparel Manufacture                         | 3                    | 0 | 0 | 3 | I                  |  |
| 2.   | P15ATT7102  | Science of Clothing Comfort                               | 3                    | 0 | 0 | 3 | I                  |  |
| 3.   | P15ATT7103  | Forecasting and Product Development                       | 3                    | 0 | 0 | 3 | I                  |  |
| 4.   | P15ATT7104  | Sustainable Apparel Manufacture                           | 3                    | 0 | 0 | 3 | I                  |  |
| 5.   | P15ATT7105  | Engineering of Functional Clothing                        | 3                    | 0 | 0 | 3 | I                  |  |
| 6.   | P15ATP101   | Virtual Garmenting Laboratory                             | 0                    | 0 | 3 | 1 | I                  |  |
| 7.   | P15ATP102   | Fabric and Apparel Assessment Laboratory                  | 0                    | 0 | 3 | 1 | I                  |  |
| 8.   | P15ATT7201  | Technology of Apparel Finishing                           | 3                    | 0 | 0 | 3 | II                 |  |
| 9.   | P15ATT7202  | Advanced Knitwear Technology                              | 3                    | 0 | 0 | 3 | II                 |  |
| 10.  | P15ATT7203  | Apparel Engineering                                       | 3                    | 0 | 0 | 3 | II                 |  |
| 11.  | P15ATT7204  | Fashion Entrepreneurship Management                       | 3                    | 0 | 0 | 3 | II                 |  |

| <b><u>Professional Electives (PE)</u></b> |             |  |                       |   |   |   |                    |
|---|-------------|--|-----------------------|---|---|---|--------------------|
| S. No.                                    | Course Code | Course Title   | Periods /Wk & Credits |   |   |   | Preferred Semester |
|   |             |  | L                     | T | P | C |                    |
| 1   | P15ATE101   | Technology of Surface modifications                      | 3                     | 0 | 0 | 3 | I                  |
| 2   | P15ATE102   | Medical Textiles   | 3                     | 0 | 0 | 3 | I                  |
| 3   | P15ATE103   | Computer Integrated Apparel Manufacture                  | 3                     | 0 | 0 | 3 | I                  |
| 4   | P15ATE104   | Functional Clothing and Evaluation                       | 3                     | 0 | 0 | 3 | I                  |
| 5   | P15ATE201   | Textile composites                                       | 3                     | 0 | 0 | 3 | II                 |
| 6   | P15ATE202   | Home Textiles  | 3                     | 0 | 0 | 3 | II                 |
| 7   | P15ATE203   | Protective Clothing                                      | 3                     | 0 | 0 | 3 | II                 |
| 8   | P15ATE204   | Logistics Management in Apparel industry                 | 3                     | 0 | 0 | 3 | II                 |
| 9   | P15ATE301   | Apparel Systems Engineering                              | 3                     | 0 | 0 | 3 | II                 |
| 10  | P15ATE302   | Mechanism of Apparel Machinery                           | 3                     | 0 | 0 | 3 | II                 |
| 11  | P15ATE303   | Nano Textiles and Apparels                               | 3                     | 0 | 0 | 3 | II                 |
| 12  | P15ATE304   | Finance and Human Resource Management                    | 3                     | 0 | 0 | 3 | II                 |
| 13  | P15ATE401   | Lean Manufacture   | 3                     | 0 | 0 | 3 | III                |
| 14  | P15ATE402   | Compliance Standards for Apparel Industry                | 3                     | 0 | 0 | 3 | III                |
| 15  | P15ATE403   | Energy Management in Apparel Industry                    | 3                     | 0 | 0 | 3 | III                |
| 16  | P15ATE404   | Operations Research and Statistics in Apparel Production | 3                     | 0 | 0 | 3 | III                |
| 17  | P15ATE405   | Strategic Marketing                                      | 3                     | 0 | 0 | 3 | III                |
| 18  | P15ATE501   | Technology of Textile Printing                           | 3                     | 0 | 0 | 3 | III                |
| 19  | P15ATE502   | High Performance Clothing                                | 3                     | 0 | 0 | 3 | III                |
| 20  | P15ATE503   | Sports Apparels  | 3                     | 0 | 0 | 3 | III                |
| 21  | P15ATE504   | Apparel Production Management                            | 3                     | 0 | 0 | 3 | III                |
| 22  | P15ATE505   | Fashion Communication                                    | 3                     | 0 | 0 | 3 | III                |

| <b><u>Employability Enhancement Courses (EEC)</u></b> |                    |                       |                                  |          |          |          |                           |  |
|---|--------------------|-----------------------|----------------------------------|----------|----------|----------|---------------------------|--|
| <b>S. No.</b>   | <b>Course Code</b> | <b>Course Title</b>   | <b>Periods /Wk &amp; Credits</b> |          |          |          | <b>Preferred Semester</b> |  |
|   |                    |                       | <b>L</b>                         | <b>T</b> | <b>P</b> | <b>C</b> |                           |  |
| 1.  | P15ATP301          | Project Work Phase I  | 0                                | 0        | 12       | 6        | III                       |  |
| 2.  | P15ATP401          | Project Work Phase II | 0                                | 0        | 24       | 12       | IV                        |  |

| <b>SEMESTER – I</b>       |                    |  |                 |                      |          |          |          |          |
|---------------------------|--------------------|--|-----------------|----------------------|----------|----------|----------|----------|
|                           | <b>Course Code</b> | <b>Course Title</b>                      | <b>Category</b> | <b>Contact Hours</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b><u>Theory</u></b>      |                    |  |                 |                      |          |          |          |          |
| 1.                        | P15AT7101          | Automation in Apparel Manufacture        | PC              | 45                   | 3        | 0        | 0        | 3        |
| 2.                        | P15AT7102          | Science of Clothing Comfort              | PC              | 45                   | 3        | 0        | 0        | 3        |
| 3.                        | P15AT7103          | Forecasting and Product Development      | PC              | 45                   | 3        | 0        | 0        | 3        |
| 4.                        | P15AT7104          | Sustainable Apparel Manufacture          | PC              | 45                   | 3        | 0        | 0        | 3        |
| 5.                        | P15AT7105          | Engineering of Functional Clothing       | PC              | 45                   | 3        | 0        | 0        | 3        |
| 6.                        | <b>E1</b>          | Elective                                 | PE              | 45                   | 3        | 0        | 0        | 3        |
| <b><u>Practicals</u></b>  |                    |  |                 |                      |          |          |          |          |
| 1.                        | P15ATP101          | Virtual Garmenting Laboratory            | PC              | 45                   | 0        | 0        | 3        | 1        |
| 2.                        | P15ATP102          | Fabric and Apparel Assessment Laboratory | PC              | 45                   | 0        | 0        | 3        | 1        |
| <b>Total credits - 20</b> |                    |  |                 |                      |          |          |          |          |

| <b>SEMESTER – II</b> |                    |                                 |                 |                      |          |          |          |          |
|----------------------|--------------------|---------------------------------|-----------------|----------------------|----------|----------|----------|----------|
|                      | <b>Course Code</b> | <b>Course Title</b>             | <b>Category</b> | <b>Contact Hours</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b><u>Theory</u></b> |                    |                                 |                 |                      |          |          |          |          |
| 1.                   | P15AT7201          | Technology of Apparel Finishing | PC              | 45                   | 3        | 0        | 0        | 3        |
| 2.                   | P15AT7202          | Advanced Knitwear Technology    | PC              | 45                   | 3        | 0        | 0        | 3        |
| 3.                   | P15AT7203          | Apparel                         | PC              | 45                   | 3        | 0        | 0        | 3        |

|  |                    |   |                 |                      |          |          |          |          |
|--|--------------------|---|-----------------|----------------------|----------|----------|----------|----------|
|  |                    | Engineering   |                 |                      |          |          |          |          |
| 4.   | P15AT7204          | Fashion Entrepreneurship Management                       | PC              | 45                   | 3        | 0        | 0        | 3        |
| 5.   | E2                 | Elective  | PE              | 45                   | 3        | 0        | 0        | 3        |
| 6.   | E3                 | Elective  | PE              | 45                   | 3        | 0        | 0        | 3        |
| <b><u>Practicals</u></b>   |                    |   |                 |                      |          |          |          |          |
| 1.   | P15ATP201          | Statistical Analysis and Design of Experiments Laboratory | FC              | 45                   | 0        | 0        | 3        | 1        |
| <b>Total credits - 19</b>  |                    |   |                 |                      |          |          |          |          |
| <b>SEMESTER – III</b>  |                    |   |                 |                      |          |          |          |          |
|  | <b>Course Code</b> | <b>Course Title</b>                                       | <b>Category</b> | <b>Contact Hours</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b><u>Theory</u></b>   |                    |   |                 |                      |          |          |          |          |
| 1.   | P15FTT301          | Research Methodology                                      | FC              | 45                   | 3        | 0        | 0        | 3        |
| 2.   | E4                 | Elective  | PE              | 45                   | 3        | 0        | 0        | 3        |
| 3.   | E5                 | Elective  | PE              | 45                   | 3        | 0        | 0        | 3        |
| 4.   | E6                 | Self Study Elective*                                      | PE              | 45                   | 0        | 0        | 0        | 3        |
| <b>*Any one course could be selected from the list of elective courses</b> |                    |   |                 |                      |          |          |          |          |
| <b><u>Practicals</u></b>   |                    |   |                 |                      |          |          |          |          |
|  | P15ATP301          | Project Work (Phase I)                                    | EEC             |                      | 0        | 0        | 12       | 6        |
| <b>Total credits - 18</b>  |                    |   |                 |                      |          |          |          |          |
| <b>SEMESTER – IV</b>   |                    |   |                 |                      |          |          |          |          |
|  | <b>Course Code</b> | <b>Course Title</b>                                       | <b>Category</b> | <b>Contact Hours</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b><u>Practicals</u></b>   |                    |   |                 |                      |          |          |          |          |
| 1.   | P15ATP401          | Project Work (Phase II)                                   | EEC             |                      | 0        | 0        | 24       | 12       |
| <b>Total credits - 12</b>  |                    |   |                 |                      |          |          |          |          |
| <b><u>Electives</u></b>  |                    |   |                 |                      |          |          |          |          |
|  | <b>Course Code</b> | <b>Course Title</b>                                       | <b>Category</b> | <b>Contact Hours</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| 1.   | P15ATE101          | Technology of Surface modifications                       | PE              | 45                   | 3        | 0        | 0        | 3        |
| 2.   | P15ATE102          | Medical Textiles  | PE              | 45                   | 3        | 0        | 0        | 3        |
| 3.   | P15ATE103          | Computer Integrated Apparel                               | PE              | 45                   | 3        | 0        | 0        | 3        |

|     |           |  |    |    |   |   |   |   |
|-----|-----------|--|----|----|---|---|---|---|
|     |           | Manufacture  |    |    |   |   |   |   |
| 4.  | P15ATE104 | Functional Clothing and Evaluation                       | PE | 45 | 3 | 0 | 0 | 3 |
| 5.  | P15ATE201 | Textile composites                                       | PE | 45 | 3 | 0 | 0 | 3 |
| 6.  | P15ATE202 | Home Textiles  | PE | 45 | 3 | 0 | 0 | 3 |
| 7.  | P15ATE203 | Protective Clothing                                      | PE | 45 | 3 | 0 | 0 | 3 |
| 8.  | P15ATE204 | Logistics Management in Apparel industry                 | PE | 45 | 3 | 0 | 0 | 3 |
| 9.  | P15ATE301 | Apparel Systems Engineering                              | PE | 45 | 3 | 0 | 0 | 3 |
| 10. | P15ATE302 | Mechanism of Apparel Machinery                           | PE | 45 | 3 | 0 | 0 | 3 |
| 11. | P15ATE303 | Nano Textiles and Apparels                               | PE | 45 | 3 | 0 | 0 | 3 |
| 12. | P15ATE304 | Finance and Human Resource Management                    | PE | 45 | 3 | 0 | 0 | 3 |
| 13. | P15ATE401 | Lean Manufacture   | PE | 45 | 3 | 0 | 0 | 3 |
| 14. | P15ATE402 | Compliance Standards for Apparel Industry                | PE | 45 | 3 | 0 | 0 | 3 |
| 15. | P15ATE403 | Energy Management in Apparel Industry                    | PE | 45 | 3 | 0 | 0 | 3 |
| 16. | P15ATE404 | Operations Research and Statistics in Apparel Production | PE | 45 | 3 | 0 | 0 | 3 |
| 17. | P15ATE405 | Strategic Marketing                                      | PE | 45 | 3 | 0 | 0 | 3 |
| 18. | P15ATE501 | Technology of Textile Printing                           | PE | 45 | 3 | 0 | 0 | 3 |
| 19. | P15ATE502 | High Performance Clothing                                | PE | 45 | 3 | 0 | 0 | 3 |
| 20. | P15ATE503 | Sports Apparels  | PE | 45 | 3 | 0 | 0 | 3 |
| 21. | P15ATE504 | Apparel Production Management                            | PE | 45 | 3 | 0 | 0 | 3 |
| 22. | P15ATE505 | Fashion Communication                                    | PE | 45 | 3 | 0 | 0 | 3 |
|     |           |  |    |    |   |   |   |   |

| <b>ONE CREDIT ELECTIVE COURSE**</b> |   |  |                 |
|-------------------------------------|---|--|-----------------|
| <b>Sl. No</b>                       | <b>Course Title</b>                                       | <b>Industry that will offer the course</b> | <b>Category</b> |
| 1                                   | P15ATIN01 Implementation of Six Sigma in Apparel Industry | Apparel Industry                           | EEC             |
| 2                                   | P15ATIN02 Vendor Compliance and Audit                     | Apparel Industry/Certification Agencies    | EEC             |
| 3                                   | P15ATIN03 Apparel Machinery Maintenance and Audit         | Apparel Machinery Manufacturers/Suppliers  | EEC             |
| 4                                   | P15ATIN04 Global Fashion Enterprise                       | Apparel Industry                           | EEC             |
| 5                                   | P15ATIN05 Sustainable Packaging Design                    | Apparel Industry                           | EEC             |
| 6                                   | P15ATIN06 Store Presentation for Effective Retailing      | Apparel Industry                           | EEC             |

\*\* Students can complete such one credit courses during the semesters 1 to 3 as and when these courses are offered by any of the departments. The one credit courses will not be considered for computing CGPA.



**DEPARTMENT OF FASHION TECHNOLOGY**

**M. Tech. - APPAREL TECHNOLOGY**

**REGULATIONS 2015**

**CHOICE BASED CREDIT SYSTEM**

**SYLLABUS**

# **SEMESTER I**

## **P15ATT101 AUTOMATION IN APPAREL MANUFACTURE**

| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------|----------|----------|----------|
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Acquire knowledge on various mechanical and electrical drives used in automation of apparel manufacture.

**CO2:** Explain the working of automated elements in cutting, sewing and special machines.

**CO3:** Gains knowledge about automated apparel finishing equipment.

**CO4:** Describe the concepts of automated material handling equipment.

**CO5:** Explain the application robotics in various areas in apparel industry.

**Pre-requisite: Nil**

### **CONCEPT OF AUTOMATION**

**9 Hours**

Base subject information, basic terms and definitions from mechanization area and automation area. Energy transfer in kinematic system, drive requests, types of drives, comparison, characteristics, fluid drives, characteristics, comparing, pneumatic drives, air properties as a medium for energy transfer. Hydraulic drives, schematic diagram, power packs, Proportional hydraulic system, servo-operated valves, circuits with PAS (power assisted steering). Electric drives, general view, characteristics, powers (outputs).

### **AUTOMATION IN APPAREL DESIGNING AND FIT ANALYSIS**

**9 Hours**

Automated elements in clothing production - cutting of fabric - cutting by water jet, laser, plasma - automated sewing machines - Types of driving mechanism of sewing machines – single needle lock stitch machine, over lock and flat lock machine. Automation in special machines – bar tack, pocket making and patterning machines, button holing and sewing machines.

### **AUTOMATION IN APPAREL FINISHING:**

**9 Hours**

Automation in fusing, pressing and folding machines. Automation in apparel packing equipments.

### **AUTOMATION IN MATERIAL HANDLING**

**9 Hours**

Types of equipment- Automated storage and retrieval systems- Overview of conceptions of “Work Robots” and “Manipulators”. Conveyor systems – Unit production systems. Ply separation; Transportation - position and orientation, pick and place – clamping grippers and pinch grippers. Machine vision system – image acquisition, feature enhancement; Image segmentation – feature extraction, image understanding.

### **ROBOTICS IN APPAREL INDUSTRY**

**9 Hours**

Robotics in spreading and cutting; Robotics in sewing – double lock stitching, one side stitching, Tufting; Robotics for material handling; Robots as 2D and 3D folding machines; Robot control and simulation. Return on investment on automation.

**Theory: 45 Hours**

**Total :45 Hours**

### **REFERENCES**

1. Berkstresser, G.A. & Buchanan, E.M., Automation and Robotics in the Textile and Apparel Industries, Noyes Publications, 1986.
2. M.G.Mahadevan, “Textile Robotics and Automation”, Abhishek Publications, Chandigarh, 2001.
3. A.Gordan, et al., “Automation and Robotics in the Textile and Apparel Industries (Textile series)”, Noyes Publication, UK, 1986.
4. G.A.Berkstresser, “Automation in the Textile Industry: From Fibers to Apparel”, 1<sup>st</sup> Edition, Technomic Publishing Co., Inc, UK, 1995.
5. M.Acar, “Mechatronic Design in Textile Engineering”, NATO Science Series, 1st edition, Springer, USA, 1994.
6. Carr, H. and Latham, B., ‘The Technology of Clothing Manufacture’, Wiley-Blackwell, 2009.

7. Relis, N. & Strauss, G, 'Sewing for Fashion Design', Upper Saddle River, NJ: Prentice Hall, 1997.
8. Stylios G, 'Textile Objective Measurement and Automation in Garment Manufacture' Ellis Horwood Ltd., U.K., 1991
9. Solinger, J, 'Apparel Manufacturing Handbook', 2<sup>nd</sup> Ed., Van Nostrand Reinhold, New York, 1995
10. Crum, R.J, 'Methods of Joining Fabrics', Shirley Institute, 1983.
11. V.Jayakumar, " Applied Hydraulics & Pneumatics", Lakshmi Publications, Chennai, June 2010.
12. Tain kok Kiong, Andi Sudjana Putra " Drives and Control for Industrial Automation", Springer – Verlag London Limited 2011.
13. Dave Polka, "Motors and Drives – A Practical Technology Guide", ISA – The Instrumentation Systems and Automation Society, 2003
14. P. Khanna, "Industrial Engineering and Management", Dhanpat. Rai Publications, New Delhi, 1999.

## **P15ATT102 SCIENCE OF CLOTHING COMFORT**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Understand what is comfort and its importance in fabrics

**CO2:** Define and classify the different types of comfort.

**CO3:** Evaluate comfort for fabrics using necessary equipments

**CO4:** Recognize the suitability of garment based on comfort level.

**CO5:** Design and develop garment with necessary comfort for various end uses

**Pre-requisite:** Nil

### **INTRODUCTION TO COMFORT**

**9 Hours**

Definition, Sensory comfort, Human-clothing-environment system.

**Comfort Perception and Preferences:** Influences of different factors on overall comfort perception- Dimensions of sensory comfort perceptions

**Thermal comfort:** Thermo-physiology of the human body, Thermoregulation of the human body, Thermal - interaction between the body and clothing, Physics of thermal comfort, Heat and moisture transfer, Moisture exchange between fibre and air; Moisture behavior of fabrics made from various fibres.

### **BODY AND TACTILE SENSATIONS**

**9 Hours**

Introduction, coolness and warmth to touch, dampness sensation, clamminess and moisture buffering during exercise, environmental buffering.

**Tactile sensation:** Fabric prickliness, itchiness, stiffness, softness, smoothness, roughness and scratchiness; Garment fit and pressure comfort.

### **LOW STRESS MECHANICAL CHARACTERISTICS**

**9 Hours**

Low stress Mechanical Characteristics and their influence on Physical comfort. Objective evaluation of comfort by KES and FAST and analysis of KES results.

### **EVALUATION OF MOISTURE COMFORT AND THERMAL COMFORT**

**9 Hours**

Evaluation of thermal comfort – Alambeta equipment and analysis of Alambeta results, Tog meter- Sweating guarded hot plate method-Evaluation of moisture comfort-Permetest water vapour permeability tester-Water vapour permeability test using cup method- Interaction between moisture, thermal and Physical Comfort.

### **SUBJECTIVE EVALUATION OF COMFORT**

**9 Hours**

Methods of assessment - Calculation of subjective preferences of clothing-rating scales- Relationship between subjective and objective analysis of fabric hand-Statistical analysis and survey.

**Theory: 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. Li.Y, "The Science of Clothing Comfort", Textile Progress, Vol.31, Textile Institute, 2001.
2. Saville B.P, "Physical Testing of Textiles", The Textile Institute, Wood head Publishing Limited, Cambridge, 1999.
3. Ed.Postle R., Kawabata.S and Niwa. M., "Objective Evaluation of fabrics", Textile Machinery Society, Japan, Osaka, 1983.
4. Laing R.M., and Selivert G.G., "Clothing Textile and Human Performance". Textile Progress, Vol.32, No.2, 2002.
5. Ukpononmwan .J.O., "The Thermal Insulation Properties of Fabrics", Textile Progress, Vol.24,No.4, 1992.
6. Buchanan D.R, "The Science of Clothing Comfort", Textile Progress, Vol.31,No.1/2, 1999.

7. Apurba Das and R. Alagirusamy, “Science in Clothing comfort”, Indian Institute of Technology, New Delhi, India ([www.woodheadpublishing.com](http://www.woodheadpublishing.com))
8. Hassan Behery, Professor Emeritus, “Effect of mechanical and physical properties on fabric hand” Woodhead Publishing Series in Textiles No. 42

## **P15ATT103 FORECASTING AND PRODUCT DEVELOPMENT**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Acquire knowledge on types, sources, processes and services of fashion forecasting.

**CO2:** Explain the forecaster's and forecasting services role and decision making processes

**CO3:** Develop plans to engineer apparel products

**CO4:** Develop new products and evaluate it from design to commercialization

**CO5:** Evaluate the economics underlying apparel products and projects

**Pre-requisite:** Nil

### **FASHION FORECASTING**

**9 Hours**

Definition of forecasting - types of forecasting – source of Fashion forecasting information – forecasting agencies and their role in forecasting. Seasons and their impact on fashion. Compiling fashion forecasting information - forecasting agencies – forecasting magazines – websites – information in the forecasting publications.

### **ROLE OF FORECASTERS**

**9 Hours**

Fashion forecasting packages and magazines specialist fashion forecasting companies –the role of forecaster in aiding fashion designers, developers and retailers- process of forecasting- decision making process- when to start forecasting for the selling season.

### **APPAREL PRODUCT ENGINEERING**

**9 Hours**

Design logic of apparel products - Classification of textile products, components, Aesthetics and Comfort of textile products, Material, Specification, Properties, and Technology of constituent fibres, yarns, fabrics and apparels

### **FASHION TRIANGLE OF BALANCE**

**9 Hours**

Building of the first design ideas, planning to costing, line building, from spec to samples, production selling, three seasons.

**Developing New Product:** Idea generation, idea screening, Concept testing, Business Analysis, the product development Process, group product development, research, Test marketing, commercialization.

### **ECONOMIC ANALYSIS**

**9 Hours**

Evaluation of Portfolio of products or projects – introduction and purpose of economic analysis – market potential – market demand – estimating sales – estimating cost and profit

**Theory: 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. Susan Dillon, "The Fundamentals of Fashion Management", AVA Publishing (UK) LTd., 2012
2. Kathryn McKelvey and Janine Munslow, "Fashion Forecasting", Wiley – Blackwell, USA, 2008
3. Rita Perna, "Fashion Forecasting: A Mystery or a Method", Fairchild Publishers, USA, 1987.
4. Maurice J. Johnson & Evelyn C. Moore, "Apparel Product Development", 2<sup>nd</sup> Edition, Prentice Hall, 2001.
5. Mastudaira T and Suresh M.N., "Design Logic of Textile Products", Textile Progress, Textile Institute, Manchester, 1997.
6. Donald R. Lehmann, Russell S. Winer, "Product Management", McGraw Hill International, 1996.
7. Metha, P.L., "Managerial Economics" Sultan Chand and Co. Delhi, 2007.
8. Doris H. Kincade, Fay Gibson, and Ginger Woodard "Merchandising Math: A Managerial Approach", Pearson Education, Inc. Published by Prentice Hall, 2004.
9. Chelsea Rousso, Fashion Forward A Guide to Fashion Forecasting, Fairchild Books Inc, Newyork.

## **P15ATT104 SUSTAINABLE APPAREL MANUFACTURE**

### **Course Outcomes**

| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------|----------|----------|----------|
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Upon completion of the course the student should be able to:**

**CO1:** Gain knowledge importance and concept of sustainability

**CO2:** Understand features of product and process design with focus on sustainability

**CO3:** Learn about sustainable manufacturing of apparel and reuse and recycling in the apparel manufacturing to achieve sustainability

**CO4:** Gain knowledge on Corporate Social Responsibility and mandatory certification towards sustainability.

**CO5:** Understand the concepts norms for technical and social compliance requirements for apparel industry in domestic and international context

**Pre-requisite: Nil**

### **SUSTAINABLE DESIGN**

**11 Hours**

Definition of Sustainability – need for sustainability. Factors influencing sustainability. Impact of ecology, economy, and culture on sustainability. Product Life Cycle. Product design sustainability using low - impact materials, recyclable material content. Energy efficient product design, design for longer-lasting and better-functioning products, product design for reuse and recycling. Assessing the product sustainability. Sustainable fibres – organic cotton, recycled polyester, alternative sustainable fibers.

### **SUSTAINABLE PROCESS DEVELOPMENT**

**9 Hours**

Sustainability through Manufacturing Resource Efficiency - raw material, plant and machinery, human resource, financial resource. Sustainable manufacture through application of alternative energy source, reuse and recycle of energy. Sustainable process through technology innovation – application of CAD / CAM / CIM in process innovation and improvement. Extending product life cycle through reuse and recycle of process waste. Assessing process sustainability

### **SUSTAINABLE MANUFACTURE**

**9 Hours**

Sustainable elements in manufacture – cost of production, power consumption, and waste creation – process waste and defects, operational safety and ergonomics, environmental friendliness. Sustainability in supply chain - supplier sustainability assessment. Safe and efficient care method for apparels to increase sustainability.

### **REUSE AND RECYCLE OF WASTE**

**7 Hours**

Types of wastes in textile and apparel manufacture – material waste, human resource waste, energy waste. Scope of reuse and recycle of waste in textile and apparel manufacture. Waste elimination at source in textile and apparel manufacturing.

### **CORPORATE SOCIAL RESPONSIBILITY**

**9 Hours**

Role of National and international regulating organizations in environment sustainability – Occupational Safety and Health Administration (OSHA), Worldwide Responsible Accredited Production (WRAP), Global Organic Textile Standard (GOTS), OEKO TEX. Social issues in textile industry – overtime, wages, bonded labour, child labour, health and safety. Corporate Social Responsibility (CSR) – mandatory requirements – benefits to company, labour and society.

**Theory: 45 Hours**

**Total : 45 Hours**

### **REFERENCES**

1. Lewis, H. and Gertsakis, J. Design and Environment: A Global Guide to Designing Greener Goods, Greenleaf Publishing, Sheffield, 2001.



2. [Dalcacio Reis, Julius Wiedemann](#) 'Product Design in the Sustainable Era', TASCHEN Publication. 2000
3. [Cynthia L. Regan](#), 'Apparel Product Design and Merchandising Strategies', Prentice Hall, 2007.
4. Janet Hethorn, Connie Ulasewicz, 'Sustainable Fashion: Why Now? A conversation exploring issues, practices, and possibilities', Fairchild Books, 2007.
5. V. Ann Paulins and Julie L. Hillery, Ethics in the Fashion Industry New York, Fairchild Books, 2009.
6. Bartlett N., Mc Gill I. and Morley N., Maximising the Reuse and Recycling of UK Clothing & Textiles, UK: Oakdene Hollins, 2009
7. Liz Parker and Marsha A. Dickson, 'Sustainable Fashion: A Handbook for Educators' Labour Behind the Label, 2009.
8. [Marsha A. Dickson](#), [Suzanne Loker](#), [Molly Eckman](#), Social Responsibility in the Global Apparel Industry, Bloomsbury Publishing Plc. 2011
9. Goodell, E. Standards of Corporate Social Responsibility', Social Venture Network: San Francisco, 1999.

## **P15ATT105 ENGINEERING OF FUNCTIONAL CLOTHING**

| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------|----------|----------|----------|
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Acquire knowledge on different functional requirements of clothing and technology used in the manufacture of various functional clothing.

**CO2:** Explain the basic principle of materials used for functional clothing

**CO3:** Explore new ideas to design and use different materials for creating new functional clothing.

**CO4:** Evaluate design new functional clothing based on the requirement

**CO5:** Explain basic science and engineering principle used in Functional clothing design.

**Pre-requisite:** Nil

### **FUNCTIONAL CLOTHING**

**7 Hours**

Introduction, definition, classification of functional clothing- protective, medical, sports, vanity, cross functional assemblies, clothing for special needs

### **PROTECTIVE FUNCTIONAL CLOTHING**

**12 Hours**

Environmental hazard protective- Protection against extreme heat or cold, fire, rain, snow, dust, wind or UV exposure, Biological, chemical and radiation hazard protective-Protection against ignition, penetration or skin contact of hazardous chemicals, toxic gases, body fluids, germs or radioactive particulate matter

Injury protective- slash and cut protection, ballistic and blunt impact protection

### **MEDICAL FUNCTIONAL CLOTHING**

**10 Hours**

Therapeutic rehabilitative clothing- pressure garments for lymphatic and venous disorders, scar management

Bio sensing- Monitoring of physiological parameters, heart rate, blood oxygenation, body temperature, telemedicine applications

### **SPORTS FUNCTIONAL CLOTHING**

**8 Hours**

Performance enhancing, fatigue reduction, body shaping to reduce drag Vanity functional clothing- Body shaping, support and contouring for enhanced appearance

### **MULTIFUNCTIONAL CLOTHING / CROSS FUNCTIONAL ASSEMBLIES**

**8 Hours**

Multi functional performance, protection, life support, comfort, communication clothing for special needs- enabling clothing for elderly, infants, and disabled

**Theory: 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. S.C. Anand, M.M.Traftab, S. Rajendra, 'Medical Textiles & Biomaterial for Healthcare', Woodhead Publication, 2005
2. S. Rajendra, 'Advance Textile for Wound Care,' Woodhead Publication, 2009
3. J.F. Kennedy, S.C. Anand & F.Miraftab, 'Medical Textiles 2007: Proceedings of the Fourth International Conference on Health Care & Medical Textile. CRC Press, 1<sup>st</sup> Edition, 2009.
4. S.C Anand, Medical Textile: Proceeding of the Second International Conference & Exhibition, CRC Press; 1<sup>st</sup> Edition, 2001.

**P15ATP101 VIRTUAL GARMENTING LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1 |

**Course Outcomes**

**Upon completion of the course the student should be able to:**

- CO1:** Describe the pattern drafting and grading of different types of garments for children, men and women using software's.
- CO2:** Define and classify the different types of garment components, measurements, sizes for children, men and women.
- CO3:** Identify, marker making and construct the different types of garments using suitable construction techniques.
- CO4:** Recognize the suitability of measurements, sizes, garment components of children, men and women's garments and selection factors for developing 2D to 3D garment styles.
- CO5:** Analyze the effect of 2D garments using different views.

**Pre-requisite: Nil**

1. Develop design, Pattern Drafting (2D), grading, Marker Planning for Baby frock
2. Develop design, Pattern Drafting (2D), grading, Marker Planning for Ladies top
3. Develop design, Pattern Drafting (2D), grading, Marker Planning for Ladies skirt
4. Develop design, Pattern Drafting (2D), grading, Marker Planning for T-shirt
5. Develop design, Pattern Drafting (2D), grading, Marker Planning for Formal shirt
6. Develop design, Pattern Drafting (2D), grading, Marker Planning for Formal trouser
7. Simulation of garment fit (3D) for Baby frock
8. Simulation of garment fit (3D) for Ladies top
9. Simulation of garment fit (3D) for Ladies skirt
10. Simulation of garment fit (3D) for T-shirt
11. Simulation of garment fit (3D) for Formal shirt
12. Simulation of garment fit (3D) for Formal trouser

**Theory : 45 Hours**

**Total: 45 Hours**

## **P15ATP102 FABRIC AND APPAREL ASSESSMENT LABORATORY**

### **Course Outcomes**

| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------|----------|----------|----------|
| <b>0</b> | <b>0</b> | <b>3</b> | <b>1</b> |

**Upon completion of the course the student should be able to:**

**CO1:** Recognize the test equipments used for testing fabrics and apparels

**CO2:** Understand procedures involved in testing

**CO3:** Evaluate various fabric and apparel properties using appropriate equipments

**CO4:** Interpret the results from data obtained during testing

**CO5:** Suggest improvements in performance of product based on results

**Pre-requisite: Nil**

### **LIST OF EXPERIMENTS**

1. Determination of needle penetration force.
2. Determination of thermal resistance of fabrics.
3. Determination of water vapour permeability of fabrics
4. Determination of air permeability of fabrics.
5. Determination of sublimation fastness of fabrics.
6. Evaluation of spray rating for various types (raw materials) of knitted fabrics.
7. Surface evaluation of plasma treated fabrics by optical microscopy.
8. Analysis of seam pucker.
9. Analysis of peel bond strength of fabrics under different temperature and pressure.
10. Analysis of stretchability of various types (raw materials) of knitted fabrics.
11. Analysis of spirality of various knitted fabrics.
12. Evaluation of mechanical properties of yarn & fabric using universal instron tensile tester

**Theory : 45 Hours**

**Total: 45 Hours**

## **SEMESTER II**

## **P15ATT201            TECHNOLOGY OF APPAREL FINISHING**

| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Discuss and describe the advanced printing and garment finishing techniques.

**CO2:** Describe the advanced finishing techniques and unconventional finishing techniques.

**CO3:** Identify advanced finishing techniques for different finishing applications.

**CO4:** Define and identifying the eco parameters for eco-friendly finishing processes and chemicals.

**CO5:** Suggest and adopt eco friendly measures for dyeing, printing and finishing for sustainable development

### **Pre-requisite:**

1. Fundamentals of Textile Finishing

### **TECHNIQUES INVOLVED IN DYEING AND PRINTING**

**10 Hours**

New developments in reactive dyes like HFDyes, low and no salt reactive dyes, multifunctional dyes, neutral fixing and acid fixing reactive dyes. Developments in dyes, Microwave, Electrochemical, low liquor ratio dyeing techniques, Ultra sonic assisted dyeing, Supercritical carbondioxide, Natural dyes.

**Advanced Printing:** Digital printing, Xerographic printing, Developments in transfer printing

### **ADVANCED GARMENT FINISHING**

**10 Hours**

Different finishes - normal finishing sequences. Easy care finishes- Durable press finish, Wrinkle free finish, Bio Finishing.

**FUNCTIONAL FINISHING:** water repellent, water proof, flame retardant, anti microbial, soil resistance, anti static, UV repellent finish, cool finish, deodorizing finish.

### **UNCONVENTIONAL FINISHING**

**9 Hours**

Plasma & types, Plasma treatments for fabric finishing, Microencapsulation techniques and finishing using micro capsules, nano particle preparation of finishing materials and nano finishes, Electro chemical treatment of textile materials.

### **ADVANCED FINISHING TECHNIQUES**

**8 Hours**

Pad-dry cure methods, advanced Spin finishes, coating techniques – film coating, spray coating, powder coating, foam coating. Coating materials for functional finishes. Process conditions and chemicals used.

### **ECO-FRIENDLY PROCESSING & FINISHING**

**8 Hours**

Problems faced in the Conventional processing. Recent developments in eco-friendly dyeing, printing and finishing for natural and synthetic textiles.

**Theory : 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. Dr.C.V.Koushik &Mr.Antao Irwin Josico, “Chemical processing of Textiles-Preparatory processes and Dyeing”-NCUTE revised edition 2008
2. S.R. Karmakar, “Chemical technology in the pre-treatment processes of textiles”, Elsevier Publication, 1999.
3. Miles.L.W.C., “Textile Printing”, Woodhead Publishing limited, UK, 2003.
4. Hitoshi Ujiie, Digital printing of textiles, Woodhead publishing ltd

5. Zamin, A and Demsey, E, "International Textile Bulletin" (Dyeing, Printing and Finishing), 41 (1),1995.
6. Stork Xeel BV, "New Developments in Jet Printing Boxmeer", Elsevier Publication, 1999.
7. W.D.Schindler, "Chemical Finishing of Textiles"Woodhead publishing ltd.
8. Chemical after treatments of textile by Marks, Atlas & Wooding
9. Eco-friendly Textiles Challenges to Textile Industry – Textile Committee.

**P15ATT202          ADVANCED KNITWEAR TECHNOLOGY**

| L | T | P | C |
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| 3 | 0 | 0 | 3 |

**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Appreciate importance of seamless knits in apparels

**CO2:** Identify machinery for making seamless knit apparels

**CO3:** Understand technology involved in making seamless knit apparels

**CO4:** Recognize fabric requirements for knitwear

**CO5:** Possess required knowledge on quality control of knitted apparels.

**Pre-requisite:**

1. Knitting Technology

**INTRODUCTION TO ADVANCED KNITWEAR MACHINERY****9 Hours**

Classification of knitwear machines - fully cut-stitch shaped, fully fashioned, and integral garment machines. Modern circular knitting machines, Tubular, Open width and Multi-track knitting machines. Automatic V bedflat knitting machine-Seamless garment knitting machine.

**STITCH AND SEAM GEOMETRY****9 Hours**

Classification of stitches and seams, Run-in-ratio, Application of stitches and seams in inner and outerwear knitted garments, Seam Quality. Production Technology of Intimate Apparels: Fabric requirements for intimate apparels, Operation sequence and production techniques of men's brief, lingerie and vest. Machinery used and special attachments.

**PRODUCTION TECHNOLOGY OF OUTER WEAR GARMENTS****9 Hours**

Fabric requirements for outwear garments. Operation Sequence and production techniques of knit-T- shirts, combo wears, swimwear, arm warmer, sports garments and bifurcated garments.

**PRODUCTION TECHNOLOGY OF FULLY FASHIONED SWEATERS AND INTEGRAL GARMENTS****9 Hours**

Shape generation in fully fashioned garments, production of slipovers and cardigans. Basic techniques in integral garments, integral garment production of sock, upper and lower body garments.

**QUALITY CONTROL OF KNITWEAR GARMENTS****9 Hours**

Fabric quality-course length, tightness factor, fabric aerial density, spirality of knitted fabrics, fabric dimensional state - dry relaxed state, wet relaxed state and fully relaxed state. Requirements of action and power stretch in sports garments. Common stitching and seaming defects and assembly defects, Seam Puckering and causes.

**Theory: 45 Hours****Total Hours: 45 Hours****REFERENCES**

1. Charles Richman, "Guide to manufacture of Sweater, Knit shirts and Swim wear", National Knitted Outer Wear Association, New York, 1992.
2. Terry Brackenbury, "Knitted Clothing Technology", Blackwell Science, 2005.
3. David Spencer., "Knitting Technology", Pergamon Press, Oxford 2005.
4. "A Study on Quality of Knit Wears that are being Made by Knitting Industry" –SITRA Publications, 1990.
5. Pradip V Mehta, "Introduction to Quality Control for the Apparel industry", ASQC Quality Press, 1992.



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**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Gain knowledge on the concept of apparel product engineering based on aesthetic and functional requirements

**CO2:** Gain knowledge on objective and subjective methods for assessing fabric parameters for making-up quality

**CO3:** Understand the concept of apparel product engineering based on aesthetic and functional requirements

**CO4:** Understand factors influencing selection of materials and their influence on product performance

**CO5:** Learn and appreciate the correlation between fabric and sewing parameters and product performance

**Pre-requisite:** Nil

**CONCEPTS OF APPAREL ENGINEERING****9 Hours**

Introduction to the Concepts of Apparel Engineering Relating apparel design and manufacture process to end use requirements - comfort, workmanship, appearance and appearance retention, durability, aftercare and other special functional requirements. Freedom to body movement, the effect of aesthetic factors to personal preference. Evaluation of Making-up Quality and Analysis of Making-up Problems Subjective and objective methods for evaluating the making-up quality of garments (including quality in terms of fusing, sewing, and finishing etc). Relationship between sewing quality and fabric, thread and sewing machine parameters. Solutions to sewing problems. Application of Kawabata and FAST systems for assessing fabric making-up performance.

**SELECTION OF MATERIALS****9 Hours**

Selection of fabric, yarn, fibre and fabric finishing techniques for specific end-uses. Fabric design appreciations in relation to aesthetic, fashion and functional requirements. Influence of Mechanical properties of fabrics on tailorability: Weight, thickness, tensile, shear, bending (drape), compression, stretchability. Understanding relationship of these mechanical properties with the end use of requirements both in woven and knits. Effect of fabric characteristics of Tailorability - seam appearance, puckering, thermal or mechanical damage, and seam slippage. Understanding the major characteristics of various fabric types (woven and knits) in relation to their end use/applications.

**CO-RELATION BETWEEN FABRIC CHARACTERISTICS AND SEWING PARAMETERS:****9 Hours**

Understanding of co-relation between fabric characteristics and sewing process parameters. Comparison of various types of seam finishing for industrial use in relation with performance and cost effect. Relation between end use of fabric and seam performance in regards to sewn materials. Understanding of seam properties and their application in relation to different fabrics and apparels

**ANALYSIS OF STITCHES AND SEAMS****9 Hours**

Identification of Stitches and Seams in different types of garments. Seams and their effect on performance, costs and quality in industrial sewing process Understanding of Stitch Types and Stitch Formation processes and its impact on garment performance. Suitability of different stitch types in relation to fabric behavior. Machinery used for formation of various stitch types according to classification.

**COMPATIBILITY OF SEWING NEEDLE AND SEWING THREAD****9 Hours**

Compatibility of Sewing Needle and Sewing Thread in relation with other sewing parameters. Understanding the structure and specifications of sewing machine needles and their importance in

sewing processes. Needle size and its relation to fabric and sewing quality requirements. Co relation between sewing thread and fabric and its impact to stitch performance. Controlling stitch performance and quality and minimizing of defect occurrence.

**Theory : 45 Hours**

**Total: 45 Hours**

## **REFERENCES**

1. Burns.L.D., Bryant.N.G., 'Business of Fashion – Designing, Manufacturing and Marketing,' Fairchild NewYork, 2008
2. Barbara Stewart, Beverly Kemp-Gatterson, 'Apparel Concepts and Practical Applications', Fairchild New York, 2010
3. J Fan, "Engineering Apparel Fabrics and Garments", Wood Head Publishing Limited, 2012
4. Wang, Postle And Zhang: "The Tailorability of Lightweight Wool and Wool-Blend Fabrics", Journal Of Textile Institute, Vol 94, Part I, No 3/ 4 , 2003, pp 212-222.

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**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Organize, innovate and take risk in a business activity

**CO2:** Develop a Business Plan

**CO3** Determining financial needs and the sources of finance,

**CO4** Analyze the PESTEL Business Environment and make Strategic decisions

**CO5:** Analyze the challenges and to make ethical business decisions

**Pre-requisite: Nil**

**INTRODUCTION TO ENTREPRENEURSHIP****9 Hours**

Definition, Characteristics and Functions of an Entrepreneur, Importance of Entrepreneurship and small business management. Creativity and Innovation: The role of Creativity, the Innovation process, Source of new ideas, Methods of generating ideas.

**FORMS OF BUSINESS ORGANIZATION****12 Hours**

Sole proprietorship, Partnership, Joint Stock companies, Co-operatives, Public sector, Public Utilities Feasibility and technical analysis of business: Nature of business decision, business development cycle, and opportunity studies, pre -feasibility and feasibility studies, Technical analysis.

**DEVELOPING BUSINESS PLAN****10 Hours**

The importance of a business plan- Components of an effective business plan – Developing and writing a business plan. Financing the new venture: Determining financial needs, sources of financing, equity and debt funding, evaluating financial performance.

**STRATEGIC ANALYSIS****8 Hours**

Marketing research, Demand forecasting. Environmental analysis - PESTEL frame work, environmental scanning, competitive forces- porter's frame work, Internal analysis – resources, critical success factor (CSF), quantitative and qualitative assessments, SWOT analysis. Growth strategies: Expansion strategies – Intensification, Integration and International. Diversification – concentric, conglomerate diversifications, mergers and acquisitions, strategic partnering.

**CHALLENGES FOR ENTREPRENEURS****6 Hours**

Ethical, Political, Cultural, Regional, Technological and social responsibility – ethics and business decisions.

**Theory : 45 Hours**

**Total: 45 Hours****REFERENCES**

1. Robert D Hisrich, Michael P Peters and Dean Shepherd, "Entrepreneurship", Tata McGraw Hill, Sixth Edition, 2007.
2. Marc J Dollinger, "Entrepreneurship – Strategies and Resources", Pearson Education, Third Edition, 2003.
3. Buree R Barringer and Duane Ireland, "Entrepreneurship – Successfully Launching New Ventures", Pearson, Prentice Hall, Third Edition, 2006.
4. Mary Coulter, "Entrepreneurship in Action", Prentice Hall of India, Second Edition, 2009
5. S.S.Khanka "Entrepreneurial Development" S.Chandand CompanyLtd revised Edition , 2012

**P15ATP201                      STATISTICAL ANALYSIS AND DESIGN OF  
EXPERIMENTS LAB**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1 |

**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Use rawdata on statistical software for experimental designs

**CO2:** Obtain results in graphical form for interpretation

**CO3:** Analyze and conclude various fabric and apparel properties

**Pre-requisite: Nil**

**List of experiments**

1. Data Collection and Processing of Data
2. Frequency Distribution-Graphical Representation
3. Probability distributions-Binomial, Poisson, Normal-Weibull
4. Testing of hypothesis-Large samples
5. Testing of hypothesis-Small samples-T-Test, F-Test, Chi-squared test
6. Optimization Techniques-Anova-1-way
7. Optimization Techniques-Anova-2 way
8. Factorial designs-Box and Benhnken-Response surface
9. Correlation
10. Regression
11. Control Charts
12. Time series analysis

**Theory: 45 Hours**

**Total: 45 Hours**

**REFERENCES**

1. “Montgomery D C Design and Analysis of Experiments”, John Wiley & Sons,2004
2. Kothari .C. P. Research Methodology- “Methods and Techniques”, Mishra Prakeshan 2000
3. Minitab-Software manual
4. SPSS software manual

## **SEMESTER III**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1 :** Understand various aspects of research methodology

**CO2 :** Know about experimental design, and data collection methods

**CO3 :** Optimize given data using different techniques

**CO4 :** Interpret results based on output data

**CO5:** Carry out projects and write thesis

**Pre-requisite: Nil**

**INTRODUCTION TO RESEARCH****9 Hours**

Research objectives and approaches - Literature review -Data base and search engines - Defining research problems - Research design - formulation of hypothesis **Descriptive Statistics:** Introduction, Scope- Frequency Distribution: graphical representation, histograms, frequency polygon, cumulative frequency curve, Ogives.

**EXPERIMENTAL DESIGN****9 Hours**

Laboratory and the Field Experiment –Internal and External Validity –Factors affecting Internal validity. Measurement of variables –Scales and measurements of variables. Developing scales – Rating scale and attitudinal scales –Validity testing of scales – Reliability concept in scales being developed –Stability Measures.

**DATA COLLECTION METHODS****9 Hours**

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design –Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility.

**OPTIMIZATION TECHNIQUES****9 Hours**

Data Analysis–Factor Analysis –Cluster Analysis- Analysis of variance –One way classification- CRD-Two way Classification - RBD – Latin square - Optimization by steepest ascent – Multi criterion-Optimization- variables, Constraints and objective functions - Application of neural network– Correlation & regression.

**RESEARCH REPORT****9 Hours**

Purpose of the written report –Concept of audience–Basics of written reports. Integral parts of a report –Title of a report, Table of contents, Abstract, Synopsis, Introduction, Body of a report – Experimental, Results and Discussion –Recommendations and Implementation section – Conclusions and Scope for future work.

**Theory : 45 Hours**

**Total: 45 Hours****REFERENCES**

1. Donald R. Cooper and Ramela S. Schindler, Business Research Methods, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2000
2. Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000.
3. C.R.Kothari, Research Methodology, Wishva Prakashan, New Delhi, 2001.
4. Donald H.McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2002.
5. G.W.Ticehurst and A.J.Veal, Business Research Methods, Longman, 1999.
6. Ranjit Kumar, Research Methodology, Sage Publications, London, New Delhi, 1999.
7. Raymond-Alain Thie'tart, et.al., Doing Management Research, Sage Publications, 1999
8. Montgomery D C, "Design and Analysis of Experiments", John Wiley & Sons, 2004.

## **LIST OF ELECTIVES**

## **P15ATE101 TECHNOLOGY OF SURFACE MODIFICATIONS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1 :** Identify the suitable methods of surface modification for different applications in textiles

**CO2 :** Analyse the surface modification characters using advanced equipments

**CO3 ;** Formulate surface modification techniques using plasma or enzymes

**CO4 :** Characterize and interpret the effects of surface modification

**CO5:** Implement latest technologies in surface modification in project and industry

**Pre-requisite:** Nil

### **INTRODUCTION TO SURFACE MODIFICATION**

**9 Hours**

Methods for achieving surface modification – Surface grafting, electroless deposition, Plasma-aided methods, physical vapour deposition (PVD), chemical vapour deposition (CVD), enzymatic, Nanotechnology, sol-gel technique.

### **TEXTILE SURFACE CHARACTERIZATION TECHNIQUES**

**9 Hours**

Surface characterization by advanced microscopies: Working principles and analysis of results from Atomic Force Microscopy (AFM), scanning electron microscope (SEM), environmental scanning electron microscope (ESEM), transmission electron microscope (TEM); Surface characterization by advanced spectrometers: Working principles and analysis of results from Fourier Transform Infrared Spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), Energy Dispersive X-ray Spectrometry (EDS); Mechanism and Analysis of Surface wetting and contact angles on substrates.

### **SURFACE MODIFICATION OF TEXTILES BY PLASMA**

**9 Hours**

Methods of plasma generation – low pressure and atmospheric pressure plasmas; mechanisms for surface reactions, plasma-aided functionalization, etching, grafting/deposition, implantation and polymerization; plasma modification of cellulosic, protein, and synthetic fibres; Advantages and limitations of plasma surface modification of textile materials.

### **ENZYME SURFACE MODIFICATION OF TEXTILES**

**9 Hours**

Role and action of various enzymes in the surface modification of cellulosic, protein and synthetic fibres - reaction of textile surfaces to enzymatic treatments – Strengths and weaknesses of enzyme surface modification.

### **APPLICATIONS OF SURFACE MODIFIED TEXTILE MATERIALS**

**9 Hours**

Polypyrrole coating on textiles by chemical vapour deposition (CVD), Sol-gel finishing for water/oil repellence and self-cleaning property, layer-by-layer deposition of various materials on textile fibres, surface modification of textiles for composites and for filtration, surface hydrolysis of Polyester.

### **LATEST TRENDS IN SURFACE MODIFICATION TECHNOLOGY**

Atom transfer radical polymerization – Ultrasonic waves – Molecular imprinting – Ionic liquids – Biomimetic approaches.

**Theory : 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. Q. Wei, 'Surface modification of Textiles', Woodhead Publishing, 2009.
2. Michael A. Lieberman, Allan J. Lichtenberg, 'Principles of Plasma Discharges and Materials Processing', John Wiley & Sons, 1994.
3. Edited by Roshan Shishoo, 'Plasma Technologies for Textiles', Woodhead Publishing, 2007.
4. Rory A. Wolf, 'Atmospheric Pressure Plasma for Surface Modification, John Wiley & Sons, 2012.



## P15ATE102 MEDICAL TEXTILES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

### Course Outcomes

After successful completion of this course, the students should be able to

**CO1:** Describe the bio materials of metals, ceramics, polymers, natural bio materials and specialty fibers.

**CO2:** Define and classify the different types of healthcare and hygiene products, infection control and barrier materials and non woven products.

**CO3:** Identify and construct the different types of bandaging materials and pressure garment with suitable construction techniques.

**CO4:** Recognize the suitability, specifications of medical textile products and garments for wounds and selection factors for different implantable products for various end uses and intelligent textiles.

**CO5:** Identify the suitable materials for developing implantable products.

**Pre-requisite:** Nil

### BIO MATERIALS

**9 Hours**

Metals, ceramics, composites and textile materials; specialty medical fibres

### HEALTHCARE AND HYGIENE PRODUCTS TYPES

**9 Hours**

Advanced textile materials in healthcare; infection control and barrier materials; study of non-woven hygienic products; plasma treated barrier materials

### PRESSURE GARMENTS & BANDAGES

**9 Hours**

Specification, properties and manufacture of range of bandages and pressure garments - elastic and non elastic compression bandages, support and retention bandages, bandaging textiles, evaluation of bandage and bandages for various end uses

### WOUND DRESSINGS

**9 Hours**

Types, healing process; requirement of wound dressing; an overview of wound care materials - study of various kinds of wound care dressing and advanced wound dressings.

### IMPLANTABLE PRODUCTS

**9 Hours**

Implantable products; sutures – requirements, classifications, specifications, materials used –their properties and application; vascular grafts, artificial ligaments, artificial tendons and scaffolds; intelligent textiles for medical applications.

**Theory : 45 Hours**

**Total: 45 Hours**

### REFERENCES

1. Allison Mathews and Martin Hardingham, “Medical and Hygiene Textile Production – A hand book”, Intermediate Technology Publications, 1994.
2. Anand S.C., Kennedy J.F. Miraftab M. and Rajendran S., “Medical Textiles and Biomaterials for Health care”, Wood head Publishing Ltd. 2006.
3. Joon B. Park. and Joseph D. Bronzino., “Biomaterials – Principles and Applications”,CRC Press Boca Raton London, NewYork, Washington , D.C. 2002
4. Anand S., “ Medical Textiles”, Textile Institute, 1996, ISBN: 185573317X
5. Horrocks A.R. and Anand S.C, “Technical Textiles”, Textile Institute,1999, ISBN: 185573317X.
6. Adanur S., “ Wellington Sears Handbook of Industrial Textiles” Technomic Publishing Co., Inc., Lancaster Pennsylvania 1995, ISBN 1-56676-340-1.
7. Michael Szycher and Steven James Lee, “Modern Wound Dressing: A Systematic Approach to Wound Healing”, Journal of Biomaterials Applications, 1992

## **P15ATE103 COMPUTER INTEGRATED APPAREL MANUFACTURE**

| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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### **Course Outcomes**

**Upon completion of the course the student should be able to:**

- CO1 :** Assess the scope of application and features of various CAD/CAM systems available for the apparel industry
- CO2 :** Appraise the features of various computer aided fabric design systems and choose the right system suitable for an apparel industry.
- CO3 :** Acquire knowledge on the E-prototyping for apparels
- CO4 :** Prescribe the basic features required for CAD/CAM integrations which can minimize the lead time and maximize the quality in the apparel production.
- CO5 :** Evaluate the various automations in manufacturing and management systems available in apparel industry

**Pre-requisite: Nil**

### **COMPUTER AIDED FABRIC DESIGN SYSTEM:**

**11 Hours**

Introduction to the operation of design software for woven, knitted and printed textiles. Computer Aided Fashion Design System: Tools, manipulating techniques.

Knowledge Based System- Introduction to image processing and imaging system-Fabric and sewing defect identification using image processing-Artificial neural networks.

### **COMPUTER AIDED PATTERN DESIGNING:**

**7 Hours**

3D Body scanning- Digitizing- Grading and Lay Planning System: Introduction to graphic interface of the software- Tools and functions used for pattern making, grading and marker planning.

### **VIRTUAL GARMENTING AND E PROTOTYPING:**

**9 Hours**

Preparation of virtual dummies, Texture mapping, 2D and 3D draping, 3D Modeling, E-Fit analysis, Animation, Prototyping – Virtual and rapid. Made to measure systems.

### **COMPUTERIZED CUTTING AND SEWING:**

**9 Hours**

Applications of Computer integration in fabric cutting, spreading and labeling machines. Computer aided special purpose sewing machine with control panels – Preprogrammed options. Computer controlled embroidery machines.

### **AUTOMATION IN MANUFACTURING AND MANAGEMENT:**

**9 Hours**

Application of EDI - UPS- Selection of line- Control system- Data base management system. Automatic material handling, storage, tracing and retrieval system. Applications of E-Commerce and MIS in apparel industry, Supply Chain Planning. Computerized Color Matching system.

**Theory : 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. Alison.B, Terry.B,“Computer Aided Pattern Design and Product Development”, Blackwell Publishers, UK, 2004.
2. Buchman G A, Grady D R and Latimer Trend P L, “Automation in the Textile Industry form Fiber to Apparel”, Berkstresser III, Textile Institute, 1995.
3. Patrick.T, “Computer in the Fashion Industry”, Heinernann Professional Pub, London, 1990.
4. “Computers in the World of Textiles”, The Textile Institute, 1984.
5. Yixiang Frank Zhang, Randall and Bressee R, “Fabric Defect Detection and Classification using image analysis”, TRJ 65 (I), 1-9, 1995.
6. Taejin Kang, Soo hyun choi, Sung min kim and Kyung wha oh, “Automatic Structure Analysis and Objective Evaluation of Woven Fabric using Image Analysis” TRJ, 71(3), 261-270, 2001.
7. Fuzz and Pills “Evacuated on Knitted Textiles by Image Analysis” TRJ 72(I) 32-38, 2002
8. Sigmon D M, Grady P L and Winchester S C, “Computer Integrated Manufacturing and Total Quality Management”, Textile Institute Publication, 1998.

## **P15ATE104      FUNCTIONAL CLOTHING AND EVALUATION**

### **Course Outcomes**

| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**Upon completion of the course the student should be able to:**

**CO1:** Acquire knowledge on different functional requirements of clothing

**CO2:** Acquire knowledge on instruments and test methods available to test functional clothing

**CO3:** Interpret the test results and analyze the performance of functional clothing

**CO4:** To differentiate performance requirements of functional clothing to normal clothing

**CO5:** Understand the different standards requirement for functional clothing

**Pre-requisite:** Nil

### **INTRODUCTION TO FUNCTIONAL CLOTHING**

**9 Hours**

evaluation of functional clothing- protective, medical, sports, vanity, cross functional assemblies, clothing for special needs, importance and significance of functional clothing

### **EVALUATION FOR PROTECTIVE FUNCTIONAL CLOTHING**

**9 Hours**

Vertical strip test-Fire tests for upholstered composites and mattresses-Ignitability of fabrics used in tented structures- Ignitability of bedcovers and pillows by smouldering and flaming-Evaluation of textile floor coverings- Evaluation of protective clothing

### **EVALUATION OF MEDICAL FUNCTIONAL CLOTHING**

**9 Hours**

Therapeutic rehabilitative clothing- pressure garments for lymphatic and venous disorders, scar management. Bio sensing- Monitoring of physiological parameters, heart rate, blood oxygenation, body temperature, telemedicine applications

### **SPORTS FUNCTIONAL CLOTHING**

**9 Hours**

test methods and standards for different sport clothing Vanity functional clothing- Body shaping, support and contouring for enhanced appearance

### **CROSS FUNCTIONAL ASSEMBLIES**

**9 Hours**

Multi functional performance, protection, life support, comfort, communication Clothing for special needs- enabling clothing for elderly, infants, and disabled

**Theory : 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. S.C. Anand, M.M.Traftab, S. Rajendra, “ Medical Textiles & Biomaterial for Healthcare”, – Woodhead Publication
2. S. Rajendra , “Advance Textile for Wound Care”, - Woodhead Publication
3. J.F. Kennedy, S.C. Anand & F.Miraftab, “Medical Textiles 2007”, Proceedings of the fourth international conference on Health card & medical textile
4. S.C. Anand, “ Medical Textile”, Proceeding of the Second International Conference & Exhibition: CRC Publication

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**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1 :** Acquire knowledge in manufacturing techniques of textile preforms

**CO2 :** Acquire knowledge in different types of composites

**CO3 :** Explain different terminologies and different methods of manufacturing textile composites

**CO4 :** Understand the different structural parameters of composites

**CO5 :** Acquire knowledge in evaluation of textile composites

**Pre-requisite: Nil**

**INTRODUCTION****9 Hours**

Textile Reinforced Composites (TRC): Fibres – Filaments - Woven fabrics - Braided fabrics - Stitched - Knitted fabric reinforcements. Filament winding: Method – Applications.

**PREPREGS AND PREFORMS:** Introduction - manufacturing techniques - property requirements - Textile preforms - weaving, knitting and braiding.

**TYPES OF COMPOSITES POLYMER****11 Hours**

**Matrix Composites:** Types – Processing – Thermal matrix composites – Hand layup and spray technique, filament winding, Pultrusion, resin transfer moulding, autoclave moulding – Thermoplastic matrix composites – Injection moulding, film stacking – Diaphragm forming – Thermoplastic tape laying. Glass fibre / polymer interface. Mechanical properties – Fracture. Applications.

**Metal Matrix Composites:** Types. Important metallic matrices. Processing – Solid state, liquid state, deposition, insitu. Sic fibre / Titanium interface. Mechanical properties. Applications.

**Ceramic Matrix Composites:** Ceramic matrix materials – Processing – Hot pressing, liquid infiltration technique, Lanxide process, insitu chemical reaction techniques – chemical vapour deposition (CVD), CVI, sol gel process. Interface in critical micelle concentration (CMC). Mechanical properties – Thermal shock resistance – Applications – Overview of apparel soft composites.

**COMPOSITE MANUFACTURING TECHNOLOGY****11 Hours**

Vacuum bagging - compression molding - Injection molding - pultrusion Thermoforming - Filament winding - Resin Transfer Molding. Composites with Glass Fibres - Glass fibres properties; glass fiber reinforced polymers; manufacture of glass fibre composites, Composites with Carbon Fibres - Carbon fibre reinforced composites; testing of carbon reinforced composites, Composites with Fabrics - Textile structure of composites- woven, knitted, braided material and three dimensional fabrics, Flexible Composites - Fibre reinforced plastics; fabric reinforced composites; flexible composites; applications

**PROPERTIES OF COMPOSITES****9 Hours**

Geometrical Aspects: Unidirectional laminas – Volume fraction and weight fraction – Woven roving, in-plane random fibres – Fibre length and fibre orientation distribution – Voids – Fibre orientation during flow. Fatigue and Creep in Composite Materials: Fatigue – S-N curves – Fatigue behaviors of critical micelle concentration (CMC) – Fatigue of particle and whisker reinforced composites – Hybrid composites – Thermal fatigue – Creep. Characteristics of composites - tensile, shear, composition, flexural; thermoplastic responses of composite; use of high performance fibres

**EVALUATION OF TEXTILE COMPOSITES****5 Hours**

Design and analysis of textile structural composites. Toughness and thermal behaviour of composites.

**Theory : 45 Hours****Total: 45 Hours**

## REFERENCES

1. Horrocks A. R., Anand S.C., “Handbook of Technical Textiles”, Woodhead Publishing, Cambridge, 2000
2. Adanur S., “Handbook of Industrial Textiles”, Technomic Publication, Lancaster, 2001
3. Kanna M.C., Hearle, O Hear., Design and Manufacture of Textile Composites, Textile process, Textile Institute, Manchester, April 2004.
4. Mathews F L and Rawlings R D, “Composite Materials: Engineering and Science”, CRC Press and Woodhead Publishing Limited, 2002.
5. Krishnan K Chawla, “Composite Materials Science and Engineering”, Springer, 2001.
6. Handbook of Composites – American Society of Metals, 1990.
7. Derek Hull, “An introduction to Composite Materials”, Cambridge University Press, 1988.
8. Bhagwan D. Agarwal, Lawrence J. Broutman, and K. Chandrashekhara, ‘Analysis and Performance of Fiber Composites’, John Wiley & Sons, 2006.
9. Daniel Gay, Suong V. Hoa & Stephen, W. Tsai, ‘Composite Materials: Design and Applications’, CRC Press, 2002.
10. Long C. A., ‘Design and Manufacture of Textile Composites’, Woodhead Publishing, 2005

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**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1 :** Identify the most suitable fabrics for home textile application

**CO2 :** Formulate a suitable finish depending on the end use in the field of home textiles

**CO3:** Identify and develop home textile products for home and commercial applications

**CO4:** Develop home textile products based on international performance requirements, eco standards and international market requirements

**CO5 :** Evaluate the performance of home textile products as per standards

**Pre-requisite: Nil**

**INTRODUCTION TO HOME TEXTILES****9 Hours**

Concept of home textiles: Definition and classification; Home textile market scenario; Fibres used in home textiles- application of conventional and new sustainable fibres in home textiles; fabrics used in home textiles- woven, nonwoven and knitted; Special Finishes used in home textiles

**FLOOR AND WALL COVERINGS****9 Hours**

Floor coverings, wall coverings, window dressings – types, Developments in Finishing of Draperies. Factors for selecting material. Use and care of floor and wall coverings.

**BED, KITCHEN AND BATH LINEN****9 Hours**

Bed linen, Kitchen and Table linen, Bath linen – types. Madeups used in hospitals. Factors for selecting type of linen and material. Advances in the manufacture of linens. Use and care.

**PERFORMANCE SPECIFICATIONS****9 Hours**

Importance of performance specification-Performance requirements of the US market, Canada and UK market -Special performance requirements in home textiles.

**LABELLING ISSUES AND ECO STANDARDS:** General labelling requirements for home textiles in USA, EU and Canada. Different eco-friendly standards in home textiles. Importance of eco-labelling. Trademarks and labels used in environment-friendly home textiles

**SPECIAL FINISHES: FINISHES USED IN HOME TEXTILES****9 Hours**

Thermal draperies, Protection against unpleasant odour, Temperature- regulated beddings, Endure TM textile finish, Antimicrobial finish, Moisture management finish, Flame- retardant finish, Mite free mattresses, Water and oil repellent and soil release finishes, Towel finishing, Moisture cross-linking (MXL) for bed linen, Nanotechnology- based home textile enhancements, Sensory perception technology

**EVALUATION:** Flammability regulations for different home textiles – blankets, towels, curtains. Regulatory test for carpets and rugs. Surface water absorption Test methods for bath towels, sheets, kitchen towels, beach wear. Test methods for carpets and rugs, Test method of pot holders and woven mitts.

**Theory : 45 Hours**

**Total: 45 Hours****REFERENCES**

1. S Das, 'Performance of Home Textiles', Woodhead Publishing limited incorporating Chandos publishing, India, 2010
2. Robett Harding, "Curtains, Blinds and Valances", Eagtemoss, Ohio, 1998.
3. Katrin Cargill, "Simple Curtains", Ryland Peters and Small, London, 2002.
4. Charles Randall and Sharon Templeaton, "Dream Windows", Randall International Orange, California, 2003.
5. Wendy Baker, "Curtain and Fabric Selector", Collins and Brown, London, 2000.

6. Premavathy Seetharaman and Parveen Pannu, "Interior Design and Decoration", CBS Publishers and Distributors, 2005.
7. Jay Diamond and Ellen Diamond, "Fashion Apparel, Accessories and Home Furnishings", Prentice Hall, First Edition, 2007.
8. Ashley A.L., "Decorating with Fabric", Crown Trade Paper Packs, New York, 1995.
9. Foley T, "Linens and Laces", Clarkson Potter Publications, New York, 1990.

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**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Acquire knowledge on different functional requirements of protective clothing and technology used in the manufacture of protective clothing.

**CO2:** Design and select materials for new protective clothing

**CO3:** Explore new ideas to design and use different materials for creating innovative protective clothing.

**CO4:** Evaluate and design new protective clothing based on the requirement

**CO5:** Understand the different international standards for protective clothing

**Pre-requisite: Nil**

**CHEMICAL PROTECTION****12 Hours**

Chemical Hazards- Need, evaluation of barrier effectiveness of protective clothing- performance of protective clothing. Material requirements- test methods.

**THERMAL PROTECTION****13 Hours**

Thermal Protective Clothing-Thermal characteristics and combustion mechanism of fibres-Heat resistant and Flame retardant - Inherently flame retardant fibres and chemical modified fibres, Flame retardant finishes. Requirements of ballistic protection.

**MECHANICAL PROTECTION****7 Hours**

Requirements-knife performance- fundamental principle of knife impact, protection levels- test methods-ballistic protection-requirements- materials used- test methods

**ELECTRICAL AND RADIATION PROTECTION****7 Hours**

Material Selection, production techniques: Nuclear Hazards, Protection from Electromagnetic radiation waves-UV and others. Electrical protective clothing and its evaluation

**HEALTH CARE AND HYGIENE CLOTHING****7 Hours**

Material Selection, production and processing techniques: bedding, surgical wound dressings, bandages and sanitary napkins. Quality parameters.

Surgical drapes, Gowns for operating personnel, theatre masks, non-woven swabs, post operation dress-Materials and quality parameters.

**Theory : 45 Hours**

**Total: 45 Hours****REFERENCES**

1. Bajaj.P., and Sengupta.A.K., "Protective clothing", The Textile Institute, 1992.
2. Richard A.Scott., "Textile for Protection"Woodhead Publishing Ltd., 2005.
3. Eugene W Ilusz., "Military Textiles" Woodhead Publishing Ltd., 2008.
4. L.Van Langenhove., "Smart Textile For Medicine And Health Care" Woodhead Publishing Ltd
5. Johnson J.S., and Mansdork.S.Z., "Performance of Protective Clothing", American Society for Testing and Materials (ASTM),1996.
6. P.W.Harrison., "The Design of Textiles for industrial Application", The Textile Institute, Manchester, 1998
7. Sabit Adanur,Wellington Sears Handbook of Industrial textiles,Technomic publishing company,1995, ISBN 1-56676-340-1
8. J T Williams, De Montfort University, UK., "Textile for cold weather apparel" Woodhead Publishing Series in Textiles No. 93



# **P15ATE204                      LOGISTICS MANAGEMENT IN APPAREL INDUSTRY**

| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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## **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO 1 :** Acquire knowledge on principle and strategies applied in logistics management

**CO 2 :** Comprehend the process of designing and managing supply chain system

**CO 3:** Understand sourcing and supply strategies in global context

**CO 4:** Understand the tools and concepts in distribution network planning

**CO 5:** Gain knowledge in new trends in supply chain management.

**Pre-requisite: Nil**

## **OVERVIEW OF SCM AND LOGISTICS**

**9 Hours**

Logistics and supply chain management, development of logistics, logistics and competitive performance, physical distribution management. Principles of supply chain management. Apparel supply chain management, Customer focus in supply chain management – customer service, efficient consumer response (ECR), quick and accurate consumer response.

## **DESIGN AND MANAGEMENT OF SUPPLY CHAIN**

**9 Hours**

Inbound and outbound logistics – suppliers to manufacturers, manufacturers to consumers. Pull and push strategy. Demand management in fashion and apparel sector-demand forecasting and shaping. Types of inventory Bull wick effect- Influencing factors, control measures.

## **STRATEGIC SUPPLY CHAIN MANAGEMENT**

**9 Hours**

Types of sourcing, supply alliances, supplier quality management, supply chain re engineering. Case studies .Organizing for global markets – world class supply chain management (WCSCM). Global strategies to apparel SCM

## **IT ENABLED SUPPLY CHAIN MANAGEMENT**

**9 Hours**

Information technology in the integrated supply chain, importance, information requirements and applications. Intelligence information system – material resource planning, manufacturing resource planning, enterprise resource planning. IT packages – SAP R/3 ERP, BAAN ERP solutions, i2 Rhythm, Case studies

## **DISTRIBUTION NETWORK PLANNING**

**9 Hours**

Transportation mix – ware housing, transportation cost, transportation decision, and RFID ,futuristic direction in transportation. Location strategy – plant location, distribution problem, ware house location, retail facility location.

**EMERGING TRENDS IN SUPPLY CHAIN MANAGEMENT** Collaborate strategies, vendor managed inventory (VMI), third and fourth party logistics, green supply chain, reverse logistics and world class supply chain (WCSC).Lean concepts.

**Theory : 45 Hours**

**Total: 45 Hours**

## **REFERENCES**

1. Donald J.Bowersox, Davis J.Closs, “Logistics Management – The Integrated Supply Chain Process”, Columbia Boblin media Corp., 1988.
2. Benjamin S.Blanchard, “Logistics Engineering and Management”, Mc Graw Hill, Inc. New york, 1992.
3. Sunil Chopra, Peter Meindal, “Supply Chain Management: Strategy, planning and operations”, Prentice Hall Inc., 2001
4. Burt, David. N Dobler, Starling, World Class Supply Management: The Key To Supply Chain Management, seventh edition McGraw-Hill/Irwin,2002

5. Douglas M.Lambert, James R.Stock, Lisa. M.Ellram, “Fundamentals of Logistics Management”, Columbia Boblin Media Corp., 1998.
6. David Blanchard, Supply Chain Management Best Practices, John Wiley & Sons, 2010.
7. Micheal H.Hugos, Essentials of supply chain management ,John Wiley & Sons, 2003

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**Course Outcomes**

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

**CO 1 :** Gain knowledge on concepts of system engineering in the context of apparel industry and understand concept of productivity and measures to improve productivity

**CO 2 :** Understand process analysis towards improving enterprise efficiency

**CO 3 :** Understand operation analysis towards improving enterprise efficiency

**CO 4 :** Become skilled in application of time study and method study in apparel production

**CO 5 :** Understand application of tools and concepts for improving processes in apparel manufacture

**Pre-requisite: Nil**

**INTRODUCTION****9 Hours**

Systems Engineering – Definition, Functions, and Concepts- Application in apparel industry.

Productivity in Apparel Industry: Definition of productivity, productivity measurement methods, levels of productivity measurements, strategies for productivity improvement. Work Study: Definition, Method Study and Work Measurement- Techniques, Procedure, Flow Charts- Case study Analysis.

**PROCESS ANALYSIS****9 Hours**

Purpose and application – kind of analysis – notation: process charts and symbols – standard method of processing material. Motion Study: Level of analysis – type of analysis – method of analysis Observation methods – Work Design – Standard operation – Multiple activity chart- Evaluating Motion study data.

**OPERATION ANALYSIS****9 Hours**

Objectives, classification of a worker's behavior, observation methods – work sampling procedures, rough standard for the number of observation times - allowance rate - explanation of the points to be improved – exercises on operation analysis.

**TIME STUDY****9 Hours**

Measuring method – determination of check points - time report system – sewing time report – setting the standard time for sewing operation - PTS – leveling skill – time study allowance - practical use of the time study – Calculation of standard minutes value (SMV) in apparel production.

**IMPROVING METHODS OF GARMENT MANUFACTURE****9 Hours**

Principles for improving operation method: cutting, sewing, pressing and packing. Synthetic time values, MTM, Learning curves. Line Balancing: Objectives, types, procedure, Industrial Practice.

**Theory : 45 Hours**

**Total: 45 Hours****REFERENCES**

1. Chuter. A.J “Introduction to Clothing Production Management”, Second Edition, Blackwell publishing, 2004.
2. Rajesh Bheda, “Managing Productivity of Apparel Industry”, CBI Publishers and Distributors, New Delhi, 2002.
3. ILO, “Introduction to Work study”, Fourth Edition, Universal Publishing Corporation, Mumbai, 2005.
4. Kanawaty (George) Ed.,”Introduction To Work Study”, Universal Publishing Corporation, 1997.

## **P15ATE302          MECHANISM OF APPAREL MACHINERY**

### **Course Outcomes**

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**Upon completion of the course the student should be able to:**

**CO1 :** Explain the simple mechanisms employed apparel machineries.

**CO2 :** Recognize the influence of different machine variables on sewing quality

**CO3 :** Explain seam geometry and its effect on seam quality

**CO4 :** Acquire knowledge on developments in sewing machines

**CO5:** Understand the applications of specialty sewing machines

**Pre-requisite: Nil**

### **BASIC PRINCIPLES OF APPAREL MACHINERY**

**12 Hours**

Introduction – analysis and synthesis – terminology and definitions; Planar, spherical, and spatial mechanisms – classification of mechanisms. Definition of acceleration – angular acceleration – acceleration difference between points of a rigid body – acceleration polygons. Cam Design – introduction – classification of Cams and Followers. Robotics – introduction – Topological arrangements of robotic arms – Kinematics.

### **BASIC SEWING MACHINE MECHANISM**

**10 Hours**

Theory, measurement and control of yarn tension in unwinding from sewing thread packages during Sewing. Study of stitch formation during sewing operation. Relationship between sewing speed and stitches per inch on stitch formation. Stitch types and stitch geometry. Various types of stitch types produced on different types of sewing machines. Properties of stitches and their usefulness.

### **SEAM TYPES AND SEAM GEOMETRY**

**8 Hours**

Seam types and seam geometry: Various types of seams and their geometry. Application of different seams in producing different garments.

Feed mechanisms: Different types of sewing feed mechanisms and their uses, Control of differential feed.

### **DESIGN AND OPERATION OF MODERN SEWING MACHINE**

**8 Hours**

Development in design and operation of modern sewing machines. Theory and design principles of latest automatic controls in stitch regulation in sewing.

Kinematics of drop feed mechanism. Design problems of conventional sewing machines.

### **SPECIALITY SEWING MACHINES**

**7 Hours**

Principles underlying unorthodox sewing machinery system: Microprocessor and computer controls, Specialty sewing machines and their Kinematics. Timings for sewing operations for needle and looper systems. Automation in Laying, Cutting, Unit production system, button holing and button sewing, trimmers. CNC controlled sewing machines, automated folding, pressing, fusing, role patterning wheel in sewing machine.

**Theory : 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. R.S. Khurmi, J.K.Gupta, "Theory of Machines", 14<sup>th</sup> revised edition, S.Chand & Co Ltd., India, 2005.
2. Catherine Fairhurst, 'Advances in Apparel Production', Wood Head Publishing Ltd, Cambridge, 2008.
3. Harold Carr & B Latham, 'The Technology of Clothing Manufacture', Revised by David J.Tayler, Blackwell Publishing Ltd, 2008.
4. Solinger Jacob, "Apparel Manufacturing Handbook-Analysis, Principles and Practice", Columbia Boblin, MediaCorp., 1991.

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| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1 :** Describe the nano technology concepts and applications in textiles and apparel sector.

**CO2 :** Explain the methodology of synthesizing nano materials by different processes and techniques.

**CO3 :** Gains knowledge on nano tubes, nano composites and nano coatings.

**CO4 :** Acquire knowledge on next generation nano finishes on Textiles and Apparels.

**CO5 :** Explain the characterization techniques and instrumentation for nano materials.

**Pre-requisite: Nil**

**INTRODUCTION TO NANOTECHNOLOGY****6 Hours**

Concept of nanoscale and Historical background of nanotechnology, Fundamental concepts of nanotechnology - Bottom-up approaches, Top down approaches, Scope of nano technology in textile and apparel manufacturing.

**SYNTHESIS AND PROPERTIES OF NANOFIBRES****9 Hours**

Electro spinning of nanofibres. Continuous yarns from electrospun nanofibres. Principles of electrostatic atomization, Electro spraying and electrospinning by the capillary method, Electro spraying and Electrospinning by the charge injection method, Controlling fiber orientation, Applications of nanofibres viz, tissue engineering, filter media.

**NANOTUBES, NANO COMPOSITES****12 Hours**

Synthesis, Characterization and application of carbon nanotubes. Nano fibres reinforced polymer fibres. Production of carbon nano tubes- polymer fibres using melt spinning. Multifunctional polymer nano composites for industrial applications. Nano filled polypropylene fibres.

**POLYMER FUNCTIONALITY AND NANO COATING:** Nano structuring polymers with cyclo dextrans. Development of dyeable polypropylene, Nano technologies for coating and structuring of textiles.

**NANO TEXTILES AND APPAREL****8 Hours**

Development of nano textiles and apparel using - Nano-Tex, Nano-Care®, Nano-Dry®, Nano-Touch®, for home furnishing, technical textiles, smart and medical apparels

**CHARACTERIZATION OF NANOPARTICLES****10 Hours**

X-Ray Diffraction, Transmission Electron Microscopy and Spectroscopy; Scanning electron microscopy (SEM); Transmission electron microscopy (TEM); Energy-dispersive x-ray spectroscopy (EDS), Small-Angle X-Ray Scattering (SAXS), The Cone Calorimeter (CC), The Mass Loss Calorimeter (MLC).

**Theory : 45 Hours**

**Total: 45 Hours****REFERENCES**

1. Brown P J and Stevens K, "Nanofibres and Nanotechnology in Textiles", Woodhead Pub. Ltd., Cambridge, 2007
2. Yury Gogotsi, "Nanotubes and Nanofibres", CRC Taylor & Francis, Boca Raton, 2006
3. Guazhong Cao, "Nanostructure and nanomaterials", Imperial College Press, USA, 2006
4. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simons and Burkhard Raguse, "Nanotechnology- Basic Science and Emerging Technologies", Overseas Press, New Delhi, 2005. ISBN:81-88689-20-3

## **P15ATE304 FINANCE AND HUMAN RESOURCE MANAGEMENT**

| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Understand the overall nuances of a finance manager

**CO2:** Develop ability to make investment decisions

**CO3:** Build up ability to manage the working capital and long term finance requirement in an organization

**CO4:** Develop skills needed for human resource planning and making a best fit employee

**CO5:** Understand to manage human resource performance appraisal, training and control systems

**Pre-requisite: Nil**

### **INVESTMENT DECISIONS:**

**9 Hours**

Financial management – An overview- Time value of money - Principles and techniques of Capital Budgeting - Nature of capital budgeting- Identifying relevant cash flows - Evaluation Techniques: Payback, Accounting rate of return, Net Present Value, Internal Rate of Return, Profitability Index - Comparison of DCF techniques - Project selection under capital rationing - Inflation and capital budgeting - Concept and measurement of cost of capital - Specific cost and overall cost of capital

### **WORKING CAPITAL MANAGEMENT:**

**9 Hours**

Principles of working capital: Concepts, Needs, Determinants, issues and estimation of working capital - Accounts Receivables Management and factoring - Inventory management - Cash management - Working capital finance : Trade credit, Bank finance and Commercial paper.

### **LONG TERM SOURCES OF FINANCE:**

**9 Hours**

Indian capital and stock market, New issues market Long term finance: Shares, debentures and term loans, lease, hire purchase, venture capital financing, Private Equity.

### **THE CONCEPT OF BEST FIT EMPLOYEE:**

**9 Hours**

Importance of Human Resource Planning – Forecasting human resource requirement –matching supply and demand - Internal and External sources- Recruitment - Selection – induction – Socialization benefits. -Types of training methods –purpose- benefits- resistance. Executive development programmes – Common practices - Benefits – Self development – Knowledge management-Career management – Development of mentor

### **PERFORMANCE EVALUATION AND CONTROL PROCESS**

**9 Hours**

Method of performance evaluation – Feedback – Industry practices. Promotion, Demotion, Transfer and Separation – Implication of job change. The control process – Importance – Methods – Requirement of effective control systems grievances – Causes – Implications – Redressal methods.

**Theory : 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. M.Y. Khan and P.K.Jain Financial management, Text, Problems and cases Tata McGraw Hill, 6th edition, 2011.
2. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 10th edition, 2012.
3. Dessler Human Resource Management, Pearson Education Limited, 2007
4. Decenzo and Robbins, Human Resource Management, Wiley, 8th Edition, 2007.

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**Course Outcomes**

**Upon completion of the course the student should be able to:**

- CO 1 : Understand concepts and tools in lean manufacture and the difference between traditional management concepts and lean.
- CO 2 : Gain skill in application of lean concepts and tools in manufacturing process
- CO 3 : Gain knowledge on application of statistical tools in analysis and reduction of defects
- CO 4 : Comprehend application of lean concepts and tools in inventory and production control
- CO 5 : Appreciate the application of Six Sigma concepts designing defect free product and process and process control.

**Pre-requisite: Nil**

**INTRODUCTION****9 Hours**

Introduction – Lean Vs other tools and techniques - Lean practices Vs traditional business practices - Lean practices as distinguished from TQM, Management Systems of QMS, EMS, OSHAS and TPM. 8 Wastages - profit leakages due to wastages – over production, higher inventory, waiting time, unnecessary conveyance and motion of materials, over processing, rework- repairs - rejections, customer returns, wastage of people talents. Cost of Poor Quality – Cost of Quality – calculation of Cost of Poor Quality. 5 S – Seiri, Seiton, Seisō, Seiketsu, Shitsuke – house keeping practices for cleaner production.

**CRITICAL TO QUALITY AND VALUE STREAM MAPPING****9 Hours**

Critical to Quality (CTQ) – defining process objectives important to customer as CTQ. Supplier Input – Process Output – Customer (SIPOC) – SIPOC and Process Flow – what it desires to be – what it is – how to improve. Identifying non – value activities – eliminating non – value activities through Value Stream Mapping (VSM)

**STATISTICAL TOOLS****9 Hours**

Defect / defective distribution measurement – using normal distribution. DMAIC (Define-Measure-Analyze-Improve-Control) Model in world class Zero Defect programme. Calculation of Parts per Million (PPM) using attribute and normal distribution. Sampling - sampling plan for attributes and continuous variables. AQL levels.

**LEAN CONCEPTS IN INVENTORY CONTROL****9 Hours**

Lean concepts applied in transparent flow of information and production between processes and customers. Takt Time - Calculation of time for producing exactly quantity required. Reduction of inventory using simple Economic Order Quantity (EOQ) and Batch Production Models. Continuous Improvement – application of KAIZEN in reducing rejections. Application of KANBAN Cards for production planning and control for traceability and identification.

**DESIGN FOR SIX SIGMA (DFSS)****9 Hours**

Six Sigma Basics: Overview and Implementation. Process measurement, Process analysis, Process improvement (Six Sigma and Lean concept) and Process control. Design for Six Sigma, Six Sigma implementation. Six Sigma Metrics: DPU, DPO, DPMO, Sigma levels, Yield, First Time Yield, Overall Yield, Throughput Yield, Rolled Throughput Yield, Normalized Yield Process Capability Indices: Cp, Cpk, Cpm, Cpkm. Dealing with non-normality through transformations. Return on Investment (ROI) for technological upgradation – calculations.

**Theory : 45 Hours**

**Total: 45 Hours****REFERENCES**

1. Gopalakrishnan N, Simplified Lean Manufacture: Elements, Rules, Tools and Implementation, Prentice Hall of India Learning Pvt. Ltd., 2010

2. Askin Ronald G; Goldberg Jeffrey B, "Design and Analysis of Lean Production Systems", John Wiley & Sons Inc, 2003
3. Hobbs Dennis P, "Lean Manufacturing Implementation: A Complete Execution Manual for Any Size Manufacturer", Cengage Learning India Private Ltd, New Delhi, 2009.
4. Rajmanohar T P, "Lean Product Development: Concept and Models", ICFAI Press, 2009.
5. Desai, Aruna, "Lean manufacturing: Perspectives and Applications", ICFAI Press, 2008.
6. [Chowdhury](#), Subir, "Design for Six Sigma", Dearborn Trade, 2002.
7. [Chowdhury](#), Subir, "The Power of Six Sigma", Pearson Education (Singapore) Pvt. Ltd., 2001.
8. Creveling C M; Sluisky J L; Antis, Jr. D, "Design for Six Sigma Technology and Product Development", Pearson Education (Singapore) Pvt. Ltd., 2004.
9. Truscott William T, "Six Sigma Continual Improvement for Business: A Practical Guide", Elsevier, 2009.
10. Rajmanohar T P, "Cost of Poor Quality: Concept and Applications", ICFAI Press, 2008.
11. Colenso Michael, "Kaizen Strategies for Successful Organizational Change", Pearson Education (Singapore) Pvt. Ltd., 2002.
12. Imai, Masaaki, "Kaizen: The Key to Japan's Competitive Success", McGraw-Hill, 1986.



## **P15ATE402 COMPLIANCE STANDARDS FOR APPAREL INDUSTRY**

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### **Course Outcomes**

**After successful completion of this course, the students will be able to**

**CO 1 :** Acquire knowledge on concept and need for compliance in Apparel industry.

**CO 2 :** Acquire knowledge on social compliance followed in Apparel industry.

**CO 3 :** Gain knowledge on health and safety compliance followed in Apparel industry.

**CO 4 :** Understand on environmental compliance to be adhered by Apparel industry.

**CO 5 :** Comprehend technical compliance norms followed in Apparel industry.

**Pre-requisite: Nil**

### **DEFINITION OF COMPLIANCE**

**9 Hours**

Scope and Need for different compliances Social, health and safety, environmental, technical, international compliance - concept, need, benefits for industry, workers, and society. Social accountability and Corporate Social responsibility - scope and need. Social Compliance in supply chain management.

### **SOCIAL COMPLIANCE**

**9 Hours**

Conventions on Gender and caste discrimination, forced labour, child labour, minimum age convention. SA 8000 – Elements, Worldwide Responsible Apparel Production (WRAP). Ethical Trading Initiative (ETI). Corporate Social Responsibility (CSR) Compensation – norms applicable in India, Code of conduct, Minimum wages Act, remuneration, Trade Union Acts.

### **HEALTH AND SAFETY**

**9 Hours**

Environment and climate, health and safety – safety norms and measures to be enforced for safe working environment – protection against fire, water facilities, rest rooms, working hours - conventions on Acquired Immune Deficiency Syndrome (AIDS). Requirements of local statutory bodies - PF, ESI etc, OHSAS 18001

### **ENVIRONMENTAL COMPLIANCE**

**9 Hours**

Environmental Laws and Regulations, The Regulations Related to Handling, Recycling, and Disposal of Hazardous Materials. Requirements of Pollution Control Board, ISO 14000 – elements and certification. Eco standards, Eco labels, REACH, OEKO TEX, GOTS Certification requirements for apparel industry

### **TECHNICAL COMPLIANCE**

**9 Hours**

Elements and requirements of ISO 9000, Meeting vendor compliance – WALMART, JC PENNY, etc. Needle policy, maintenance of safety data of materials in stain removal, Poly bags, Children wear requirements.

**Theory : 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. S Das, Li & Fung, “Product safety and restricted substances in apparel”, Woodhead Publishing India,, ISBN 85709 824 1
2. R Christie,, “Environmental aspects of textile dyeing”, Woodhead Publishing Series in Textiles No. 66
3. SA 8000 – NITRA Tablet
4. Rajesh Chhabara, “Social Accountability”, Ava softech Pvt. Ltd., 2005
5. <http://www.labour.nic.in>
6. <http://www.unicef.org>
7. <http://www.paycheck.in>
8. <http://www.sa-intl.org>.

## **P15ATE403 ENERGY MANAGEMENT IN APPAREL INDUSTRY**

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### **Course Outcomes**

**Upon completion of the course the student should be able to:** CO1 : Gain

knowledge on need for energy management and global concerns on energy.

**CO2 :** Understand the process and metrics in energy audit.

**CO3 :** Learn about on energy consumption analysis and factors influencing consumption and means to reduce consumption

**CO 4:** Gain knowledge on developments in energy efficient technologies

**CO 5 :** Gain knowledge on non-conventional energy sources and developments in energy efficient technologies.

**Pre-requisite:** Nil

### **ENERGY MANAGEMENT AND CONSERVATION**

**7 Hours**

Concept of energy management - need for energy conservation - Demand - Supply Management. Global Energy Concerns: Global energy conservation scenario – energy conservation measures in India. United Nations Framework on sustainable development, Kyoto Protocol.

### **ENERGY MANAGEMENT AND AUDIT**

**11 Hours**

Definition of Energy Audit, need and types of energy audit, energy audit instruments. Understanding energy costs, bench marking energy performance, matching energy use to requirement, basic principles for optimizing the input energy requirements. Energy Management Department - Top management support, managerial function, roles and responsibilities of energy manager, accountability. Motivation of employees: Information system – overcoming barriers. Energy Monitoring and Control: Cumulative Sum of Differences (CUSUM) of Energy production and consumption, Energy production and consumption monitoring and control, elements for monitoring, data analysis and control.

### **ENERGY CONSUMPTION ANALYSIS**

**12 Hours**

Methods for energy consumption analysis. Analysis for apparel manufacturing machineries and finishing equipments. Cost of energy Vs sales value of apparel product. Energy Conservation in Factory: Energy saving opportunities with energy efficient motors. Factors affecting the electrical energy performance and energy saving opportunities. Factors affecting Refrigeration and Air conditioning system performance and saving opportunities. Lighting System - Light source, choice of lighting, luminance requirements, and energy conservation avenues. Diesel Generating system - Factors affecting selection, diesel energy conservation avenues. Waste Heat Recovery - Classification of waste heat. Source of waste heat in apparel industry. Commercially viable waste heat recovery devices, saving potential.

### **DEVELOPMENTS IN ENERGY EFFICIENT TECHNOLOGIES**

**7 Hours**

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, and energy efficient lighting controls.

### **APPLICATION OF NON CONVENTIONAL ENERGY SOURCES**

**8 Hours**

Scope of application of non-conventional energy - Solar energy: different type of collectors — photovoltaic cells. Wind energy, Bio energy, environmental impact on energy and co-generation by using different techniques.

**Theory : 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. Kalyanaraman. A.R, “Energy Conservation in Textile Industries”, SITRA 1995 (Revised)

2. Palaniappan. C et al, “Renewable Energy Applications to Industries”, Narose Publishing House, New Delhi, 1998.
3. "Energy Management" PCRA Monograph.
4. Pradeep Chaturvedi and Shalini Joshi, “Strategy for Energy Conservation in India”, Concept Publishing Co., New Delhi, 1995.
5. Proceedings of International Seminar cum Exhibition ASIA Energy Vision 2020 — Sustainable Energy Supply, November 15-17, 1996
6. Proceedings of 12 Shirley International Seminar, “Profitable Energy Savings in the Textile Industry”, September 16-18, 1980
7. Proceedings of the Seminar, “Strategies for Sustainability of Energy Efficient and Environmental Friendly Technologies in Small and Medium Scale Sector”, PSG College of Technology, November 24, 2000.
8. Proceedings of All India Workshop, “Latest Trends in Energy Audit Systems”, Institution of Engineers (I), December 12-13, 1993.

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**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1 :** Understand what is operation research and statistics in apparel production

**CO2 :** Apply inventory, probability and hypotheses testing in apparel related research

**CO3 :** Evaluate process control and capability analyses in apparel industry

**CO4:** Recognize importance of inventory in apparel industry

**CO5:** Apply OR concepts in apparel industry and carry project work.

**Pre-requisite:** Nil

**LINEAR PROGRAMMING****9 Hours**

Formulation of Linear Programming Problem (L.P.P) – Graphical method – Simplex Algorithm – two phase simplex method – transportation problem – assignment problem- Hungarian method.

**INVENTORY THEORY****9 Hours**

Costs that are involved in inventory problems – single item deterministic models economic lot size models without shortages and with shortages having production rate infinite and finite – quantity discounts – multi item deterministic models.

**PROBABILITY DISTRIBUTION****9 Hours**

Probability - Conditional probability – Baye’s theorem, Binomial distribution, Negative binomial distributions - Poisson distribution - Normal distribution and Weibull distribution-Applications in textile/apparel industry

**HYPOTHESIS TESTING****9 Hours**

Testing of Hypothesis for large samples (single mean, difference of means, single proportion, difference of proportion) – Small samples – t - test ( single mean,difference of means, paired t-test) – F- test (Variance ratio test), Chi-square test - Tests for independence of attributes and goodness of fit- Applications in textile/apparel industry

**PROCESS CONTROL AND CAPABILITY ANALYSIS****9 Hours**

Control charts for variables and attributes - basis, development, interpretation, sensitizing rules, average run length; capability analysis

**Theory: 45 Hours**

**Total: 45 Hours**

**REFERENCE**

1. Montgomery D.C., “Introduction to Statistical Quality Control”, John Wiley and Sons, Inc., Singapore, 2002, ISBN: 997151351X.
2. Leaf G.A.V., “Practical Statistics for the Textile Industry, Part I and II”, The Textile Institute, Manchester, 1984, ISBN: 0900739517.
3. Douglas C. Montgomery, “Design and analysis of experiments”, John Wiley & Sons, Inc, Singapore, 2000, ISBN 9971 51 329 3
4. Ronald D. Moen, Thomas W. Nolan, Lloyd P. Provost, “Quality improvement through planned experimentation’, McGraw-Hill, 1998, ISBN 0-07-913781-4
5. H.A Taha, “Operations Research – An Introduction”, Prentice Hall of India, Seventh Edition, 2005.
6. Kalavathy S, “Operations Research”, Second Edition, Vikas Publishing House, 2004.
7. Gupta P.K and Man Mohan, “Problems in Operations Research”, (Methods and Solutions), Sultan Chand and Sons, 9<sup>th</sup> Edition, 2009.
8. Hayavadana, J., ‘Statistics for Textile and Apparel Management’, Woodhead Publihing, 2012

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**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1 :** Understand the concept of marketing strategy planning and business strategy planning

**CO2 :** Acquire knowledge on environmental scanning and market analysis

**CO3 :** Understand the process of developing new product and marketing mix

**CO4 :** Acquire ability to carry out independently carry out marketing research activity

**CO5 :** Acquire ability to Implement and Control of Marketing Strategy,

**Pre-requisite: Nil**

**9 Hours**

**MARKETING STRATEGY PLANNING** Scope- Functions - Marketing Concepts.

**BUSINESS STRATEGY PLANNING:** Strategic Vision, Mission, SWOT Analysis, Strategic Management Process.

**9 Hours**

**ENVIRONMENTAL SCANNING** Political, Economic, Social, Political, Cultural and Technological environments

**MARKETING PROCESS:** Segmentation, Identifying market segments Targeting and Positioning,

**MANAGING MARKETING MIX**

**9 Hours**

New Product Development, Product Life Cycle, Pricing – Pricing strategies, Promotion mix, Channel management- Vendor development

**MARKETING RESEARCH**

**9 Hours**

Marketing Research types, Process: problem definition developing research objectives, collecting secondary data, designing primary research, data collection analysis, report preparation, conducting research study methods and tools.

**MARKETING STRATEGY, IMPLEMENTATION AND CONTROL**

**9 Hours**

Strategic Planning, Evaluation, implementation and control - Tools for strategic decision making, recent trends and challenges in Marketing, Strategic importance of Indian Apparel and Garment industry in the era of globalization.

**Theory : 45 Hours**

**Total: 45 Hours**

**REFERENCES**

1. Philip Kotler- Marketing Management – Millennium Edition PHI
2. Ramaswamy Namakumari - Strategic Planning and control, Macmillan
3. Pearce and Robinson -Strategic Management, McGraw Hill
4. M.Jeyarathnam - Strategic Management- \_Himalaya Publication House
5. C.G.Beri- Marketing research- TMH
6. Leon G. Schiffman, Leslie Lazar Kanuk, “Consumer Behavior”, Prentice Hall of India
7. (P) Ltd., New Delhi, 2000.
8. Drayton bide , “Common Sense Direct Marketing”, NTC Business books,1993.
9. Philip Kotler, Kevin Lane Keller, Abraham Koshy, and Mithileshwar Jha, “Marketing
10. Management - A South Asian Perspective”, Pearson Education India, 2006.

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**Course Outcomes**

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

**CO1:** Discuss the styles and types of printing

**CO2 :** Describe the printing preparatory and printing processes.

**CO3 :** Recognizing the printing auxiliaries and their suitability on printing chemical requirements.

**CO4 :** Recognizing the process for printing natural and synthetic textiles.

**CO5:** Identifying suitable printing techniques and machineries for advanced printing techniques.

**Pre-requisite: Fundamentals of Textile Finishing**

**PRINTING INTRODUCTION****7 Hours**

Printing Introduction, printing ingredients, styles of printing - Direct, resist, and discharge styles (coloured and white) and their specific dye requirements, Khadi printing.

**PRINTING PREPARATORY PROCESS****9 Hours**

Selection of fabrics, preparation of cloth for printing, preparation of printing paste. Selection of dye stuffs and their fibre suitability, Dye suitability for different printing styles, fastness properties of dyes and printed fabrics.

**PRINTING AUXILIARIES****9 Hours**

Wetting agents, solvents, defoaming agents, oxidizing agents, reducing agents, catalyst and oxygen carriers, acids and alkalis, carriers and swelling agents.

**PRINTING THICKENERS** Introduction, types of thickeners, natural and synthetic thickeners, selection of thickeners, properties of thickeners, thickeners compatibility to dyestuffs.

**PRINTING ON NATURAL AND SYNTHETIC FABRICS****11 Hours**

Printing on cellulosic fabric in all printing styles( direct, resist and discharge) with direct, reactive, vat, sulphur dyes, Printing on wool and silk with acid dyes, mordant dyes in different styles, Printing on nylon, polyester, triacetate, acrylic, and carpet printing.

**SPECIAL PRINTING TECHNIQUES AND MACHINERIES****9 Hours**

Yarn printing, warp printing, flock printing, glitter, pearl, foam and rubber printing. transfer printing – Heat transfer, photo transfer techniques, digital printing- fabric preparation - ink for digital printing, Dye-fibre interaction in digital printing, Printing post treatments.

Overview of carpet printing and pigment printing.

**Theory : 45 Hours**

**Total: 45 Hours****REFERENCES**

1. Shenai V.A., "Technology of Printing", 3<sup>rd</sup> edition, Sevak Publication, India. 1990.
2. Clarke W., 'A Introduction to Textile Printing', 4<sup>th</sup> edition, Woodhead Publishing limited, 2004.
3. Ujjie H. (ed.), "Digital Printing of Textiles", Woodhead Publishing limited, 2006.
4. Lesile W.C. Miles, "Textile Printing", Society of Dyers and Colourists, Mumbai, 2003

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**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1 :** Acquire knowledge on application of high performance clothing in various situations.

**CO2 :** Select new fibres and fabrics for development of new performance clothing

**CO3:** Design and develop speciality performance clothing

**CO4 :** Design and develop seamless knitwear and stitchfree seaming

**CO5:** Design and develop wearable electronics clothing

**Pre-requisite: Nil**

**INTRODUCTION****9 Hours**

Aspects of high-performance clothing, differences between normal clothing and high-performance clothing, Need for the development of high-performance clothing.

**FIBRES FOR HIGH PERFORMANCE WEAR****9 Hours**

Fibres used in high-performance clothing- properties and application - carbon, aramid, graphite, glass fibres, ceramic fibres, polyurethane elastomeric fibres, polyethylene fibres, polyphenyl sulphide fibres, metallic compound fibres, polystyrene based fibres, bio absorbable fibre.

**HIGH PERFORMANCE WEAR****9 Hours**

Breathable thermo wear, anti drag-swim wear, athletes wear with pressure receptors, temperature controlled garment, liquid insulated garment, high tech cooling vest, energy expenditure wear, anti cellulites panty hose, undergarment for catheters, life shirts, ceramic coated health care apparels, smart trousers and T-shirts.

**WEARABLE ELECTRONICS****9 Hours**

Introduction, model of a design. Business executive applications – medicine safety – their applications – entertainment and recreational applications – musical jackets – electronic table cloth.

**SEAMLESS & STITCHLESS WEAR****9 Hours**

Manufacturing of high performance clothing -Seamless knitting, stitch-free seaming technologies, High performance sewing machines, Trims and accessories.

**Theory : 45 Hours****Total: 45 Hours****REFERENCES**

1. Vigo T.L, “Intelligent Fibres”, J.Text. Inst., 90, Part 3, Textile Institute, 1999.
2. Xiaoming Tao, “Wearable Electronics and Photonics”, The Textile Institute, CRC Press, 2005.
3. Xiaoming Tao, “Smart fibres, Fabrics and Clothing”, The Textile Institute, CRC Press, 2005.
4. Hearle J.W.S., “High performance fibres”, Woodhead Publishing, 2001.
5. C Fairhurst, “Advances in Apparel Production” Edited by Manchester Metropolitan University, UK, Woodhead Publishing Series in Textiles No. 69

**P15ATE503****SPORTS APPARELS**

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**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1 :** Describe the sportswear apparel requirements and applications.

**CO2 :** Selecting the suitable raw materials for the sports apparel requirements based on the applications.

**CO3 :** Discuss the coated and laminated techniques used and suitable for different apparels for sportswear.

**CO4 :** Identifying and applying different composites used for sportswear apparels and components.

**CO5 :** Discuss and identifying the comfort properties of sportswear based on materials, styles and sports types

**Pre-requisite: Nil**

**INTRODUCTION TO SPORTSWEAR****9 Hours**

Sportswear Market overview, Components for special sports: low and medium activity sports, endurance sports, outdoor and water sports, key trends in sportswear design: evolution of layering and re-organization of material, external influences and future trends.

Requirements for designing performance sportswear: Factors affecting design of performance sportswear, Design development process for performance sportswear, Emerging trends: commercial reality; smart clothes and wearable technology; biomimicry; environmental issues

**INNOVATIVE FIBRES AND FABRICS IN SPORTS****9 Hours**

Overview of High-performance fibres: high modulus/high strength/shear stability; high stability towards heat and fire; high stability towards environment chemicals/gases/weather; Smart textile materials: phase change materials; shape memory materials; auxetic materials; chromic materials; conductive fibres and textiles; other smart materials; holofiber; stomatex; d3o (dee-three-oh); Wearable technology , adjustable thermal insulation, the Intelligent Knee Sleeve

**COATED AND LAMINATED TEXTILES IN SPORTSWEAR****9 Hours**

Fabric preparation , Coating methods: coating add on and blade profile; determination of coating add on; transfer coating; rotary screen coating; other methods of coating; production of microporous coatings; Lamination: general considerations; adhesives; - Environmental aspects: direct effects of coating and lamination, health and safety aspects; eco-labeling; recycling.

**TEXTILE COMPOSITES IN SPORTS PRODUCTS****9 Hours**

Materials: reinforcing fibres and resins; Design: reinforcement shapes, material design, material partition and positioning, some special design features; Production technology – continuous process; Applications of composites in sports

**SPORTSWEAR AND COMFORT****9 Hours**

Aspects of wear comfort - Measurement of physiological comfort: wear comfort as a measurable quantity; wearer trials; skin model; skin sensorial test apparatus; wear comfort vote applications Sportswear and Protection: Protection against impact - injuries sustained during sporting activities, Impact protection provided through protective clothing/equipment and its



effectiveness; standard test methods; Protection against extreme weather- Requirements for protection, Measurements of clothing performance: thermal insulation; evaporative resistance; wind resistance; water resistance; water vapour transfer; standards for protective clothing against cold and foul weather, under wind driven rainy conditions and condensation problems in sportswear

**Theory : 45 Hours**

**Total: 45 Hours**

## **REFERENCES**

1. Shishoo R., 'Textiles in Sport', Woodhead Publishing Limited, CRC Press,, 2005
2. Boisse P., 'Composite Reinforcements for Optimum Performance', Woodhead Publishing Limited, CRC Press, 2011
3. Jenkins M . 'Materials in Sports Equipment', Volume 1, Woodhead Publishing Limited, CRC Press, 2003.
4. [J. W. S. Hearle](#), 'High Performance Fibres', Woodhead Publishing Limited, CRC Press, 2001
5. 'Surfaces for Sports Areas. Determination of Resistance to Impact', B S I Standards, 2000
6. Y Li and A S W Wong , 'Clothing Biosensory Engineering', Woodhead Publishing Series in Textiles No. 51, 2006

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## **P15ATE504 APPAREL PRODUCTION MANAGEMENT**

### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO 1 :** Acquire knowledge on basic techniques of production control in apparel industry.

**CO 2 :** Describe the preproduction functions and product development process.

**CO 3 :** Identify the production systems for apparel industry based on style and quantity of merchandise.

**CO 4 :** Prepare the flow process grids and scheduling charts for production control and Explain the cut order planning and control forms for apparel industry.

**CO 5 :** Determine the capacity planning and line balancing techniques to achieve balanced production.

**Pre-requisite: Nil**

### **INTRODUCTION TO PRODUCTION CONTROL**

**9 Hours**

Definition, objective of production control, relationship of production control to the functional areas of a manufacturing organization.

### **PRODUCTION PREPLANNING**

**9 Hours**

Pre production functions – product acceptance, Steps from Creative Design- Rapid Prototype, Virtual Prototype, Real Designs and prototype to production model, order requirements.

### **PRODUCTION SYSTEMS**

**9 Hours**

Section production systems-whole garment production system, progressive bundle system, unit production system, multiple flow system, modular system, guidelines for choosing suitable production system. Production scheduling - Principles of scheduling, scheduling charts, GANTT chart, backlog graph, scheduling control techniques. Network representations - CPM and PERT. Flow process grids and charts - Flow process grid construction, flow process grids for production control.

### **CUT PRODUCTION ANALYSIS**

**9 Hours**

Cut order planning – types of spreads, spreading methods, marker utilization, economic cut quantities, production control forms: Functions of cutting order, cutting ticket, bundle control sheet, operator scheduling sheet.

### **PLANT LOADING AND CAPACITY PLANNING**

**9 Hours**

Determination of machinery requirements for a new factory, calculation of labour requirements, applications of line balancing techniques – balance control. Establishing factory capacity, planning for multi style production – preparation of planning board.

**Theory: 45 Hours**

**Total: 45 Hours**

### **REFERENCES**

1. Solinger Jacob, “Apparel Manufacturing Handbook-Analysis, Principles and Practice”, Columbia Boblin, MediaCorp., 1991.
2. David J Tyler, “Materials Management in Clothing Production”, Prentice Hall, New Jersey, 1991.

3. Rajesh Bheda, "Managing Productivity of Apparel industry" CBI publishers and distributors, New Delhi 2002.
4. William K.Hodson, "Maynard's Industrial Engineering Handbook", Fourth Edition, McGraw-Hill, Inc., New York, 1992.
5. Glock R E and Kunz G I, "Apparel Manufacturing - Sewn Product Analysis", Prentice Hall, Second Edition, 1995
6. Harold Carr, "Fashion design and Product development", John Wiley and Sons Inc., New York, 1991
7. Patty Brown and Janett Rice, "Ready To Wear Apparel Analysis", Prentice Hall, 1998

**P15ATE505**

## **FASHION COMMUNICATION**

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### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1 :** Appreciate the significance of fashion communication theories of clothes.

**CO2 :** Understand the various dimensions of fashion and its impact on society.

**CO3 :** Describe the essentials of fashion communication and communication activity.

**CO4 :** Acquire knowledge on creating and designing appropriate marketing communication and describe the fashion advertising process.

**CO5 :** Explain the role of communication in sales promotion and in personal selling.

**Pre-requisite: Nil**

### **FASHION CLOTHING AND COMMUNICATION**

**9 Hours**

Fashion and Anti fashion, Fashion clothing and Deception, Fashion clothing and Communication, Fashion clothing and culture, Fashion power and Ideology. Fashion clothing and revolution: revolution and resistance, passive and active consumption, the new look

### **FASHION CLOTHING AND POST MODERNITY**

**9 Hours**

Fashion and modernity, fashion and post modernity, fashion art, performance, masquerade fashion and allegory, fashion and un-decidability, fashion and pastiche, fashion and bricolage, fashion and ambivalence

### **ESSENTIALS OF FASHION COMMUNICATION**

**9 Hours**

Introduction to components of fashion marketing communications. Theoretical frameworks - communication strategies within the fashion industry

**Communication Activity:** International fashion marketing communications, impact of technology in fashion communication, regulatory and ethical issues in fashion marketing communication.

### **FASHION ADVERTISING**

**9 Hours**

The role of advertising - encoding messages, advertising control bodies, creating and designing appropriate marketing communications strategies. Media planning, market research and account planning, the advertising brief, print advertising, editorial, photography. Creating a market position through strategic marketing communication.

### **COMMUNICATION IN SALES PROMOTION**

**9 Hours**

The role of communication in promoting sales – of public relations, sponsorships and endorsements, exhibitions, tradeshow and fashion shows.

**COMMUNICATION IN PERSONAL SELLING:** The role of communication in personal selling - direct marketing and e-marketing

**Theory: 45 Hours**

**Total: 45 Hours**

## REFERENCES

1. Smith, P. R. & Taylor, J., "Marketing Communications: An Integrated Approach", Kozan Page, London, U.K. 2005.
2. Agins, T. "The end of Fashion; How Marketing Changed the Clothing Business Forever", Perennial, 2000.
3. Hines, T and Bruce, M. "Fashion Marketing-Contemporary Issues", CIM, 2001
4. George Belch, Michael A Belch, "Advertising Promotion: An Integrated Marketing Communication Perspective", Tata Mc Graw Hill, 2001.
5. Malcom Barnard," Fashion as Communication", Routledge and Kegan Paul, 2002.  
John M Penrose, Robert W Rasberry, Robert J. Myers, "Advanced Business Communication", South Western Publication Company, 2001.

## **ONE CREDIT ELECTIVE COURSES**

## **P14FTIN01            IMPLEMENTATION OF SIX SIGMA IN APPAREL INDUSTRY**

### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Understand the concept of Six Sigma and its application to evaluate and control a process

**CO2:** Gain knowledge on various metrics used in Designing, implementing and for evaluating Six Sigma process

**CO3:** Implement six sigma concept in apparel industry to improve process

**Pre-requisite: Nil**

### **DESIGN FOR SIX SIGMA (DFSS):**

**6 Hours**

Six Sigma Basics: Overview and Implementation. Process measurement, Process analysis, Process improvement (Six Sigma and Lean concept) and Process control.

### **DESIGN FOR SIX SIGMA AND IMPLEMENTATION:**

**9 Hours**

Design for Six Sigma, Six Sigma implementation. Six Sigma Metrics: DPU, DPO, DPMO, Sigma levels, Yield, First Time Yield, Overall Yield, Throughput Yield, Rolled Throughput Yield, Normalized Yield Process Capability Indices: Cp, Cpk, Cpm, Cpk<sub>m</sub>. Dealing with non-normality through transformations.

**Theory : 15 Hours**

**Total: 15 Hours**

### **REFERENCES**

1. Chowdhury, Subir, “Design for Six Sigma”, Dearborn Trade, 2002.
2. Chowdhury, Subir, ”The Power of Six Sigma”, Pearson Education (Singapore) Pvt. Ltd., 2001.
3. Creveling C M; Sluisky J L; Antis, Jr. D, “Design for Six Sigma Technology and Product Development”, Pearson Education (Singapore) Pvt. Ltd., 2004.
4. Truscott William T, “Six Sigma Continual Improvement for Business: A Practical Guide”, Elsevier, 2009.

**Course Outcomes****Upon completion of the course the student should be able to:**

**CO1:** Understand the different requirements of various product certification processes in Apparel Industry.

**CO2:** Understand the different requirements of various process certification processes in Apparel Industry.

**CO3:** Apply and follow certification procedures for health, safety and environment protection.

**Pre-Requisites:** Nil

**PROCESS CERTIFICATION:****7 Hours**

Cleaner Technology Production (CTP) - Occupational Health and Safety Assessment Specifications (OHSAS) –Worldwide Responsible For Apparel Production (WRAP) - Code of Vendor Conduct.

Global Sourcing and Operating Guidelines - Country Assessment Guidelines - Health and Safety Conditions , Human Rights Environment, Legal System, Political, Economic and Social Environment. Business Partner Terms of Engagement (TOE) - Ethical Standards, Legal Requirements, Environmental Requirements, Environmental Philosophy and Guiding Principles. Community Involvement, Employment Standards - Evaluation and Compliance.

**PRODUCT CERTIFICATION:****8 Hours**

ECO-Labeling - Oeko-Tex 100, EU Eco-Label for Textiles. Care Labelling - Sun protective labelling - Fibre content labelling - Country of origin labelling - Product Safety Standards (Children's Nightwear and Limited Daywear Having Reduced Fire Hazard) Regulations, Accessories on infants apparel.

**FABRIC CERTIFICATION** UPF Rated certificate, certification for Fabrics, accessories and trims for children's nightwear and other daywear. Mandatory fabric test certification - Fibre Analysis - (Composition / Fibre Content) Construction, Yarn Count, Dimensional Stability Shrinkage, Spirality - Tensile Strength - Tear Strength - Colour Fastness, Seam Slippage, Pilling, Stretch & Recovery for fabric with elastane - Water Repellancy, Flammability, Water Absorbency/Wicking. Product Safety Certification - Drawcords / ties, Elastic, Zippers, Broken Needle Policy, Pins Policy, Replacement Needle Policy, Shipment certification.

**Theory : 15 Hours**

**Total: 15 Hours**

**References:**

1. 'Walmart Supplier Standards and Requirements', [www.walmart.com](http://www.walmart.com)
2. 'Compliance with international standards (Guidelines for textile industry)', Small & Medium Enterprise Development Authority, Ministry of Industries and Production Government of Pakistan <http://www.smeda.org.pk>



3. 'THE BONTON STORES, INC. - International Vendor Compliance Guide', [www.bonton.com](http://www.bonton.com)
4. <http://www.ohsas-18001-occupational-health-and-safety.com/>
5. [www.wrapcompliance.org](http://www.wrapcompliance.org)
6. [www.oeko-tex.com](http://www.oeko-tex.com)
7. Janace E. Bubonia, 'Apparel Quality - A Guide to Evaluating Sewn Products', Fairchild Books, 2014.
8. Das, Subrata, 'Product Safety and Restricted Substances in Apparel' Woodhead Publishing India, 2013.

## **P14FTIN03 APPAREL MACHINERY MAINTENANCE AND AUDIT**

### **Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Understand the importance of machinery maintenance in apparel industry

**CO2:** Acquire knowledge in different types of maintenance for apparel machineries

**CO3:** Acquire knowledge in maintenance program for spreading and cutting machines.

**CO4:** Acquire knowledge in maintenance program for sewing machines.

**CO5:** Acquire knowledge in maintenance program for finishing machines.

**Pre-requisite: Nil**

### **BASIC CONCEPTS**

**5 Hours**

Objectives of Maintenance. Different types of maintenance, Planned and unplanned Maintenance, their scope and suitability, merits and demerits (brief study only) Basic requirements of maintenance – Organization of maintenance in large, medium and small apparel units. Need for Systems and procedures, checklists, various forms and formats such as weekly work order, machine card, bin card etc., and their design. Roll of maintenance supervisor in an apparel industry- his duties and responsibilities.

### **SCHEDULING AND CONTROLLING OF MAINTENANCE**

**5 Hours**

Scheduling and rescheduling of maintenance activities Need for controlling, methods and tools for controlling maintenance activities. Yearly maintenance program – Importance of Equipment history record, recommendations of machinery manufacturers, experts etc., in fixing frequencies and priorities of various operations, grouping of related operations, etc. Preparation of yearly maintenance program. Maintenance audit and its importance.

### **MAINTENANCE PROGRAM AND MAINTENANCE**

**5 Hours**

Regular and routine maintenance program for spreading and cutting department - Regular and routine maintenance program for sewing department - Regular and routine maintenance program for Finishing department - Preventive maintenance program for different departments in apparel Industry.

**Theory : 15 Hours**

**Total: 15 Hours**

### **REFERENCES**

1. Harold Carr and Barbara Latham, “The Technology of Clothing Manufacture”, Om Book Service, 2002.
2. Shaeffer Claire, “Sewing for the Apparel Industry”, Prentice Hall, New Jersey, 2001.
3. Singer, “Sewing Lingerie”, Cy DeCosse Incorporated, 1991.
4. Laing R.M., Webster J., “Stitches and Seams”, The Textile Institute, Manchester, 1999
5. Technical Advisory Committee of AAMA, “A New Look at Apparel

Mechanization”, 1978.

6. Jacob Solinger, “Apparel Production Handbook”, Reinhold Publications, 1998.

**P14FTIN04****GLOBAL FASHION ENTERPRISE****Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Gain knowledge on fundamentals of Fashion Business

**CO2:** Understand the process of product development and evaluation

**CO3:** Gain knowledge on fashion global sourcing and factors influencing global sourcing

**Pre-requisite: Nil**

**INTRODUCTION FASHION BUSINESS****4 Hours**

Benchmarking successful organizational strategies. Integrating product functionalities, usages, design concepts, and apparel manufacturing. Evaluating fashion strategies, from both the technical and business perspectives

**PRODUCT DEVELOPMENT AND EVALUATION****5 Hours**

Influence of preference and individual choices, function, fit and appearance and to their interrelationship with apparel product. Use of product assessment as a tool for process and product improvement. Complexity of the fiber, yarn, fabric and product-forming systems in product development and manufacturing process

**Fashion Global Sourcing****6 Hours**

global perspective of apparel industry. Critical international marketing and sourcing decisions within a complex economic environment. Major variations which occur across international markets—economic, social, and cultural; examine the behavior of business within different marketing and manufacturing contexts; and consider the factors involved in making effective global marketing and sourcing decisions.

**Theory : 15 Hours**

**Total: 15 Hours**

**REFERENCES**

1. Maurice J. Johnson & Evelyn C. Moore, "Apparel Product Development", Second Edition, Prentice Hall Upper saddle river, New Jersey, 2001.
2. Mastudaira T and Suresh M.N., "Design Logic of Textile Products", Textile Progress, Textile Institute, Manchester, 1997.
3. Donald R. Lehmann, Russell S. Winer, "Product Management", McGraw Hill International, 1996.
4. Torben Tambo, 'Advanced Technologies Management for Retailing: Frameworks and Cases' Business Science Reference, 2011.

**Course Outcomes**

**Upon completion of the course the student should be able to:**

**CO1:** Understand the concept of packaging design in the context of sustainability

**CO2:** Gain knowledge on the material selection Recycling and recovery of packaging materials

**CO3:** Understand the process of materials sourcing, and manufacturing packaging products

**CO4:** Gain knowledge on evaluation of sustainability in packaging based on domestic and international regulations

**Pre-requisite: Nil**

**FOUNDATION OF SUSTAINABLE PACKAGING DESIGN****2 Hours**

Sustainability in packaging design as a business strategy. Effective brand communication and sustainable messaging. Innovative structural design

**SYSTEMS THINKING IN SUSTAINABLE PACKAGING DESIGN****5 Hours**

Systems thinking - how each part relates to others within a whole - and its application to sustainability.

Prevailing and new materials for sustainable packaging. Recycling and recovery of packaging materials

**TECHNOLOGIES AND LOGISTICS IN SUSTAINABLE PACKAGING****8 Hours**

Materials sourcing, and manufacturing and packaging implementation Assess existing and new packaging materials to maximize various levels of sustainability. Apply the cradle-to-cradle concept and life cycle analysis (LCA) tools and techniques to the creative process. Supply chain logistics such as fuel use, energy costs, and shipping.

**EVALUATION OF SUSTAINABILITY IN PACKAGING** - Evaluate sustainable packaging criteria, based on domestic and international regulations, definitions and guidelines from nongovernment organizations (NGOs) - Evaluate the environmental impact of packaging production and print technologies. - Integrating sustainable best practices into package design management processes.

Case Studies / Mini Project in Sustainable Packaging Design

**Theory: 15 Hours****Total: 15 Hours****REFERENCES:**

1. Bartlett N., Mc Gill I. and Morley N., Maximising the Reuse and Recycling of UK Clothing & Textiles, UK: Oakdene Hollins, 2009
2. Scott Boylston, 'Designing Sustainable Packaging, Laurence King Publishing, 2009.
3. Wendy Jedlicka, 'Packaging Sustainability: Tools, Systems and Strategies for Innovative Package Design', Wiley& Sons, 2011.
4. Verghese, Karli, Lewis, Helen, Fitzpatrick, Leanne, 'Packaging for Sustainability', Springer-Verlag London Limited, 2012.

