

**ANNA UNIVERSITY, CHENNAI**  
**NON- AUTONOMOUS COLLEGES**  
**AFFILIATED TO ANNA UNIVERSITY**  
**M. TECH. TEXTILE TECHNOLOGY (with Specialization in TEXTILE CHEMISTRY)**  
**REGULATIONS 2025**

**PROGRAMME OUTCOMES (POs):**

<b>PO</b>	<b>Programme Outcomes</b>
<b>PO1</b>	An ability to independently carry out research /investigation and development work to solve practical problems
<b>PO2</b>	An ability to write and present a substantial technical report/document.
<b>PO3</b>	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

**PROGRAMME SPECIFIC OUTCOMES(PSOs):**

<b>PSO</b>	<b>Programme Specific Outcomes</b>
<b>PSO1</b>	Apply knowledge of textile chemistry and technology to improve wet processing operations and product quality.
<b>PSO2</b>	Demonstrate proficiency in using modern analytical and processing tools for sustainable textile wet processing.



## ANNA UNIVERSITY, CHENNAI

### POSTGRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

**Programme:** M. Tech., Textile Technology  
(with Specialization in Textile Chemistry)

**Regulations:** 2025

**Abbreviations:**

**BS** – Basic Science (Mathematics)

**ES** – Engineering Science (General (**G**),  
Programme Core (**PC**), Programme  
Elective (**PE**))

**SD** – Skill Development

**SL** – Self Learning

**L** – Laboratory Course

**T** – Theory

**LIT** – Laboratory Integrated Theory

**PW** – Project Work

**TCP** – Total Contact Period(s)

### Semester I

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.	MA25C08	Statistics for Technologists	T	3	1	0	3	4	ES (PC)
2.	TY25101	Advanced Textile Chemistry (Fibres, Dyes and Auxiliaries)	T	3	0	0	3	3	ES (PC)
3.	TY25102	Green Chemistry and Sustainable Processing	T	3	0	0	3	3	ES (PC)
4.	TY25103	Costing and Process House Management	T	3	0	0	3	3	ES (PC)
5.	TY25104	Environmental Social Governance	T	3	0	0	3	3	ES (PC)
6.	TY25105	Coloration and Finishing Laboratory	L	0	0	4	4	2	SD
7.	TY25106	Product Design and Characterisation of Technical Textiles - I	L	0	0	4	4	2	ES (PC)
8.	TY25107	Technical Seminar	-	0	0	2	2	1	SD
<b>Total Credits</b>							<b>25</b>	<b>21</b>	

### Semester II

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.	TY25201	Environmental Audit in Textile Processing Industry	T	3	0	0	3	3	ES (PC)
2.	TY25202	Circular Economy and Ecolabelling	T	3	0	0	3	3	ES (PC)
3.	---	Programme Elective - I	T	3	0	0	3	3	ES (PE)
4.	---	Programme Elective - II	T	3	0	0	3	3	ES (PE)
5.	---	Programme Elective - III	T	3	0	0	3	3	ES (PE)
6.	TY25203	Product Design and Characterisation of Technical Textiles - II	L	0	0	4	4	2	ES (PC)
7.	---	Industry Oriented Course I	---	1	0	0	1	1	SD
8.	---	Self-Learning Course	--	-	-	-	-	1	-
9.	TY25204	Industrial Training#	---	---	--	---	---	--	SD
<b>Total Credits</b>							<b>20</b>	<b>19</b>	

# Evaluation will be done in third semester for the summer internship.

### Semester – III

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
<b>THEORY</b>									
1.	---	Programme Elective - IV	T	3	0	0	3	3	ES (PE)
2.	---	Programme Elective - V	T	3	0	0	3	3	ES (PE)
3.	---	Programme Elective - VI	T	3	0	0	3	3	ES (PE)
4.	TY25204	Industrial Training#	---	---	--	---	---	2	SD
5.	---	Industry Oriented Course I	---	1	0	0	1	1	SD
6.	TY25301	Project Work I	---	0	0	12	12	6	SD
<b>Total Credits</b>							<b>22</b>	<b>18</b>	

### Semester IV

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.	TY25401	Project Work II	---	0	0	24	24	12	SD
<b>Total Credits</b>							<b>24</b>	<b>12</b>	

## PROGRAMME ELECTIVE COURSES (PE)

S. No.	Course Code	Course Title	Periods			Total Contact Periods	Credits
			L	T	P		
1.	TX25C01	Coated and Laminated Textiles	3	0	0	3	3
2.	TX25C02	Sustainability in textile industry	3	0	0	3	3
3.	TX25C03	Textile Reinforced Composites	3	0	0	3	3
4.	TX25C04	Functional Dyes	3	0	0	3	3
5.	TY25001	Textile Costing and process Optimization	3	0	0	3	3
6.	TY25002	Protective Clothing	3	0	0	3	3
7.	TY25003	Characterization of Textile Polymers	3	0	0	3	3
8.	TY25004	Chemical Processing of Manmade fibres.	3	0	0	3	3
9.	TY25005	Non-woven and specialty Textiles	3	0	0	3	3
10.	TY25006	Advanced Instruments for Textile Wet Processing.	3	0	0	3	3
11.	TY25007	Bio processing of Textiles	3	0	0	3	3
12.	TY25008	High Performance Fibres	3	0	0	3	3
13.	TY25009	Eco-Friendly dyes, Chemicals and Processing	3	0	0	3	3
14.	TY25010	Technical Textiles	3	0	0	3	3
15.	TY25011	Advanced Wet Processing Machinery	3	0	0	3	3
16.	TY25012	Design of Textile Experiments	3	0	0	3	3
17.	TY25013	Home Textiles	3	0	0	3	3
18.	TY25014	Total Quality Management	3	0	0	3	3

# **Semester I**

MA25C08	Statistics for Technologists	L	T	P	C
		3	1	0	4
<p><b>Course Objective:</b> To make the students to learn about the</p> <ul style="list-style-type: none"> <li>• Probability distributions, sampling and testing of hypothesis.</li> <li>• Process control using charts and process capability.</li> <li>• Design of experiments for industry applications and</li> <li>• Modeling the probabilistic phenomena.</li> </ul>					
<p><b>Probability Distribution and Estimations:</b> Applications of Binomial, Poisson, normal, t, exponential, chi-square, F and Weibull distributions in engineering; point estimates and interval estimations of the parameters of the distribution functions.</p> <p><b>Activity:</b> Use real or simulated data sets to fit different probability distributions (Binomial, Poisson, Normal, Weibull, etc.) using software or spreadsheets.</p>					
<p><b>Hypothesis Testing:</b> Sampling distribution; significance tests applicable– normal test, t-test, chi-square test and F- test; p-Values; selection of sample size and significance levels with relevance to industry applications; acceptance sampling.</p> <p><b>Activity:</b> Perform hypothesis tests (t-test, Chi-square, F-test) and interpret results.</p>					
<p><b>Analysis of Variance and Non-Parametric Tests:</b> Analysis of variance for different models; non-parametric tests – sign test, rank test, concordance test.</p> <p><b>Activity:</b> Conduct ANOVA and non-parametric tests on sample data.</p>					
<p><b>Process Control and Capability Analysis:</b> Control charts for variables and attributes – basis, development, interpretation, sensitizing rules, average run length; process capability analysis.</p> <p><b>Activity:</b> Create control charts and calculate process capability.</p>					
<p><b>Design and Analysis of Experiments:</b> 2k full-factorial designs; composite designs; robust designs; development of regression models, regression coefficients; adequacy test; process optimizations.</p> <p><b>Activity:</b> Demonstration of Design of experiments software tool.</p>					
<p><b>Weightage:</b> Continuous Assessment: 40%, End Semester Examinations: 60%</p>					
<p><b>Assessment Methodology:</b> Quiz (20%), Assignments (30%), Internal Examinations (50%)</p>					
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1 Chatfield, C. (1983). <i>Statistics for technology: A course in applied statistics</i>. Routledge. <a href="https://doi.org/10.1201/9780203738467">https://doi.org/10.1201/9780203738467</a></li> <li>2 Leaf, G. A. V. (1984). <i>Practical statistics for the textile industry (Parts I &amp; II)</i>. The Textile Institute.</li> <li>3 Moen, R. D., Nolan, T. W., &amp; Provost, L. P. (1998). <i>Quality improvement through planned experimentation</i>. McGraw-Hill.</li> <li>4 Montgomery, D. C. (2000). <i>Design and analysis of experiments</i>. John Wiley &amp; Sons.</li> <li>5 Montgomery, D. C. (2002). <i>Introduction to statistical quality control</i>. John Wiley &amp; Sons</li> </ol>					

	<b>Description of CO</b>	<b>PO</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	Apply probability distributions to analyze and interpret engineering data.	PO1 (3), PO2(2),	2	1
CO2	Perform hypothesis testing, ANOVA, and non-parametric tests for decision-making.	PO1 (3), PO2(2), PO4(2)	3	2
CO3	Construct control charts and assess process capability in quality control.	PO1 (3), PO2(2), PO4(2)	1	2
CO4	Design and analyze experiments for process optimization.	PO1 (3), PO2(2), PO4(2)	1	3

TY25101	Advanced Textile Chemistry (Fibres, Dyes and Auxiliaries)	L	T	P	C
		3	0	0	3
<p><b>Course Objective:</b></p> <ul style="list-style-type: none"> <li>To acquire a detailed knowledge about pre-treatment.</li> <li>To acquire knowledge chemistry of dyeing</li> <li>To educate technically the various methods and process of dyeing, printing and finishing and auxiliaries.</li> </ul>					
<p><b>Grey Preparation:</b> Single stage grey preparation. Degradation of fibres associated with chemical pre-treatment process –degradation of cotton during desizing, scouring, bleaching. Damage of wool, silk, polyester during pre-treatment process. Recent developments in pre-treatments. Auxiliaries associated with De-sizing, scouring, Bleaching of cellulosic fibres, Protein fibres and synthetic fibres.</p> <p><b>Activity:</b> Investigate the effects of chemical pre-treatment on cotton fiber strength by comparing tensile strength before and after desizing, scouring, and bleaching.</p>					
<p><b>Physical Chemistry of Dyeing:</b> Kinetic and Equilibrium of dyeing. Adsorption isotherms- Langmuir, Freundlich and " C" isotherms. Determination of dye affinity. State of dye in solutions. Aggregation number-its determination and effect on dyeing. Use of solubility parameter concept in dyeing.</p> <p><b>Activity:</b> Plot adsorption isotherms (Langmuir and Freundlich) using dye uptake data to analyze dye affinity on a given fabric sample.</p>					
<p><b>Dyeing:</b> Natural dyes &amp; their dyeing. Antimicrobial dyes, Water repellent dyes and other fluorine containing functional dyes. Biodegradable dyes. Florescent dyes and phosphorescent colorants. Super critical fluid and CO2 dyeing, IR dyes, Ultrasonic, magnetic dyeing. Redox and low temperature processes. Microencapsulation technology in dyeing. Auxiliaries associated with Dyeing with Direct Dyes, Reactive, Vat, Sulphur dyes, Acid dyes, Disperse dyes and natural Dyes.</p> <p><b>Activity:</b> Perform a small-scale dyeing experiment using a natural dye and analyze the color fastness and antimicrobial properties of the dyed fabric.</p>					
<p><b>Printing:</b> Pigment printing-optical effect pigment, substrate-based effect. Digital carpet printing. Sublimation. Thermal inkjet printing- Ink systems, Fabric pre-treatments and post treatment, Jet printing machines, Limitations. Transfer printing, Garment printing-chest printing. Evolution of textile printing workflow, new design styles. Steamer. Auxiliaries associated with printing: Direct Style of Printing, Discharge style of Printing, Resist style of printing.</p> <p><b>Activity:</b> Design a simple pattern and simulate digital pigment printing using software or sketching; explore the effects of different printing auxiliaries on fabric appearance.</p>					
<p><b>Finishing:</b> Use of enzymes in textile finishing - Enzymatic processing of natural fibres - Surface modification and functionalization of synthetic fibres. Comfort and health issues related to functional finishes. Super-hydrophobic nano finishes - Photo catalytic self-cleaning nano finishes - Antimicrobial nano finishes. Coating and Lamination methods. Auxiliaries used in Resin Finishing, Stiff finishing, soft finishing, Water repellent, Water Proof, Flame retardant, Soil release.</p> <p><b>Activity:</b> Apply an enzymatic treatment on cotton fabric and assess changes in surface properties like softness and hydrophobicity; compare with untreated fabric.</p>					

<b>Weightage:</b> Continuous Assessment: 40%, End Semester Examinations: 60%
<b>Assessment Methodology:</b> Quiz (20%), Assignments (30%), Internal Examinations (50%)
<b>Reference(s):</b> <ol style="list-style-type: none"> <li>1. M Gulrajani, "Advances in the dyeing and finishing of technical textiles", The Textile Institute, woodhead publishing, 2013</li> <li>2. A.A. Vaidya, "Chemical Processing of Man-made Fibres and Blends", John Wiley and Sons, New York,2004</li> <li>3. Johnson, A. (n.d.). The theory of colouration of textiles. SDC. ISBN: 0901956481</li> <li>4. Chakraborty, J. N. (2009). Fundamentals and practices in colouration of textiles. Woodhead Publishing/The Textile Institute.</li> <li>5. Venkataraman. (2000). Chemistry of synthetic dyes. London: Academic Press.</li> <li>6. Ujji, H. (2006). Digital printing of textiles. Woodhead Publishing/The Textile Institute.</li> <li>7. Shore, J. (1999). Colourants &amp; auxiliaries (Vols. I &amp; II). New York: Wiley and Sons Ltd.</li> </ol>

	<b>Description of CO</b>	<b>PO</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	Analyze the impact of pre-treatment methods on fiber properties and fabric quality.	PO1(3), PO2(2)	3	2
CO2	Apply dyeing principles and evaluate the performance of various dye classes.	PO1 (3), PO2(2), PO4(2)	2	2
CO3	Explain and implement different textile printing techniques and their auxiliaries.	PO1 (3), PO2(2), PO4(2)	2	3
CO4	Utilize advanced finishing technologies to improve textile performance and sustainability.	PO1 (3), PO2(2), PO4(2)	2	1

TY25102	Green Chemistry and Sustainable Processing	L	T	P	C
		3	0	0	3

**Course Objective:**

To make the students aware of principles of green chemistry, Engineering and sustainability.

- To impart knowledge on global environmental issues, need of risk assessment.
- To provide knowledge on pollution prevention and property estimation.
- To learn about evaluation exposure and green chemical synthesis pathways.
- To make the students understand about the methods available for flow sheet analysis and life cycle assessments

**Introduction to Green Chemistry:** Understanding the issues; Green Chemistry, Definition, Principles of Green Chemistry and Examples; Green Chemistry Methodologies; Green Engineering, Definition, Principles of Green Engineering; Initiatives Taken Up by Countries Around the World; The Green Chemistry Expert System case studies; Principles of Sustainability; The Sustainable Process.

**Activity:** Identify and discuss real-life examples of green chemistry principles applied in industry. Create a poster or presentation summarizing key green chemistry practices.

**Environmental Issues and Risk Assessment:** Role of chemical processes and chemical products; An overview of Major Environmental Issues; Global Environmental Issues; Air Quality Issues; Water Quality Issues; Ecology, Natural Resources, Description of Risk; Value of Risk Assessment in the Engineering Profession; Risk-Based Environmental Law; Risk Assessment Concepts; Hazard Assessment, Dose Response, Exposure Assessment, Risk Characterization.

**Activity:** Analyze a case study on air or water pollution. Perform a basic risk assessment outlining hazards, exposure, and risk characterization.

**Pollution Prevention and Property Estimation:** Pollution Prevention Concepts and Terminology; Responsibilities for chemical process safety; Responsibilities for environmental protection, Chemical and Physical Property Estimation; Estimating Environmental Persistence; Estimating Ecosystem Risks; Using Property Estimates to Estimate Environmental Fate and Exposure; Classifying Environmental Risks Based on Chemical Structure.

**Activity:** Estimate environmental persistence and potential risks of a selected chemical using online tools or databases. Suggest greener alternatives.

**Evaluating Exposures:** Occupational Exposures, Recognition, Evaluation and Control; Exposure Assessment for Chemicals in the Ambient Environment; Designing Safer Chemicals; Quantitative / Optimization, Based Frameworks for the Design of Green Chemical Synthesis Pathways; Green Chemistry Pollution Prevention in Material Selection for Unit Operations; Reactors, Separation Devices, Storage Tanks and Fugitive Sources.

**Activity:** Conduct a mock workplace exposure assessment for a chemical used in a lab or industry. Propose control measures based on findings.

**Flow Sheet Analysis and Life Cycle Assessment:** Process Energy Integration; Process Mass Integration; Case Study of a Process Flow sheet; Estimation of Environmental Fates of Emissions and Wastes; Introduction to Product Life Cycle Concepts, Life-Cycle Assessment, Life-Cycle Impact Assessments, Streamlined Life-Cycle Assessments, Uses of Life-Cycle Studies; A Framework for Evaluating Environmental Costs.

**Activity:** Perform a simplified life cycle assessment (LCA) for a common product (e.g., plastic bottle) and discuss environmental impacts at each stage.

**Weightage:** Continuous Assessment: 40%, End Semester Examinations: 60%

**Assessment Methodology:** Quiz (20%), Assignments (30%), Internal Examinations (50%)

**References:**

1. Allen, D. T., & Shonnard, D. R. (2002). Green engineering: Environmentally conscious design of chemical processes. Prentice Hall PTR.
2. Marteel-Parrish, A. E., & Abraham, M. A. (2014). Green chemistry and engineering: A pathway to sustainability. John Wiley & Sons, Inc.
3. Doble, M., & Kruthiventi, A. K. (2007). Green chemistry and engineering. Elsevier.
4. Clarke, J., & Macquarrie, D. (Eds.). (n.d.). Handbook of green chemistry and technology. Blackwell Publishing.
5. Anastas, P. T., & Warner, J. C. (1998). Green chemistry: Theory and practice. Oxford University Press.
6. Matlack, A. S. (2001). Introduction to green chemistry. Marcel Dekker.
7. Bishop, P. L. (2000). Pollution prevention: *Fundamentals and practice*. McGraw-Hill.

	Description of CO	PO	PSO1	PSO2
CO1	Explain key concepts and global initiatives in green chemistry and sustainability.	PO1(3), PO2(2)	2	3
CO2	Analyze environmental issues and perform risk assessments related to chemical processes.	PO1 (3), PO2(2), PO4(2)	3	2
CO3	Apply pollution prevention techniques and estimate environmental fate of chemicals.	PO1 (3), PO2(2), PO4(2)	2	1
CO4	Utilize life cycle assessment and process integration methods to minimize environmental impact.	PO1 (3), PO2(2), PO4(2)	2	2

TY25103	Costing and Process House Management	L	T	P	C
		3	0	0	3

**Course Objective:**

- To practice the fundamental concepts of costing and costing systems followed in textile industry.
- To know about the costing of textile products
- To understand the costing fundamentals and its different methods

**Fundamentals of Costing:** Cost concept; Classification of cost, elements of cost.; Methods of costing; Unit and operating costing, preparation of cost sheet; Estimation of cost of production and component of total cost. Profit planning, job order, batch process, conversion cost. Inventory costing

**Activity:** Calculate the break-even point for a textile product using given fixed and variable costs.

**Cost Accounting:** Cost accounting, compare cost accounting and financial accounting, elements of cost, examples from apparel industry, methods of costing, cost sheet preparation

**Activity:** Prepare a comparison chart highlighting differences between cost accounting and financial accounting with textile industry examples.

**Costing Systems:** Job order costing; contract costing; process costing: joint and by product costing in apparel manufacturing.

**Activity:** Simulate process costing by tracking costs through stages of fabric production and calculating cost per unit.

**CMT Cost:** Costing of garments; factors that determine the price of garments, material cost, cost of yarn, cost of fabric production, cost of fabric processing and design, lot size, cost of components, cutting cost, making and trim cost.

**Activity:** Conduct a mock cost analysis for a batch of garments, including material, labor, and overheads, and prepare a quotation.

**New concepts in costing:** New concepts in costing, Activity based costing, Target costing, Cost restructuring issues and cost reduction measures in the textile industry, Cost audit and control measures in spinning, weaving, processing, knitting, garmenting and made-ups.

**Activity:** Role-play a cost audit meeting where students propose cost restructuring and reduction strategies for a knitting unit.

**Weightage:** Continuous Assessment: 40%, End Semester Examinations: 60%

**Assessment Methodology:** Quiz (20%), Assignments (30%), Internal Examinations (50%)

**Reference(s):**

1. Bhattacharyya, A. K. (2010). *Principles and practice of cost accounting*. PHI.
2. Iyengar, S. P. (2005). *Cost accounting – Principles and practice*. Sultan Chand & Sons.
3. Shinn, W. E. (1995). *Elements of textile costing*. NCSU School of Textiles.
4. Ratnam, T. V. (1992). *Cost control and costing in spinning mills*. SITRA Publications.
5. Varma, H. K. (1992). *Costing in textile industry*. Prentice Hall.
6. Jain, I. C. (2001). *Cost accounting – An introduction*. Prentice Hall.

7. Khan, M. Y., & Jain, P. K. (2003). *Cost accounting*. Tata McGraw-Hill Publishing Co. Ltd.

	<b>Description of CO</b>	<b>PO</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	Calculate and manage costs associated with textile production processes accurately.	PO1(3), PO2(2)	2	3
CO2	Evaluate costing methods and their applications in different segments of the textile industry.	PO1 (3), PO2(2), PO4(2)	1	2
CO3	Develop cost estimation and pricing strategies for garment manufacturing.	PO1 (3), PO2(2), PO4(2)	2	2
CO4	Implement contemporary costing techniques to improve cost efficiency and auditing in textiles.	PO1 (3), PO2(2), PO4(2)	3	2

TY25104	Environmental Social Governance	L	T	P	C
		3	0	0	3
<p><b>Course Objective:</b></p> <ul style="list-style-type: none"> <li>Identify social factors impacting business sustainability.</li> <li>Explore ways to enhance stakeholder well-being.</li> </ul>					
<p><b>ESG Fundamentals &amp; Global Context:</b> Definition, scope, and evolution of ESG; ESG vs. CSR vs. Sustainability; Global drivers, climate change, social justice, corporate transparency; Stakeholders and their expectations; UN Sustainable Development Goals; Emerging ESG trends; Role of ESG in risk management</p> <p><b>Activity: Create an infographic comparing ESG, CSR, and Sustainability, highlighting their evolution and key differences.</b></p>					
<p><b>Environmental Pillar:</b> Climate change and environmental risks; Carbon footprint measurement and reduction strategies; Energy efficiency and renewable adoption; Water stewardship; Waste management and circular economy; Biodiversity conservation; Environmental performance metrics; Global standards, GHG Protocol, CDP; Case studies in environmental best practices.</p> <p><b>Activity:</b> Conduct a case study analysis of a company's water stewardship or waste management program and present findings.</p>					
<p><b>Social Pillar:</b> Labor rights and ethical employment; Diversity, equity, and inclusion (DEI) policies; Community engagement; Occupational health and safety; Human rights in supply chains; Consumer protection and product safety; Social impact measurement tools (SA8000, ISO 26000); Addressing modern slavery</p> <p><b>Activity:</b> Role-play a stakeholder meeting addressing workplace diversity and human rights challenges in a supply chain.</p>					
<p><b>Governance &amp; ESG Reporting:</b> Corporate governance principles; Board roles, diversity, and independence; Ethical business conduct; Risk management integration; Transparency and accountability; ESG reporting frameworks (GRI, SASB, TCFD, ISSB); Materiality assessment; ESG KPI selection; Data assurance and verification</p> <p><b>Activity:</b> Develop a mock materiality matrix for a company, prioritizing ESG issues based on stakeholder input.</p>					
<p><b>ESG Implementation, Finance &amp; Future Trends:</b> Building an ESG strategy and roadmap; Setting and tracking ESG KPIs; ESG-linked finance, green bonds, sustainability-linked loans; ESG ratings and investor expectations; Regulatory frameworks, EU CSRD, SEBI norms, SEC proposals; Sector-specific ESG applications; Digital tools and AI for ESG management; Future trends, climate tech, blockchain, net-zero transitions</p> <p><b>Activity:</b> Simulate an ESG investor pitch, explaining the company's ESG strategy and potential for sustainable financing.</p>					
<p><b>Weightage:</b> Continuous Assessment: 40%, End Semester Examinations: 60%</p>					
<p><b>Assessment Methodology:</b> Quiz (20%), Assignments (30%), Internal Examinations (50%)</p>					

**References:**

1. Krosinsky, C., & Robins, N. (2018). Sustainable investing: Revolutions in theory and practice. Routledge.
2. Krosinsky, C. (2022). Principles for responsible investment: ESG investing. Routledge.
3. Hill, J. (2020). Environmental, social, and governance (ESG) investing: A balanced analysis of the theory and practice of a sustainable portfolio. Academic Press.
4. de Villiers, C., Hsiao, P.-C. K., & Maroun, W. (2020). Sustainability accounting and integrated reporting. Routledge.

	<b>Description of CO</b>	<b>PO</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	Define and differentiate ESG, CSR, and sustainability concepts and their relevance to global challenges.	PO1(3), PO2(2)	3	2
CO2	Analyze environmental and social performance indicators and their application in corporate settings.	PO1 (3), PO2(2), PO4(2)	2	2
CO3	Interpret governance structures and frameworks supporting ethical and transparent business conduct.	PO1 (3), PO2(2), PO4(2)	2	1
CO4	Design ESG implementation plans incorporating finance mechanisms and emerging technologies.	PO1 (3), PO2(2), PO4(2)	1	1

TY25105	Coloration and Finishing Laboratory	L	T	P	C
		0	0	4	2

**Course Objective:**

- To impart practical skills in textile dyeing, printing, and finishing processes.
- To understand the behavior of different textile substrates during coloration and finishing.
- To assess the performance and durability of applied dyes and finishes.
- To ensure students are familiar with industrial practices and eco-friendly methods.
- To practice the students in finishing of textile materials for different requirements and end uses.
- To train the students in pre-treatment, dyeing, printing and testing of textile materials

**List of Experiments:**

1. Dyeing of Cotton fabric/yarn using Direct dyes
2. Dyeing of Cotton fabric/yarn using reactive dye
3. Dyeing of Cotton fabric/yarn using Vat dye
4. Dyeing of silk fabric/yarn using acid dyes.
5. Printing of Cotton fabric using Pigments by direct style using block/Screen
6. Discharge style of Printing on cotton fabric dyed with reactive dyes.
7. Printing of polyester fabric with disperse dyes using direct style using block/screen
8. Resist style of printing on cotton fabric using block/screen
9. Resin finishing.
10. Weight reduction of polyester.
11. Scroopy finish for silk.
12. Water repellent Finishing.
13. Finishing of fabric using softener
14. Antimicrobial finishing
15. Denim finishing techniques

**Weightage:** Continuous Assessment: 60%, End Semester Examinations: 40%

**Assessment Methodology:** Project (30%), Assignment (10%), Practical (30%), Internal Examinations (30%)

	Description of CO	PO	PSO1	PSO2
CO1	Demonstrate dyeing methods for different fibers using various dye classes.	PO1(3), PO2(2)	3	2
CO2	Evaluate fabric printing techniques for cotton, polyester, and silk.	PO1 (3), PO2(2), PO4(2)	2	2
CO3	Analyze fabric finishing processes to improve performance and aesthetics.	PO1 (3), PO2(2),	1	2

TY25106	Product Design and Characterisation of Technical Textiles - I	L	T	P	C
		0	0	4	2

**Course Objective:**

- To develop hands-on skills in the testing, evaluation, and performance characterisation of selected technical textile products, enabling students to apply standard test methods and interpret results for real-world applications.

**List of Experiments:**

**Geotextiles**

- Determination of tensile strength and elongation of geotextiles (ASTM D4595 / ISO 10319).
- Measurement of permeability/permittivity of geotextile samples (ASTM D4491).
- Evaluation of puncture resistance and burst strength (ASTM D6241).

**Medical Textiles (Medtech)**

- Assessment of biocompatibility using simulated cytotoxicity tests (ISO 10993 – lab-scale method).
- Measurement of barrier properties against synthetic blood penetration (ASTM F1670).
- Determination of antimicrobial activity of medical fabrics (AATCC 100 / ISO 20743).

**Protective Clothing (Protech)**

- Measurement of thermal protective performance (TPP test – ASTM F2700).
- Determination of flame resistance (vertical flammability test – ASTM D6413).
- Abrasion resistance testing of protective fabrics (Martindale method – ISO 12947).

**Sports Textiles (Sportech)**

- Moisture management test for sportswear fabrics (AATCC 195).
- Determination of air permeability (ASTM D737 / ISO 9237).
- Stretch and recovery test for compression fabrics (ASTM D2594).

**Filtration Textiles**

- Measurement of filtration efficiency for air filter media (ISO 16890 / EN 1822 – lab simulation).
- Pressure drop measurement in filtration fabrics.
- Particle retention and dust-holding capacity test for filter fabrics.

**Weightage:** Continuous Assessment: 60%, End Semester Examinations: 40%

**Assessment Methodology:** Project (30%), Assignment (10%), Practical (30%), Internal Examinations (30%)

	<b>Description of CO</b>	<b>PO</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	Conduct standardized tests to evaluate mechanical and functional properties of various technical textiles.	PO1(3), PO2(2)	2	3
CO2	Interpret test results to assess textile performance in real-world applications.	PO1 (3), PO2(2), PO4(2)	1	2
CO3	Analyze performance of sports and filtration textiles for moisture management and efficiency.	PO1 (3), PO2(2),	3	2

TY25201	Environmental Audit in Textile Processing Industry	L	T	P	C
		3	0	0	3
<p><b>Course Objective:</b></p> <p>To make the students to learn about the</p> <ul style="list-style-type: none"> <li>• The concepts of environmental management, sustainability and regulatory framework applicable to textile processing industries.</li> <li>• Environmental impacts associated with various textile wet processing operations.</li> <li>• Knowledge on environmental audit principles, procedures and documentation.</li> <li>• Environmental monitoring, assessment techniques and compliance evaluation.</li> <li>• Design and suggest effective pollution control and sustainable solutions for textile processing units.</li> </ul>					
<p><b>Environmental Management in Textiles:</b> Concept of Environment and Sustainability, Environmental challenges in textile industry, Role of environmental management in textile processing, Pollution sources in textile wet processing, Environmental legislation and regulatory framework in India, Environmental policies &amp; compliance in textile sector, Concept of Cleaner Production and Sustainable Development</p>					
<p><b>Activity:</b> prepare a chart showing major environmental problems caused by the textile industry; Prepare a report on Indian environmental laws related to textiles (CPCB, TNPCB, Water Act, Air Act, etc.)</p>					
<p><b>Textile Processing and Environmental Impact:</b> Overview of textile wet processing operations, Water consumption &amp; wastewater generation in each process, Chemical usage and hazardous substances, Air emissions and solid waste generation, Energy consumption patterns in textile processing, Life Cycle Assessment (LCA) of textile products</p> <p><b>Activity:</b> Perform a <b>simple LCA</b> for a cotton fabric from fiber to disposal.</p>					
<p><b>Environmental Audit: Principles &amp; Methodology:</b> Definition and objectives of Environmental Audit, Types of Environmental Audits, Audit principles and standards (ISO 14001 &amp; EMS), Steps in Environmental Audit process, Audit tools and techniques</p> <p><b>Activity:</b> conduct a <b>mock audit</b> of a local dyeing unit / college processing lab.</p>					
<p><b>Environmental Monitoring &amp; Assessment:</b> Environmental monitoring parameters, Water quality - BOD, COD, TDS, pH, color, heavy metals, Air quality - particulates, SO<sub>x</sub>, NO<sub>x</sub>, CO<sub>2</sub>, Noise pollution, Sampling methods and testing procedures, Environmental Impact Assessment (EIA), Risk assessment &amp; hazard analysis, Documentation and reporting systems</p> <p><b>Activity:</b> Analyze industrial effluent samples (real or simulated data) for pH, TDS, BOD / COD</p>					

**Pollution Control & Sustainable Practices:** Wastewater treatment in textile processing, Air pollution control systems, Solid waste, management & recycling, Energy conservation techniques, Green chemistry & eco-friendly dyes and chemicals, Sustainable textile processing technologies, Carbon footprint and water footprint reduction strategies

**Activity:** Propose an **eco-friendly solution** to reduce water/chemical/energy consumption in any one textile process.

**Weightage:** Continuous Assessment: 40%, End Semester Examinations: 60%

**Assessment Methodology:** Quiz (20%), Assignments (30%), Internal Examinations (50%)

**References:**

- 1 S.C. Bhatia & Sarvesh Devraj (2017). Pollution Control in Textile Industry. Woodhead Publishing India
- 2 Subramanian Senthilkannan Muthu (2020). Assessing the Environmental Impact of Textiles and the Clothing Supply Chain. Woodhead Publishing

	<b>Description of CO</b>	<b>PO</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	Explain the importance of environmental management and sustainability in textile processing industries.	PO1 (3), PO2(2),	2	1
CO2	Identify environmental problems and pollution sources in different textile processing operations.	PO1 (3), PO2(2), PO4(2)	3	2
CO3	Apply environmental audit principles and conduct basic environmental audits in textile units.	PO1 (3), PO2(2), PO4(2)	1	2
CO4	Analyze environmental data and evaluate compliance with environmental standards and regulations.	PO1 (3), PO2(2), PO4(2)	1	3
CO5	Design appropriate pollution control strategies and propose sustainable textile processing solutions.	PO1(3) PO2(2) PO(3)	3	3

**Course Objective:**

To make the students to learn about the

- Fundamental concepts and principles of circular economy and sustainable development.
- Circular economy practices with special reference to the textile industry.
- Ecolabelling systems, environmental standards and certification mechanisms.
- Sustainability performance evaluation using life cycle assessment and environmental metrics.
- Sustainable product design and circular business models.

**Circular Economy:** Concept and principles of Circular Economy, Linear economy vs circular economy, Need for circular economy in textile & manufacturing industries, Resource efficiency and sustainable development, Role of circular economy in climate change mitigation, Stakeholders in circular economy ecosystem, Global circular economy frameworks and policies

**Activity:** Identify all stakeholders involved in circular textile economy and explain their roles.

**Circular Economy in Textile Industry:** Circular textile value chain, Sustainable fiber sourcing and material innovation, Textile product life cycle & circular loops, Recycling technologies in textiles - Mechanical recycling, Chemical recycling, Biological recycling. Design for circularity in textiles, Waste management and textile waste valorization

**Activity:** Redesign a common textile product (T-shirt / jeans) using circular design principles.

**Ecolabelling Concepts & Standards:** Definition and objectives of ecolabelling, Types of ecolabels - Type I (ISO 14024), Type II (ISO 14021), Type III (ISO 14025), International ecolabelling standards, Environmental claims and green marketing, Consumer awareness & sustainable purchasing behavior

**Activity:** Collect 5 textile product labels and analyze their environmental claims for authenticity

**Textile Ecolabels & Certification Systems:** Textile ecolabels - OEKO-TEX, GOTS, Bluesign, EU Ecolabel, Global Recycled Standard (GRS), Cradle to Cradle Certification, Certification procedures and compliance requirements, Environmental performance indicators, Role of certification bodies & audits

**Activity:** Draw the step-by-step **certification process** for any one textile ecolabel.

**Assessment Tools & Sustainability Metrics:** Life Cycle Assessment (LCA), Carbon footprint & water footprint analysis, Material flow analysis, Circularity indicators & performance metrics, Environmental Product Declaration (EPD)

**Activity:** Perform a basic **Life Cycle Assessment** of a cotton T-shirt.

**Weightage:** Continuous Assessment: 40%, End Semester Examinations: 60%

**Assessment Methodology:** Quiz (20%), Assignments (30%), Internal Examinations (50%)

**References:**

- 1 S.C. Bhatia & Sarvesh Devraj (2017). Pollution Control in Textile Industry. Woodhead Publishing India
- 2 Subramanian Senthilkannan Muthu (2020). Assessing the Environmental Impact of Textiles and the Clothing Supply Chain. Woodhead Publishing.
- 3

	<b>Description of CO</b>	<b>PO</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	Explain the principles of circular economy and the need for sustainable production systems.	PO1 (3), PO2(2),	2	1
CO2	Apply circular economy concepts to textile product design and manufacturing processes.	PO1 (3), PO2(2), PO4(2)	3	2
CO3	Identify different types of ecolabels and interpret textile certification standards.	PO1 (3), PO2(2), PO4(2)	1	2
CO4	Evaluate the environmental performance of textile products using LCA, carbon and water footprint tools.	PO1 (3), PO2(2), PO4(2)	1	3
CO5	Develop sustainable solutions and propose circular business models for textile industries.			

**Course Objective:**

- To expose students to various categories of technical textiles To understand standard testing methods used for evaluation of functional and performance properties of technical textiles.
- To analyze test results in relation to end-use requirements and applicable standards

**LIST OF EXPERIMENTS****Agricultural Textiles (Agrotech)**

1. Determination of tensile strength and elongation of agrotexiles  
(*ASTM D4595*)
2. Evaluation of air permeability and porosity of shade net fabrics  
(*ASTM D737*)
3. Measurement of water permeability and drainage characteristics of mulch fabrics  
(*ISO 11058*)

**Construction Textiles (Buildtech)**

4. Determination of tensile and tear strength of construction textiles  
(*ASTM D5035 / ASTM D5587*)
5. Evaluation of water resistance of architectural fabrics  
(*AATCC 127 / ISO 811*)
6. Assessment of flame resistance of buildtech materials  
(*ASTM D6413 – demonstration*)

**Automotive & Transport Textiles (Mobiltech)**

7. Abrasion resistance testing of automotive upholstery fabrics  
(*ISO 12947 – Martindale method*)
8. Flammability testing of automotive interior textiles  
(*FMVSS 302 / ISO 3795*)
9. Colour fastness to light of automotive textiles  
(*ISO 105-B02*)

**Packaging Textiles (Packtech)**

10. Determination of tensile and bursting strength of textile packaging materials  
(*ASTM D3786*)
11. Tear resistance of woven packaging fabrics  
(*ISO 13937*)
12. Evaluation of seam strength of textile packaging materials  
(*ASTM D1683*)

**Industrial Textiles (Indutech)**

13. Abrasion resistance of industrial textiles  
(*ISO 12947*)
14. Oil repellency testing of industrial fabrics  
(*AATCC 118*)
15. Dimensional stability testing of industrial textiles  
(*ISO 5077*)

**OUTCOMES:**

Upon completion of this practical course, the students would be able to

CO1: Perform physical, mechanical, and functional tests on different technical textile products.

CO 2: Follow ISO, ASTM, and AATCC protocols for accurate and reproducible test results.

CO 3: Interpret test data to evaluate compliance with specific end-use requirements.

CO 4: Relate fibre/material choice and fabric construction to observed product behaviour.

CO 5: Prepare professional laboratory reports with clear presentation of methods, results, and recommendations

	<b>Description of CO</b>	<b>PO</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	Perform physical, mechanical, and functional tests on different technical textile products.	PO1(3), PO2(2)	2	3
CO2	Follow ISO, ASTM, and AATCC protocols for accurate and reproducible test results.	PO1 (3), PO2(2), PO4(2)	1	2
CO3	Interpret test data to evaluate compliance with specific end-use requirements	PO1 (3), PO2(2),	3	2
CO4	Relate fibre/material choice and fabric construction to observed product behaviour	PO1 (3), PO2(2),	3	2
CO5	Prepare professional laboratory reports with clear presentation of methods, results, and recommendations	PO1 (3), PO2(2), PO4(2)	1	2

**Objectives**

To enable the students to learn the production and applications of coated and laminated textile and their testing.

**Polymers for Coating and Lamination**

Natural latex & synthetic rubbers, synthetic polymers: polyurethanes, poly (vinyl chloride), polyacrylate elastomers, silicone elastomers, poly (Tetrafluoroethylene), polyethylene, chlorinated and chlorosulphonated polyethylenes, foams for laminates; textile substrate for coating

**Coating and Laminating Methods**

Knife coating, roll coating, dip coating, transfer coating, gravure coating, rotary screen printing, calendaring, hot melt coating, foam coating, lamination by adhesives, welding

**Application Of Coated and Laminated Textile I**

Breathable textiles, microporous coatings and films, hydrophilic coatings, smart temperature responsive breathable coatings; synthetic leather, architectural textiles, fluid containers, tarpaulins, automotive applications, carpet backing, flocking, fusible interlinings

**Application Of Coated and Laminated Textile II**

Thermochromic fabrics, temperature adaptable fabrics, fabrics for chemical protection, camouflage nets, high visibility garments, intumescent coating, metal and conducting polymer coated fabrics, coating with hydrogel and shape memory polymers

**Characterization of Coated and Laminated Textiles**

Tensile strength, elongation, adhesion, tear resistance, flexing, ageing, weathering behavior, microbiological degradation, yellowing, testing standards

**OUTCOMES**

Upon completion of this course the student shall know

CO1: Different kinds of polymers used for coating and lamination

CO2: Different methods of coating and lamination

CO3: Application of coated and laminated textiles in automotive and architectural textiles

CO4: Application of coated and laminated textiles in protective textiles

CO5: Characterization of coated textiles

**REFERENCES:**

1. Walter Fung, "Coated and Laminated Textiles", Woodhead Publishing Ltd, UK, 2002, ISBN 978-1-85573-576-7.
2. Carr C M, "Chemistry of the Textile Industry", Blackie Academic & Professional, UK, 1995.
3. Smith W C, "Smart textile Coatings and Laminates", Woodhead Publishing Ltd, UK, 2010, ISBN 978-1-84569-379-4.
4. Brown P J and Stevens K, "Nanofibers and Nanotechnology in Textiles", Woodhead Publishing Ltd, UK, 2007, ISBN 978-1-84569-105-9.
5. Ashish Kumar Sen, "Coated Textiles: Principles and Applications", CRC Press, New York, 2008, ISBN 978-1-42005-345-6.

**Course Articulation Matrix:**

<b>Course Outcomes</b>	<b>Program Outcomes</b>					
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
CO1	3	3	2	3	2	1
CO2	3	3	2	3	2	1
CO3	2	2	2	2	2	2
CO4	2	2	2	2	2	2
CO5	2	3	2	3	2	3
<b>Overall CO</b>	2.4	2.6	2	2.6	2	1.8

1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**Objectives**

To enable the students to learn the concepts of sustainability and its importance in textile industry.

**Introduction to Sustainability**

Sustainability; Concepts and terminologies in sustainable approach; principles of sustainability; importance and application of sustainable approaches in textile industry

**Sustainability in Textile Industry**

Supply chain in textile industry; sustainable cotton, wool, and synthetic fibre production and processing; sustainability in non-production activities

**Sustainability in Processing**

Enzyme biotechnology, plasma technology in textiles; waterless dyeing technologies, low liquor dyeing

**Recycling**

Textile recycling: polymer, fibre, yarn and fabric; consumer perception of recycled textile products

**Eco Designing and Ecolabelling**

Eco-design, building eco-design through supply chain; sustainability for credit rating; environmental management systems; standards for labelling, textile labels and environmental labelling; life cycle analysis of textiles

**Outcomes**

Upon completion of this course the student shall be able to

CO1: Comprehend the concept of sustainability and its importance

CO2: Analyze the scope of sustainability in textile fibre production

CO3: Analyze the scope of sustainability in dyeing of textiles

CO4: Evaluate the importance of recycling in textile industry

CO5: Compare the various eco-labels in industry

**References:**

1. Marim I. Tobler. Rohr., "Handbook of Sustainable Textile Production", Woodhead Publishing Limited, Cambridge, 2011, ISBN 0-85274-426-9.
2. Miraftab M and Horrocks R, "Eco-Textiles", Woodhead Publishing Limited, Cambridge, 2007, ISBN 978-1-42004-444-7.
3. Youjiang Wang, "Recycling in Textiles", Woodhead Publishing Limited, Cambridge, 2006, ISBN 1-85573-952-6.
4. Chavan R B and Radhakrishnan J, "Environmental Issues - Technology Options for Textile Industry", IIT Delhi Publication, 1998.
5. Cavaco-Paulo and Gübitz G M, "Textile Processing with Enzymes", Woodhead Publishing Ltd., UK, 2003, ISBN 978-1-85573-610-8.
6. Manivasakam N, "Treatment of Textile Processing Effluents", Chemical Publishing Company, U.S.A, 2013, ISBN 978-0-82060-175-5.
7. Peter P Rogers., "An Introduction to Sustainable Development", Glen Educational Foundation, Inc, 2008, ISBN 978-1-84407-520-1.
8. Blackburn R S., "Sustainable Textiles", Woodhead Publishing Limited, 2009, ISBN 978-1- 84569-453-1.

**Course Articulation Matrix:**

<b>Course Outcomes</b>	<b>Program Outcomes</b>					
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
CO1	3	2	2	1	3	2
CO2	3	2	2	1	3	2
CO3	3	2	2	1	3	2
CO4	3	2	2	1	3	2
CO5	3	2	2	1	3	2
<b>Overall CO</b>	3	2	2	1	3	2

1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**Objectives**

To enable the students to learn about

- Reinforcements, matrices used for the composites.
- Manufacture and testing of composites and
- Mechanics of failure of composites.

**Reinforcements**

Introduction – composites –classification of reinforcements - matrices; selection of fibre for reinforcement and their properties; preparation of reinforced materials and quality evaluation; composite-design requirements and its application; preforms for various composites

**Matrices**

Properties and applications of matrices - natural, synthetic - thermoplastic and thermoset; mechanism of interaction of matrices and reinforcements; optimization of matrices

**Composite Manufacturing**

Classification; methods of composites manufacturing for both thermoplastics and thermosets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites

**Testing**

Fibre volume and weight fraction, specific gravity of composites, calculations; mechanical behavior of thermoset and thermoplastic composites; non impact testing of composite- ultrasonic C scan, vibrometry, infrared thermography, void analysis, internal damage.

**Mechanics**

Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory and its derivations, failure theories – maximum stress, maximum strain, Tsai-Hill and Hashin-Rotem analysis, prediction and derivations; prediction of inter laminar stresses.

**Outcomes**

Upon completion of this course, the student shall be able to

CO1: Elucidate the different types of textile reinforcements

CO2: Comprehend the different types of matrices

CO3: Describe the manufacturing of composites

CO4: Evaluate the properties of composite

CO5: Interpret the mechanics of composites failure

**References:**

1. BorZ.Jang, "Advanced Polymer composites", ASM International, USA, 1994.
2. Carlsson L.A. and Pipes R.B., "Experimental Characterization of advanced composite Materials", Second Edition, CRC Press, New Jersey, 1996.
3. George Lubin and Stanley T. Peters, "Handbook of Composites", Springer Publications, 1998.
4. Mel. M. Schwartz, "Composite Materials", Vol. 1 &2, Prentice - Hall PTR,

- New Jersey,1997.
5. Richard M.Christensen, "Mechanics of composite materials", Dover Publications,2005.
  6. Sanjay K. Mazumdar, "Composites Manufacturing: Materials, Product, and Process Engineering",CRCPress,2001

**Course Articulation Matrix:**

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	1	2	2
CO2	3	3	2	1	2	2
CO3	3	3	3	2	1	2
CO4	3	3	3	2	2	2
CO5	3	3	3	2	2	2
<b>Overall CO</b>	3	3	2.6	1.6	1.8	2

1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**Course Objectives:**

To enable the students to

- Recall the basics of dyes and their use in textile industry
- Define functional dyes and recognize their use
- Understand the application of functional dyes
- Know the importance of toxicity and health aspects of dyes

**Basics of Dyes:** General survey of dyes; chemical structure of dyes, general properties of dyes, chromophores and dye classes for textile application

**Dyes Used in Textiles:** Dyeing technology; standardization of textile dyes: dyes for cellulosic fibres, polyamides, polyesters and acrylic fibres; optical brightening agents: chemistry and evaluation of OBA

**Functional Dyes:** Functional dyes: dyes for leather; fur; paper; hair; food and inks — introduction, chemical structure and requirements

**Application of Functional Dyes:** Dyes used for imaging, invisible imaging, displays, electronic materials and biomedical applications; solar cells

**Toxicology and Health Aspects:** Toxicity and environmental assessment; regulatory and legislative aspects

**Outcomes**

Upon completion of this course the student shall be able to

- CO1: Comprehend the chemical structure and properties of dyes
- CO2: Recognize about the various dyes used in processing house
- CO3: Compare the role of functional dyes on textile and other substrates
- CO4: Describe the applications of the functional dyes in different industries
- CO5: Examine toxicity and health issues with functional dyes

**References**

1. Choudhury A. K. R., "Modern Concepts of Colour and Appearance", Oxford and IBH Publishing Ltd, 2000.
2. G. Buxbaum (Ed.) Industrial Inorganic Pigments, Second, Completely Revised Edition, 1998 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.
3. Willy Herbst, Klaus Hunger, Industrial Organic Pigments- Production, Properties, Applications Third, Completely Revised Edition (With Contributions by Gerhard Wilker, Heinfred Ohleier and Rainer Winter) 2004 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.
4. Advances in Color Chemistry – Vol I, Peters A. T.
5. Advances in Color Chemistry – Vol II, Peters A. T.
6. Non-Textile Dyes, Freeman H. S.
7. Robert A. Charvat ., "Coloring of Plastics: Fundamentals", John Wiley & Sons, 2005.
8. Mc Laren K., "The Color Science of Dyes & Pigments", Adam Hilger Ltd., 1983, ISBN 0-85274-426-9.
9. Venkataraman K., "The Chemistry of Synthetic Dyes", Elsevier., 2012, ISBN 97801-271-70084

**Course Articulation Matrix:**

<b>Course Outcomes</b>	<b>Program Outcomes</b>					
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
CO1	3	2	2	1	2	2
CO2	3	2	2	1	2	2
CO3	3	2	2	1	2	2
CO4	3	2	2	1	2	2
CO5	3	2	2	1	2	2
<b>Overall CO</b>	3	2	2	1	2	2

1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**Course Objectives:**

To enable the students to know about the

- Textile Costing in manufacturing
- Cost control and reduction

**Fundamentals of Costing**

Cost concept; Classification of cost, elements of cost.; Methods of costing; Unit and operating costing, preparation of cost sheet; Estimation of cost of production and component of total cost. Profit planning, job order, batch process, conversion cost. Inventory costing

**Costing In Spinning Industry**

Elements of cost — Ascertainment of Clean Cotton Cost — Cost Statements Quantity and value of total cotton/ Man-made fiber issued input, wastage and output in each processing cost center up to yarn stage- Net Mixing Cost- Waste multipliers for each cost center mixing wise Cost Centre wise conversion cost, Selling price of various wastes. Power cost estimation, Yarn realization statement, Decision making using Contribution per frame shift among various counts of yarn production.

**Costing In Weaving Industry**

Elements of cost Calculation of Yarn requirements for weaving –computation of value loss and net realization, Cost Statements– Cost centre wise conversion cost from winding to weaving, Sort wise cost of production of Grey Cloth sort wise stock accounting of Grey cloth, Cost of Sizing material, Cost of sales of cloth sold in grey stage and sales realization

**Costing In Knitting and Garment Industry**

Elements of cost –Calculation of garment weight of different sizes, Dia-determination, Setting the knitting program, Dyeing program, Consumption of fabric per garment. Estimating of cost of process loss in Compacting, Bleaching, Raising, Shearing, Printing and Dyeing. Estimating the Knitting rates, Calculation of CMT charges. Cost sheet with Profit margins and foreign quotes.

**Cost Control and Cost Reduction**

Introduction, Process of Cost Control and Cost Reduction, Cost Reduction Programme and its implementation, Methods and Techniques-Value analysis and Value Engineering, Just -In-Time (JIT), Activity Based Costing(ABC).

**Course Outcomes:**

Upon Completion of This Course, the student shall have knowledge on

- CO1: Fundamentals of Costing
- CO2: Costing in spinning industry
- CO3: Costing in Weaving industry
- CO4: Costing in Knitting and Garment Industry
- CO5: Cost control and reduction

**References:**

1. Cost control and costing in spinning mills–SITRA, Edition 1992.
2. Cost control and accounting for Textile industry–TAIRO, Edition 1990.
3. Kalyanaraman.A.R. "Energy Conservation in Textile Industries", SITRA, 1985.
4. V.Dudeja "Textile Industry Management" (ATIRA), 1985.
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7. Varma H K, "Costing in Textile Industry", Dhanpat Rai publications, New Delhi, 1965
8. Shinn William, "Elements of Textile Costing" School of Textiles, North Carolina state, 1965
9. Jain IC, "Cost accounting-An introduction", Prentice hall, New Delhi, 2001
10. Ratnam T V, "Cost control and costing in spinning mills", Seshan printers, Coimbatore, India, 1992
11. Nathalie Evans, "Costing for the Fashion Industry" Bloomsbury Publishing, 2011

**Mapping of CO with PO**

Course outcomes	Statement	Program Outcomes					
		PO1	PO2	PO 3	PO4	PO 5	PO 6
CO1	Fundamentals of Costing	1	1	2	1	3	3
CO2	Costing in spinning industry	1	1	2	1	3	3
CO3	Costing in Weaving industry	2	1	2	1	3	3
CO4	Costing in Knitting and Garment Industry	2	1	2	2	3	3
CO5	Cost control and reduction	2	1	2	2	3	3
<b>Overall CO</b>		1.6	1	2	1.4	3	3

**Objectives:**

To enable the students to learn about

- Functional requirements of protective clothing
- Selection of fibre, yarn and fabric for developing protective clothing
- Evaluation of protective clothing

**Fibre Requirements:** Suitability and properties of high performance fibres for various protective clothing — chemical composition and physical structure

**Yarn And Fabric Requirements:** Types of yarns, woven, knitted and nonwoven fabric structures used for protective garments, methods of production, effect of structure on their performance

**Clothing Construction:** Method of construction of garments according to various protective end uses like protection against cold, ballistic protection; use of different fabric type (knitted, woven, and nonwoven), coated, laminated in different places; use of inter lining and composites; 3D structures; high tech textiles— wearable electronics; protective garments for industrial and apparel end uses

**Finishing Of Protective Clothing:** Types of finishes - fire retardant finishes, water repellent finishes, anti - microbial finishes; chemical finishes against radiation and chemicals; method of application of finishes; protective finishes for health care garments

**Quality Evaluation:** Evaluation of protective fabrics - desirable properties of protective textiles, method of testing for thermal protective performance, abrasion and wear resistance, evaluation of resistance to mildew, ageing, sunlight, chemical, electrostatic and electrical resistivity, impact properties; ASTM standards for protective garments

**Outcomes:**

Upon completion of the course, the students shall have knowledge on

CO1: Properties of fibres required for protective clothing

CO2: Selection of fibre, yarn and fabric for developing protective clothing for different applications

CO3: Protective clothing construction

CO4: Different types of finishes given to develop protective clothing

CO5: Evaluation of protective clothing

**References**

1. Adanur S., "Wellington sears handbook of Industrial textiles" Technomic publishing co. inc., 1995, ISBN : 1 — 56676 — 340 — 1
2. Pushpa Bajaj and Sengupta A.K, "Protective clothing", the Textile Institute, 1992, ISBN 1- 870812 — 44-1
3. Chellamani K.P. and Chattopadhyay D., "Yarns and Technical Textiles", SITRA, 1999.
4. Mukhopadhyay S.K. and Partridge J.F., "Automotive Textiles", Textile Progress, Vol29, No1/2, 1999, ISBN:1870372212
5. Horrocks A.R. and Anand S.C., "Handbook of Technical Textiles", The Textile Institute, anchester, 2000, ISBN: 1855733854.
6. Anand S.C., "Medical Textiles", Textile Institute, Manchester, 2001, ISBN:185573494X.
7. Scott R.A., "Textiles for protection", Woodhead Publishing Ltd., Cambridge, UK, 2005, ISBN 1-85573-921-6.
8. Saville B.P., "Physical testing of textiles", Woodhead Publishing Ltd., Cambridge, UK,

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9. Long A.C., "Design and manufacture of Textile Composites", Woodhead Publishing Ltd., Cambridge, UK, 2005, ISBN 1-85573-744-2.
  10. Fung W, "Coated and laminated textiles", Woodhead Publishing Ltd, Cambridge, UK, 2002, ISBN 1-85573-576-8.
  11. Anand S.C., Kennedy J.F., Mirafatab.M and Rajendran.S., "Medical textiles and biomaterials for health care", Woodhead Publishing Ltd, Cambridge, UK,2006, ISBN 1- 85573-683-7.
  12. Fung W. and Hardcastle, "Textiles in automotive engineering", Woodhead Publishing Ltd, Cambridge, UK, 2001, ISBN 1-85573-493-1.
  13. John N.W.M., "Geo Textile", Blackie and Sons Ltd, London, U.K. , 1987, ISBN 0-412- 01351-7.
  14. Allison Mathews. and Martin Hardingham, "Medical and Hygiene Textile Production — A hand book" Intermediate Technology Publications, 1994.

**Course Articulation Matrix:**

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Properties of fibres required for protective clothing	2	1	2	3	-	1
CO2	Selection of fibre, yarn and fabric for developing protective clothing for different applications	2	1	2	3	-	1
CO3	Protective clothing construction	2	1	2	3	-	1
CO4	Different types of finishes given to develop protective clothing	2	1	2	3	-	1
CO5	Evaluation of protective clothing	2	1	2	3	-	1
<b>Overall CO</b>		2	1	2	3	-	1

**Course Objective:**

- To enable the students to learn about characterization of polymers used in the production of textile fibres

**Molecular Weight:** Polymer solution thermo dynamics; molecular weight and molecular dimensions by end group analysis, osmometry, light scattering, viscometry, gel permeation chromatography, high performance liquid chromatography

**Molecular Structure Characterisation:** Infrared, NMR, UV–visible, Raman spectroscopy, mass spectroscopy

**Thermal Properties:** Thermal properties by differential scanning calorimetry, differential thermal analysis, thermo gravimetry, thermo-mechanical analyzer, dynamic mechanical and dielectric analysis

**Microscopy:** Optical and electron microscopy; TEM, SEM, AFM, X-ray scattering from polymers, birefringence

**Other Properties:** Crystallinity by density measurements, surface area, pore volume measurements by B.E.T. method, porosimetry, surface energy measurements and particle size measurement.

**Course Outcomes:**

Upon completion of this course, the student shall be able to

CO1: Determine the molecular weight using various techniques

CO2: Interpret molecular structure obtained from various analytical instruments

CO3: Determine the thermal properties using various instruments

CO4: Analyze the various microscopic principles

CO5 Know about the properties of textile polymers

**References:**

1. Sperling, "Introduction to Physical Polymer Science," Wiley, 1986.
2. Campell D. and White J.R, "Polymer characterization, Physical Techniques", McGraw – Hill, New York, 1969.
3. Stamm M., "Polymer surfaces and Interfaces", Springer1st ed., 2008.
4. Gupta V.B. and Kothari V.K., "Man Made Fibre production," Chapman and Hall, 1985.
5. Billmayer, "Textbooks of Polymer Science," 3rd ed., Wiley, 1984
6. V R Gowariker., NV Viswanathan., Jayadev Sreedhar., "Polymer science"., New age International Publishers, 2020

**Course Articulation Matrix:**

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Determine weight techniques the using molecular various	3	2	3	3	-	1
CO2	Interpret molecular structure obtained from various analytical instruments	3	2	3	3	-	1
CO3	Determine properties instruments	3	2	3	3	-	1
CO4	Analyze the various microscopic principles	3	2	3	3	-	1
CO5	Know about the properties of textile polymers	3	2	3	3	-	1
<b>Overall CO</b>		3	2	3	3	-	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**Objectives**

To enable the students to know about the

- Various Preparatory processes for manmade textile
- Practical problems and their solutions in wet processing of manmade textiles

**Preparatory Processes:** Various Preparatory processes for manmade textile -Heat setting of synthetic fabrics –effects of heat setting on dyeing. Mass Colouration of Polyester, Nylon, Acrylic and polypropylene, Advantages & Disadvantages of Mass Colouration; Difference between Mass Colouration and Dyeing.

**Dyeing:** Polyester Dyeing: carrier, HTHP and thermosal methods of dyeing. Practical problems and their solutions. Stripping of dyed PET. Dyeing of nylon. Dyeing with acid dyes-High temperature dyeing .Low temperature dyeing of Nylon66– Dyeing with disperses dyes. Barriness of dyeing. Dyeing of Acrylic Fibres: — Dyeing with cationic dyes– stripping of cationic dyes, dyeing with disperse dyes, dyeing of acrylic blends, differentially dye able acrylic fibres.

**Blended Dyeing:** Dyeing of Polyester Blends: Various shop floor practices of dyeing of polyester /cellulosic blended fabrics. Practical problems and their solutions. Various shop floor practices of dyeing of polyester/ wool blended fabrics. Practical problems and their solutions. Dyeing of polyester with cationic dyes. Dyeing of Micro polyester fabric. Dyeing of polyamide cellulosic blends — polyamide/wool blends, polyamide/ polyester blends-Stripping of Nylon dyed material. Practical problems and remedies in Nylon Dyeing. Dyeing of unmodified and modified polypropylene.

**Printing:** Printing of synthetic and blended fabrics with different dye classes - Direct, resist and discharge styles of printing-Transfer printing of polyester and blends.

**Finishing:** Different functional and easy care finishes on synthetics and blends like anti-stat, soil-release, soil-resistant, flame-retardant.

**OUTCOMES**

Upon completion of this course the student shall have knowledge on

CO1: The concept of heat setting and mass colouration of manmade textiles

CO2: The concept of dyeing of polyester and acrylic fabrics.

CO3: The dyeing of the blend fabrics.

CO4: The printing of synthetic fabrics and their blends.

CO5: The different types of finishing of synthetic fabrics.

**References:**

1. Vaidya, A. A., and Datye, K. V., "Chemical processing of Synthetic Fibres and Blends", John Wiley and Sons, New Delhi, 1999
2. Shore, J. "Blend Dyeing", SDC, London, 1998
3. Mittal, R. M. & Trivedi, S. S., Chemical Processing of polyester and blends – ATIRA, 1998
4. C. Duckworth, Engineering in Textile colouration, Dyers company publications trust, U.K. 1983.
5. Burkinshaw, S. M., Chemical principles of synthetic fibre dyeing, Blackie, 1995.
6. Gulrajani, M. L., "Polyester Dyeing", IIT, New Delhi, 1995.

**Mapping of CO with PO**

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	The concept of heat setting and mass colouration of manmade textiles	1	-	2	2	1	1
CO2	The concept of dyeing of polyester and acrylic fabrics.	1	-	2	2	1	1
CO3	The dyeing of the blend fabrics.	1	-	2	2	1	1
CO4	The printing of synthetic fabrics and their blends.	1	-	2	2	1	1
CO5	The different types of finishing of synthetic fabrics.	1	-	2	2	1	1
<b>Overall CO</b>		1	-	2	2	1	1

**Objectives**

- To enable the students to know about the methods of producing nonwoven fabrics
- To enable the students to know about the structure & application of non woven fabrics in industrial purposes

**Web Forming and Bonding:** Classifications of Non-woven fabrics - Raw materials. Principles of web forming — Role of cross lapper. Web bonding techniques - chemical, mechanical, thermal, air-bonding, spun bonding, needle punching, hydro entanglement processes.

**Structure and Evaluation:** Structure of Non-woven fabrics - Macro structure, Structural elements - their arrangement, bonding and binding. Homogeneity of nonwoven. Evaluation of Non-woven fabrics. End uses and Techno-economics. Felts and in the process of Felting — technical considerations of felting. Decorative techniques in non-woven production.

**Fabric Production:** Classification and Definition - Preparatory processes. Fabric Production — Conventional shuttle looms, Endless Tape Looms, Circular Hose Pipe looms. Shuttleless Looms — Catch thread and flat knitting edge looms; Multicolor Needle Jacquard looms.

**Unconventional Fabrics:** Production of Industrial Tapes, Elastic Tapes, Zip fastener tapes; Woven and printed labels. Stretch fabrics - classification and its production; Elastomeric stretch fabrics; Braided fabrics; -Tubular structures - Braiding Machine; Nets and Laces - Types and description of Lace Machines - Knitting of laces - Tricot Lace Machines. Flocked fabrics –The process of flocking.

**Carpets:** Carpets-Non-pile carpet weaves and their looms. Tufted carpets and their production–Pile surfaced carpet weaves and their looms. Needle felt floor coverings.

**Outcomes:**

Upon completion of this course the student shall have knowledge on

CO1: The different types of web forming and bonding techniques of non woven

CO2: The structure and end uses of non woven fabrics.

CO3: The different types of associated with specialty textiles

CO4: The production and end uses of industrial tapes and laces.

CO5: The production of carpets and end uses.

**References**

1. Gulrajani.M.L., "Nonwovens", The Textile Association (India) publication 1996.
2. Birrell.V., The Textile Arts, Harper & Brothers Publications, New York, 1999.
3. Denise Musk, Machine Knitting, B.T. Batsford Ltd, London, 1999
4. Wilhelm Albrecht et al., "Nonwoven fabrics", WILEY VCH Verlag GmbH & Company, Germany, 2003.
5. Russel.S., "Handbook of Nonwovens", The Textile Institute Publication, 2007.
6. Irsak.C., "Nonwoven Textiles" Textile Institute, Manchester, 1999
7. Krcma.R., Manual of Non-wovens, Textile Trade Press, Manchester 1993.

### Mapping of CO with PO

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	The different types of web forming and bonding techniques of non woven	1	-	2	2	1	-
CO2	The structure and end uses of non woven fabrics.	1	-	2	2	1	-
CO3	The different types of associated with specialty textiles	1	-	2	2	1	-
CO4	The production and end uses of industrial tapes and laces.	1	-	2	2	1	-
CO5	The production of carpets and end uses.	1	-	2	2	-	-
<b>Overall CO</b>		1	-	2	2	1	-

**Objectives:**

- To enable the students to analyse the textiles and chemicals through various analytical instruments
- To enable the students to interpret the results from analytical instruments

UV– VIS spectroscopy- Theory, Franck- Condon principle, Electronic transitions, Deviations from Beer's law– Instrumentation (block diagram only)- Applications. Infra red spectroscopy– Theory, Fundamental vibrations, Hook's law– Instrumentation (block diagram only)- Finger print region – Vibrations involved in H<sub>2</sub>O and CO<sub>2</sub> -Applications.

NMR spectroscopy– Theory, Relaxation Process – Instrumentation (block diagram only) – Chemical shift – Internal standard – TMS – Shielding and De- Shielding Effects – Factors influencing Chemical shift - Applications. Mass spectroscopy: Theory, Instrumentation (block diagram only) – Ionization Techniques – Electron impact ionization, Chemical ionization and Desorption techniques. Nitrogen rule, Mc Lafferty re arrangement.

Potentiometric measurements – Ion selective electrodes– Glass electrode – Determination of pH– Buffers– Types of potentiometric titrations– Applications of Potentiometric measurements. Thermal Methods: Thermo gravimetry– Factors affecting thermo gravimetric curves– Instrumental and sample characteristics– Instrumentation (block diagram only)– Applications. Differential Thermal Analysis– Introduction– Factors affecting DTA curves– Environmental, Instrumental and Sample factors– Instrumentation (block diagram only)– Applications.

Chromatographic Techniques – Introduction – classification – Theory, Instrumentation and Applications of Paper Chromatography, Thin Layer Chromatography, Column Chromatography, High Performance Liquid Chromatography and Gas – Liquid Chromatography.

Errors, Precision and Accuracy: Definitions, Significant figures – Types of Errors – Methods of expressing accuracy and precision, Confidence limits.

**Outcomes:**

Upon completion of the course, the students shall have knowledge on

- The concepts of spectroscopy
- The spectroscopy instruments used in textile industry.
- Analysis of the textile samples using spectroscopy.
- The concepts and types of chromatography.
- Interpretation of the results from analytical instruments

**References:**

1. Rouessac,F., "Chemical analysis – modern international method and techniques", Wiley, New Delhi,1999.
2. Day, R.A., and Unerwood, A.L., "Qualitative inorganic analysis, 5<sup>th</sup> edition", Prentice-Hall of India, New Delhi,2004
3. Bona,M., "Modern control Techniques in textile finishing and making up", Eurotex, Blachwells Bookshop, London,2001
4. Banwell,G.C., "Fundamentals of molecular spectroscopy", TMH,2003.

### Mapping of CO with PO

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	The concepts of spectroscopy	1	-	3	2	1	1
CO2	The spectroscopy instruments used in textile industry.	2	1	3	2	1	1
CO3	Analysis of the textile samples using spectroscopy.	2	1	2	3	1	1
CO4	The concepts and types of chromatography.	-	-	2	3	1	-
CO5	Interpretation of the results from analytical instruments	1	1	2	2	-	2
<b>Overall CO</b>		1.5	1	2.2	2.2	1	1.5

**Objectives**

To enable the students to know about the

- Pollution and its control in textile processing industries
- Application of bio technology in textile wet processing

**Industrial Bio-Technology:** Industrial microbial products—applications, primary metabolites and secondary metabolites, Enzymes & Proteins— sources and applications, cell and enzyme immobilization, Industrial plant products— production of enzymes and poly sacchrides.

**Environmental Bio-Technology:** Detailed study about pollution and its control in textile processing industries. Waste water treatment systems— Anaerobic & Aerobic systems, Bio-degradation— Micro organism in pollution control; Biomass production; waste as renewable sources of energy— Production of biogas production of hydrocarbon— Hydrogen fuel.

**Enzymes Used In Textile Industry:** Enzymes for desizing, scouring & bleaching Enzyme activity — initiation, propagation and termination reactions — reaction conditions — properties of substrates and results of enzyme treatment. Enzyme activity of amylo glucosidase, pectinase, glucose oxidase, peroxidases and other enzymes used for bleaching decolourisation of textiles using laccases. Bio- Polishing enzymes such as cellulases. Bio- washing enzymes using cellulase proteases for scouring of animal fibres, degumming of silk and modification of wool properties.

**Evaluation Of Enzyme Treated Fabrics:** Weight loss, Whiteness index, Absorbency, Tensile strength, Handle of fabric and Abrasion resistance. SEM analysis and other structure related studies.

**Bio-Processing In Textiles:** Bio-bleaching, combined bio - processing, bio washing, bio polishing, Denim fading, anti-odour and antimicrobial finishes, biofinishing and other applications.

**Outcomes:**

Upon completion of this course the student shall have knowledge on

- The origin and concept about enzymes.
- Waste water treatments associated with enzyme in textile wet processing industry.
- The contribution of enzyme in pretreatment processes.
- Analysis of fabric properties of enzyme treated fabrics.
- The bio processing in textile industry.

**References:**

1. Betrabet S. M. BTRA Seminar, Book of papers (Jan 1994)
2. Tyndall R. M and Raligh N.C. AATCC Book of papers (1991)
3. Asfert L.O and Videback. T Intl Textile Bulletin—Dyeing/Printing/Finishing (1990)
4. Cavaco-Paulo, Gubitz, Textile Processing With Enzymes, WoodHead Publishing Ltd, UK, 2003.
5. Ignacimuthu. S & Tata Mc Graw S.J, "Basic Bio-Technology", -Hill Publications, 1995

### Mapping of CO with PO

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	The origin and concept about enzymes.	2	-	2	3	1	1
CO2	Waste water treatments associated with enzyme in textile wet processing industry.	2	-	2	3	1	1
CO3	The contribution of enzyme in pretreatment processes.	2	-	2	2	2	1
CO4	Analysis of fabric properties of enzyme treated fabrics.	2	-	2	1	1	1
CO5	The bio processing in textile industry.	2	-	2	3	1	1
<b>Overall CO</b>		2	-	2	2.2	1.5	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**Objectives:**

To enable the students to learn about

- Advanced spinning technology for manufacturing high performance fibres, their properties and applications

**Methods of Production:** Fundamentals of high performance fibres; comparison of regular and high performance fibres; fibre forming process; manufacturing, properties and applications-aramid fibres, high performance polyethylene

**Industrial Application Fibres:** Manufacturing, properties and applications-glass fibres, basalt fibres; carbon fibres, ceramic fibres

**Biodegradable Fibres, Protein Fibres:** Manufacturing, properties and applications-alginate fibres; chitosan fibres; regenerated protein fibres–silk, wool, casein, soy bean fibre; synthetic biodegradable fibres

**Chemical Resistant Fibres:** Manufacturing, properties and applications of chemical resistance fibres–chlorinated fibres, fluorinated fibres, PPS, PEEK and PEI; thermal resistant fibres–semi carbon fibres, PBI, PBO

**Specialty Fibres:** Manufacturing, properties and applications-hollow fibres, profile fibres blended and bi-component fibres, film fibres; functionalization of fibres–methods and applications

**OUTCOMES**

Upon completion of this course, the student shall have knowledge on

- The method of producing high performance fibres
- The industrial applications of High performance fibres
- Selection of high performance fibres for medical applications
- The properties of speciality fibres for specific applications
- The end uses of high performance fibres.

**References**

1. Hearle J. W. S., "High Performance Fibres", Woodhead Publishing Ltd., Cambridge, England, 2001.
2. Hongu T. and Phillips G.O., "New Fibres", Woodhead Publishing Ltd., England, 1997.
3. Kothari V. K., "Textile Fibres: Development and Innovations", Vol. 2, Progress in Textiles, IAFL Publications, 2000.
4. Peebles L.H., "Carbon Fibres", CRC Press, London, 1995

### Mapping of CO with PO

Course Outcomes	Statement	Program Outcome					
		PO1	PO 2	PO 3	PO4	PO5	PO6
CO1	The method of producing high performance fibres	-	-	2	2	1	-
CO2	The industrial applications of High performance fibres	-	-	2	1	1	-
CO3	Selection of high performance fibres for medical applications	2	1	2	1	1	-
CO4	The properties of speciality fibres for specific applications	-	-	2	2	1	-
CO5	The end uses of high performance fibres.	-	-	2	2	1	-
<b>Overall CO</b>		2	1	2	1.6	1	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**Objectives:**

- To impart knowledge about the environmental and ecological aspects of various chemicals, dyes and auxiliaries used in processing.
- To make the students aware of the alternative chemicals and dyes that can replace the harmful chemicals.
- To update the students on the various rules, regulation that governs the textile processing industry.

**Impact of Textile Process Chemicals On Ecology:** Pollution - definition - Types - Impact of pollution on environment- Pollution capability of chemicals and products used in processing - pollution load at every stages of processing — Pollution associated with various colouration process - Need for eco-friendly processing- Important issues in exports- Red listed chemicals - Possible sources of contamination of various red listed chemicals- German Laws — Ban on amines and Azo dyes-List of banned amines and chemicals.

**Eco Standards:** Need for Eco - standards. Eco standards — European & USA. Permissible limits (norms) of chemicals, pH, colour fastness and heavy metals by different eco-standards such as MST, OEKOTEX, CLEANFASHION, STEILMANN & - Eco-labeling and labels - Eco- auditing - Eco- management - ISO 14000 — SA 8000 - Natural Textiles — Organic Cotton — GOTS & organic exchange certification –APEO , NPEO & OPEO Limitations

**Eco Testing:** Toxic substances used in processing and safe alternatives- Principles and procedures involved in the estimation of pH, pesticides, Residual formaldehyde, carcinogenic dyes, chlorinated phenols, phthalates, organo tin and heavy metals, — Consequences of presence of above compounds in Textiles — permissible limits — eco testing of antimicrobial finish with triclosan.

**Eco Friendly Processing:** Eco-friendly dyeing of sulphur dyes- Eco-friendly per-acetic acid bleaching - Eco friendly pigment printing & discharge Printing. Organic stabilizer– Application of Diazo sensitizer in screen preparation– Application of Eco-friendly preservatives– Non PVC, Non Phthalate, Plastizol inks, Formaldehyde free dye fixing agents. Enzymes and their role. Application of Enzymes in Desizing, Scouring & Peroxide killing on cotton material, Degumming of silk - Application of Enzymes in finishing — eco friendly crease recovery finish, stone wash effect by Bio-polishing

**Clean Technologies For Future:** Clean technology — Sustainable development — Ozone bleaching, RF drying, Microwave assisted dyeing, Ultrasonic assisted processing, Supercritical CO<sub>2</sub> dyeing, importance of energy & water conservation — Energy audit - Basics & application scope of Nano technology in textiles - Occupational diseases & safety measures in Textile units.

**Outcome:**

Upon completion of this course the student shall have knowledge on

- The ecology associated with textile processing.
- The eco standards.
- The eco testing relevant to textile materials.
- The eco friendly textile wet processing.
- The auditing and safety measures related to effluents in textile industry.

**References:**

1. Chavan R.B., Radhakrishnan J., Environmental Issues - Technology Options for Textile Industry, IIT Delhi Publication,1998
2. Reife A and Freeman H.S., Environmental Chemistry of dyes and pigments, Wiley,2001,ISBN:0471589276
3. Asokan R.,Eco-Friendly Textile Wet Processing, NCUTE Publications, NewDelhi,2001
4. Eco friendly Textiles: Challenges to the Textile Industry, Textiles Committee, Mumbai,1996.

**Mapping of CO with PO**

Course Outcomes	Statement	Program Outcome					
		PO1	PO 2	PO3	PO4	PO5	PO6
CO1	The ecology associated with textile processing.	2	1	2	2	1	1
CO2	The eco standards.	2	1	2	2	1	-
CO3	The eco testing relevant to textile materials.	2	1	1	2	1	-
CO4	The eco friendly textile wet processing.	2	1	2	3	1	1
CO5	The auditing and safety measures related to effluents in textile industry.	2	1	2	3	1	1
<b>Overall CO</b>		2	1	1.8	2.4	1	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**Objectives:**

- To enable the students to know about the concept, application & evaluation of technical textiles in various fields.
- To enable the students to know about finishing processes for technical textiles

**Industrial Textiles:** Design and characteristics required in textiles for transport applications; applications of textile reinforced composites in transport sector; quality requirement of yarns used in fishing industry like nets, ropes; conveyor belts, power transmission belts.

**Medical and Hygiene Textiles:** Design and characteristics required in textiles for medical and hygiene applications; antimicrobial, disposable and reusable products; textiles in sportswear

**Protective Textiles:** Garment design and choice of materials in protection from hazards due to mechanical, extreme climate, nuclear, biological, chemical and flame

**Geo Textiles:** Use of geo textiles infiltration, drainage, separation and reinforcement application in construction; type of fibre and fabric to be used in such applications; Evaluation of geo textiles; use of textile materials in permanent and temporary civil construction - tents, awnings,

**Filtration And Insulation Materials:** Sound and thermal insulation materials; Filtration basics, Filters deployed for air and water pollutants and evaluation of filtration efficiency.

**Outcomes:**

Upon completion of this course the student shall have knowledge on

- The Concept, application and evaluation of filtration and geo textiles
- The Fabric requirements for protective textiles
- The Applications of textile in transportation
- The Requirements, properties and application of textiles in medical field
- The Finishing processes for technical textiles and properties of agro textiles

**References:**

1. Horrocks A.R. and Anand S.C.,—Handbook of Technical Textiles II, The Textile Institute, Manchester, 2000, ISBN:1855733854.
2. Anand S.C.,—Medical Textiles II, Textile Institute, Manchester, 2001, ISBN:185573494X.
3. Adanur S.,—Wellington search and book of Industrial textiles II Technomic publishing co. inc., 1995, ISBN : 1 — 56676 — 340 — 1.
4. Pushpa Bajaj and Sengupta A.K.,— Protective clothing II, the Textile Institute, 1992, ISBN 1-870812 —44-1.
5. Scott R.A., —Textiles for protection II, Wood head Publishing Ltd, Cambridge, UK, 2005, ISBN1-85573-921-6.
6. Fung W, —Coated and laminated textiles II, Wood head Publishing Ltd, Cambridge, UK. 2002, ISBN1-85573-576-8.
7. Anand S.C, Kennedy J.F., Mirafab M. and Rajendran S., —Medical textiles and biomaterials for health care, Wood head Publishing Ltd, Cambridge, UK. 2006, ISBN 1-85573-683-7.

8. Fung W. and Hard castle, —Textiles in automotive engineering II, Wood head Publishing Ltd,Cambridge, U K, 2001, ISBN1-85573-493-1.John N.W.M., —Geo Textile II , Blackie and Sons Ltd, London, U.K.1987, ISBN 0-412- 01351-7
9. Allison Mathews and Martin Hardingham, — Medical and Hygiene Textile Production—A hand book II, Intermediate Technology Publications,1994.
10. David Arvil, —An Innovative Approach to Spun bond Agricultural Crop Cover II,Journal of Industrial Textiles, Vol.30, No.4, April (2001)311-319.
11. Jurg Rupp, —Creating a garden with needle — punched fabrics II, Nonwovens and Industrial Textiles, 2 (2002)49-50.

#### Mapping of CO with PO

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	The Concept, application and evaluation of filtration and geo textiles	1	-	2	3	1	1
CO2	The Fabric requirements for protective textiles	1	-	2	3	1	1
CO3	The Applications of textile in transportation	1	-	2	3	1	1
CO4	The Requirements, properties and application of textiles in medical field	1	-	2	3	1	1
CO5	The Finishing processes for technical textiles and properties of agro textiles	1	-	2	3	2	1
<b>Overall CO</b>		1	-	2	3	1.2	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**OBJECTIVES:**

- To enable the students to learn about the working principles of wet processing machineries.
- To enable the students to know about the operations of machines and its maintenance schedules
- To expose the students to latest wet processing machineries

**Yarn Dyeing Machines:** Advances in continuous processing of cotton and wool materials- - Advances in heating systems hank and yarn dyeing machines(cheese and warp) - importance of winding in yarn dyeing — calculation of winding density - detailed maintenance schedule for cheese dyeing machines.

**Fabric Dyeing Machines:** Advances in Beam dyeing- Advances in soft flow, overflow, jet dyeing machines— Developments in jiggers,— Detail maintenance schedule for beam dyeing, jet dyeing and jiggers.

**Drying Machines:** Detail study and developments in vertical drying ranges - RF dryer, yarn dryer, tubular & open width knitted fabric dryer, Tumble dryer, devellat bed screen printing machines. Principle and working of fully automatic flat bed screen printing Equipments in balloon padding, hydro extractor, rope opener, maintenance schedule for the above machines. Heating systems for hot air stenters, Clip & pin type of stenters; Jig stenters — over feeding system and its importance - Hot flue dryer—float dryer— maintenance schedule for the above machines.

**Printing Machines:** Developments in preparation of screens for roller, rotary, machine—with programmer line diagram and its advantages- developments in agers- Developments in garment printing machines - various practical problems & possible remedies, Transfer printing machines and dyeing.

**Finishing Machines:** Developments in finishing machineries — Calenders, sanforising machine, Back-filling machine, maintenance schedule for the above machineries. Shop floor problems & possible remedies in finishing department, Sandblasting machine, Peach finishing, Raising, Shearing machines.

**Outcomes:**

Upon completion of this course, the student shall have knowledge on

- The latest developments in fibre and yarn dyeing machines.
- The advancements in fabric dyeing machines.
- The developments in drying machineries.
- The latest developments in printing machines.
- The advancements in finishing machines.

**References:**

1. Datye.K.V.and Vaidya.A.A., Chemical Processing of Synthetic fibres and blends, JohnWiley & Sons, NewYork.1995
2. R.S.Bhagwat, "Development in Textile Processing Machines" Colour Publications pvt. Ltd, 2000.

### Mapping of CO with PO

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	The latest developments in fibre and yarn dyeing machines.	1	-	2	3	1	2
CO2	The advancements in fabric dyeing machines.	1	-	2	3	1	2
CO3	The developments in drying machineries.	1	-	2	3	1	2
CO4	The latest developments in printing machines.	1	-	2	3	1	2
CO5	The advancements in finishing machines.	1	-	2	3	1	2
<b>Overall CO</b>		1	-	2	3	1	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**Objectives:**

To make the students to learn about the

- Fundamentals of experimental design and
- Selection of suitable design and analysis of the results.

**Experimental Design Fundamentals:** Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression model.

**Single Factor Experiments:** Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests, in respect of textile process, machine and quality parameters

**Multifactor Experiments:** Two and three factor full factorial experiments,  $2^K$  factorial Experiments, Confounding and Blocking designs; application in textile experiments.

**Special Experimental Designs:** Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methodology, Experiments with random factors, rules for expected mean squares, approximate F- tests for textile applications.

**Taguch Imethods:** Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, case studies related to textile engineering.

**Outcomes:**

Upon completion of this course, the student shall have knowledge on

- The fundamentals of experimental design
- Statistical analysis and the single factor experiments
- Experimental design, statistical tests and analysis of the results to arrive at the conclusion
- The response surface methodology and other experimental design
- Analysis of the design parameters and case studies related to textile engineering

**References:**

1. Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons,2003.
2. Nicolo Belavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.
3. Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill,1996.
4. Leaf G.A.V., —Practical Statistics for the Textile Industry, Part I and III, The Textile Institute, Manchester, 1984,ISBN:0900739517.

### Mapping of CO with PO

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	The fundamentals of experimental design	2	2	2	3	1	1
CO2	Statistical analysis and the single factor experiments	2	2	2	2	1	-
CO3	Experimental design, statistical tests and analysis of the results to arrive at the conclusion	2	3	2	2	1	-
CO4	The response surface methodology and other experimental design	2	2	2	3	3	1
CO5	Analysis of the design parameters and case studies related to textile engineering	2	2	2	2	1	-
<b>Overall CO</b>		2	2.2	2	2.4	1.4	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**OBJECTIVES:**

To enable the students to learn about the

- Recent developments in furnishing, floor covering and other home textile products
- Various kinds of materials used in home textile.

**Home Furnishing:** Development in Textile Furnishing–Type of Furnishing Materials–Woven and Non woven Selection of facilities– Colours– Design – Textile wall hanging – Cession Cushion covers– Kitchen Textile – Apron-Dish cloth– Bread Bag– Pot Holders– Table mats– Upholstery application : Fixed upholstery –Non-stretch loose covers–Stretch covers.

**Floor Coverings:** Recent development– Hand floor covering, Resilient Floor Soft floor Rugs-Cushion and pads. Care — Tufted - Needle felt backing woven.. Woven carpet manufacture — wilton weaving, Shedding mechanism-Aximinister. Tuftedcarpet Manufacture roadloommachinery, Handtufting, Thermo-bonded products Unconventional methods for making carpets — Bonding knitted carpet, Stitch bonding flocking.

**Curtain Sand Draperies:** Advances in Home decoration– Draperies– Choice of Fabrics– Curtains– Developments in Finishing of Draperies– Developments in tucks and pleats- uses of Drapery Rods, Hooks, Tape Rings and pins. Table Textiles– Table cloths– colour– Woven Printed, Jacquard , embroidered types, non-woven types.Table mats– Colour–Woven-Printed jacquard, Embroidered.

**Bedliners:** Advances in the production –Different types: – Sheets – Blankets – Blanket Covers – Comforts – Comfort Covers – Bed Spreads – Mattress and Mattress Covers – Pads – Pillows. General: Hand/machine embroidered scarves- Stoles –Shawls–Made ups used in hospitals, Textiles care labeling Design aids.

**Towels:** Types– Bathrobes– BeadTowel– KitchenTerry– Napkins.Construction:weave– Pileheight Pattern Dyeing and Finishing.Window Textile Sun Filters –Reflective textile. Velour Type of Velvet– Jacquard– Doddery– Plain Pointed Manufacturing Methods– Construction.

**Outcomes:**

Upon completion of this course, the student shall have knowledge on

- Different types of home furnishings.
- Different types of floor coverings.
- Different types of curtains.
- Different types of bed liners.
- The production and types of towels.

**Reference:**

1. Wingatel.B.,&MohlerJ.E.,Textile Fabrics & Their Selection, Prentice HallInc, NewYork,1984.
2. Donserkery K.G. ,Interior Decoration in India, D.B.Taraporval Sons and Co. Pvt Ltd.,1973
3. Alexander N.G. Designing Interior Environment, Mass Court Brace Covanorich, Newyork,1972.

### Mapping of CO with PO

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Different types of home furnishings.	-	-	2	3	1	1
CO2	Different types of floor coverings.	-	-	2	3	2	-
CO3	Different types of curtains.	-	-	2	3	1	-
CO4	Different types of bed liners.	-	-	2	3	2	-
CO5	The production and types of towels.	-	-	2	2	1	1
<b>Overall CO</b>		-	-	2	2.8	1.4	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**Objective:**

- To facilitate the understanding of Quality Management principles and process.

**Introduction:** Introduction - Need for quality -Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby- Barriersto TQM- Customer focus- Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

**TQM Principles:** Leadership-QualityStatements,Strategicqualityplanning,QualityCouncils Employee involvement Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal -Continuous process improvement - PDCA cycle, 5S, Kaizen – Supplier partnership- Partnering, Supplier selection, Supplier Rating.

**TQM Tool Sand Techniques I:** These ventraditional tools of quality-New management tools-Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking –Reason to benchmark, Benchmarking process -FMEA- Stages, Types.

**TQM Tools And Techniques II:** Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function-TPM-Concepts, improvement needs – Performance measures.

**Quality Management System:** Introduction— Benefits of ISO Registration— ISO 9000 Series of Standards— Sector-Specific Standards— AS 9100, TS16949 and TL 9000- ISO 9001 Requirements—Implementation— Documentation— Internal Audits— Registration- environmental management SYSTEM: Introduction— ISO 14000 Series Standards— Concepts of ISO 14001—Requirements of ISO14001— Benefits of EMS.

**Outcomes:**

Upon completion of this course the student shall have knowledge on

- The concept and importance of total quality management.
- The principles of total quality management.
- The tools and techniques in total quality management.
- The quality circle and cost of quality.
- The quality management system.

**References:**

1. DaleH. Bester filed, Carol B. Michna, Glen H. Bester field, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, SixthImpression, 2013.
2. James R .E vans and William M. Lindsay, "The Management and Control of Quality",8<sup>th</sup> Edition, First Indian Edition, Cengage Learning,2012.
3. Janakiraman. B and Gopal. R.K., "Total Quality Management-Text and Cases", Prentice Hall (India)Pvt.Ltd.,2006.
4. Suganthi. Land Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt.

## Mapping of CO with PO

Course Outcomes	Statement	Program Outcome					
		PO1	PO 2	PO 3	PO 4	PO5	PO6
CO1	The concept and importance of total quality management.	1	-	2	2	1	-
CO2	The principles of total quality management.	1	-	2	2	1	-
CO3	The tools and techniques in total quality management.	1	-	2	2	1	2
CO4	The quality circle and cost of quality.	1	-	2	2	1	-
CO5	The quality management system.	1	-	2	2	1	-
<b>Overall CO</b>		1	-	2	2	1	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively