# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Master of Engineering**

**Level: PG**

**Branch: Textile Engineering**

**Subject Code : ME02025081**

**Subject Name : Sustainable Chemical Processing of Textiles**

| | |
|---|---|
| w. e. f. Academic Year: | 2024-25 |
| Semester: | 2 |
| Category of the Course: | Professional Elective Course |

| | |
|---|---|
| **Prerequisite:** | Basics of textile chemical processing of undergraduate. |
| **Rationale:** | Subject will cover various Sustainable practices used in the field of textile chemical processing's. |

**Course Outcome:**

After Completion of the Course, Student will able to:

| No | Course Outcomes | RBT Level |
|---|---|---|
| 1. | Understand the principles and importance of sustainability in textile processing. | R,U |
| 2. | Analyze the environmental impact of various textile processing techniques. | U,A,E |
| 3. | Evaluate sustainable raw materials and eco-friendly processing methods. | U,A,E |
| 4. | Apply green chemistry principles in textile processing. | U,A,E,C |
| 5. | Implement waste management and recycling strategies in textile production. | U,A,E,C |

**Revised Bloom's Taxonomy (RBT)*

**Teaching and Examination Scheme:**

| Teaching Scheme (in Hours) | | | Total Credits L+T+ (PR/2) | Assessment Pattern and Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | Tutorial / Practical | | |
| L | T | PR | C | ESE (E) | PA / CA (M) | PA/CA (I) | ESE (V) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 20 | 30 | 150 |

**Course Content:**

| Unit No. | Content | No. of Hours | % of Weightage |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | Introduction to Sustainable Textile Processing:- Overview of Sustainability in Textiles, Definition and scope of sustainability, Historical context and evolution, Key sustainability challenges in the textile industry. Environmental Impact of Textile Processing, Water and energy consumption, Chemical usage and pollution, Waste generation and management. | 5 | 12 |
| 2 | Sustainable Raw Materials:- Natural Fibers and Their Processing, Types of natural fibers (cotton, wool, silk, etc.), Sustainable farming practices, Processing techniques and environmental impact. Recycled Fibers and Their Applications, Sources of recycled fibers (post-consumer, post-industrial), Processing methods for recycled fibers, Applications and benefits of recycled fibers. Bio-based Polymers, Types of bio-based polymers (PLA, PHA, etc.), Production processes and sustainability, Applications in textiles. | 7 | 17 |
| 3 | Eco-Friendly Pretreatment Processes:- Enzymatic Desizing, Mechanism and types of enzymes used, Process parameters and optimization, Environmental benefits and limitations. Bio-Scouring, Enzymes used in bio-scouring, Comparison with traditional scouring methods, Impact on fabric properties and environment. Ozone Bleaching, Principles of ozone bleaching, Equipment and process parameters. | 8 | 19 |
| 4 | Sustainable Dyeing Techniques:- Natural Dyes and Their Applications, Sources of natural dyes (plants, insects, minerals), Extraction and application methods, Colorfastness and environmental impact, Low-Impact Synthetic Dyes, Types of low-impact dyes, Application techniques and benefits, Comparison with conventional dyes, Waterless Dyeing Technologies, Supercritical CO2 dyeing, Digital printing and other waterless methods, Environmental and economic benefits. | 8 | 19 |
| 5 | Green Finishing Processes:- Eco-Friendly Softening Agents, Types of eco-friendly softeners, Application methods and benefits, Comparison with conventional softeners. Bio-Polishing, Enzymes used in bio-polishing, Process parameters and optimization, Impact on fabric properties and sustainability. Low-Formaldehyde Finishes, Types of low-formaldehyde agents, Application methods and benefits, Regulatory standards and compliance | 8 | 19 |

| | | | |
|---|---|---|---|
| 6 | Waste Management and Recycling:- Effluent Treatment and Water Recycling, Types of effluent treatment processes, Water recycling techniques, Case studies of successful implementations, Solid Waste Management, Types of solid waste in textile processing, Reduction, reuse, and recycling strategies, Innovative waste management solutions. Recycling of Textile Waste, Mechanical and chemical recycling methods, Applications of recycled textiles, Challenges and future directions | 6 | 14 |
| | **Total** | | **100** |

**Suggested Specification Table with Marks (Theory):**

| Distribution of Theory Marks (in %) | | | | | |
|---|---|---|---|---|---|
| **R Level** | **U Level** | **A Level** | **N Level** | **E Level** | **C Level** |
| **20** | **25** | **25** | **15** | **10** | **5** |

*Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)*

**References/Suggested Learning Resources:**

**(a) Books:**

1. Sustainable Textiles: Life Cycle and Environmental Impact by Richard Blackburn
2. Handbook of Sustainable Textile Production by Marion I. Tobler-Rohr
3. Green Chemistry for Sustainable Textiles, edited by Shahid ul-Islam and B. S. Butola
4. Sustainable Textiles: Production, Processing, Manufacturing & Chemistry by Subramanian Senthilkannan Muthu
5. Textile Processing with Enzymes, edited by A Cavaco-Paulo and G Gubitz

**(b) Open source software and website:**

1. http://nptel.ac.in
2. World Wide Web, Google Search Engine etc.

**Suggested Course Practical List:**

1. Enzymatic Desizing of Cotton Fabrics
2. Bio-Scouring and Its Effect on Fabric Properties
3. Ozone Bleaching and Comparison with Conventional Bleaching
4. Application of Natural Dyes and Evaluation of Color Fastness

5. Waterless Dyeing Techniques and Their Impact on Fabric Quality
6. Use of Eco-Friendly Softening Agents and Hand Feel Assessment
7. Bio-Polishing of Fabrics and Surface Smoothness Evaluation
8. Effluent Treatment Processes and Water Quality Testing
9. Energy Consumption Analysis in Textile Processing
10. Assessment of Textile Products for GOTS Certification

**List of Laboratory/Learning Resources Required:**

Laboratory jigger dyeing machine, Laboratory Winch machine, HTHP Kier boiler, Color matching cabinet, Stenter dryer, Padding mangle, Digital Printing Machine, Color Fastness Tester, Washing Fastness Tester, Grey scale for washing and rubbing fastness etc.

**Suggested Project List:**

**Suggested Activities for Students:**

**CO- PO Mapping:**

| **Semester ___** | **Course Name (Course Code: )** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **POs** | | | | | | | | | | | |
| **Course Outcomes** | | | | | | | | | | | | |
| CO1 | | | | | | | | | | | | |
| CO2 | | | | | | | | | | | | |
| CO3 | | | | | | | | | | | | |
| CO4 | | | | | | | | | | | | |
| CO5 | | | | | | | | | | | | |

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

**Any Other:**

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