GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Textile Technology
Subject Code: BE05000521
Subject Name: Sustainability and Circularity in Textile Industry

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	MOPEC-02

Prerequisite:	Basic knowledge of chemistry
Rationale:	The objective of this course is to give a glimpse of sustainability-related issues and initiatives related to the textile and apparel industry. The course aims to apprise the students about the importance of various resources used in textile manufacturing and the ways to reduce the consumption of these resources. The various standards and certifications related to sustainability are also covered.

Course Outcomes:

No	CO statement	RBT Level
01	Understand the concepts of sustainability and circularity	U, A, N, C
02	Analyze different frameworks of sustainability and circularity	R, U, A
03	Evaluate different sustainable processes and practices adopted in the textile industry	R, U, A
04	Understand the life cycle analysis of textile products	U, A, N
05	Understand different standards and regulations related to sustainability	U, N, E

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	TW/ SL	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/CA (I)	TW/ SL (I)	ESE (V)	
30	0	30	0	60	2	70	30	20	0	30	150

Content:

Sr. No.	Content	Total Hrs	% of Weightage

1	Defining sustainability and circularity, three dimensions of sustainability, sustainable development goals, Net zero.	**2**	**5**
2	Environmental impacts of textile and fashion industry, resource consumption (water, energy etc.) in fibre production, yarn manufacturing, fabric manufacturing, and chemical processing; Types of emissions, scopes I, II and III, measuring carbon footprints, decarbonizing textile supply chain.	**6**	**13**
3	Traceability, the need for traceability in the textile value chain, use of blockchain and fibre tags/coins for traceability	**3**	**6**
4	Sustainable textile processes, restricted substances for textile and clothing industry; Concepts of green chemistry, natural dyeing, supercritical carbon dioxide, ozone, UV and plasma technologies, foam dyeing, dope dyed fibres; Renewable energy sources, solar, hydro, wind,etc.	**6**	**13**
5	Effluent treatment, primary, secondary and tertiary treatments, zero liquid discharge (ZLD), rotary evaporators, idea of cost and capacity of ZLD plants; Standards of BOD, COD, TDS, TSS, pH, and heavy metals.	**5**	**11**
6	Circularity, circular design, 3Rs (reduce, reuse and recycle), RESOLVE framework, restoration and regeneration; Textile recycling, upcycling, and downcycling, open-loop and close-loop recycling, sorting technology; Methods of recycling, mechanical, thermal and chemical recycling, recycling of pre and post-consumer textiles, challenges.	**7**	**15**
7	Life cycle analysis, cradle-to-gate, cradle-to-grave, and cradle-to-cradle approaches, cut-off and allocation approaches, system boundary; Steps of LCA, unit of analysis, inventory assessment, impact assessment, and interpretation; Case studies related to LCA analysis of textile products.	**9**	**22**
8	Standards and certifications, needs, ISO 14000, Oeko-tex 100, Higg-index, GOTS, SMETA members ethical trade audit (SEDEX), Global Recycled Standard (GRS).	**5**	**11**
9	Environmental, social and governance (ESG) factors, social sustainability, issues in textile and fashion industry, governance mechanisms	**2**	**4**
	TOTAL	**45**	**100**

Suggested Specification table with Marks (Theory):(For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	**30**	**15**	**10**	**10**	**10**

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 R. Blackburn, Woodhead Publishing Series, 2009.
2. Roadmap to Sustainable Textiles and Clothing: Eco-friendly Raw Materials,
3. Technologies, and Processing Methods edited by S. S. Muthu, Springer, 2014.
4. Roadmap to Sustainable Textiles and Clothing: Environmental and Social Aspects of Textiles and Clothing Supply Chain edited by S. S. Muthu, Springer, 2014.
5. Roadmap to Sustainable Textiles and Clothing: Regulatory Aspects and Sustainability Standards of Textiles and the Clothing Supply Chain edited by S. S. Muthu, Springer, 2015.

(b)source software and website:

1. Web sites of textile testing instrument manufacturers, namely Uster, SDL etc., BIS, BS, ASTM and other standard methods of textile testing.
2. http://nptel.iitm.ac.in, World Wide Web, Google Search Engine etc.

Suggested Activities for Students:

1. Visit to textile mill and preparing report

Overall SDG Mapping

This course on Sustainability and Circularity in Textile Industry supports United Nations **SDG 6, SDG 7, SDG 8, SDG 9, SDG 12, and SDG 13** by providing students with the tools to reduce resource consumption, implement circular design, and ensure ethical governance. It prepares graduates to lead the textile industry's transition toward carbon neutrality and zero-waste manufacturing through technical innovation and rigorous sustainability standards.

List of suggested activities for Term Work / Self Learning:

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data
2	Assignment writing. Numericals based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.

3	Self-learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
4	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills
5	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
6	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
7	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/ any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions
8	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
9	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.

- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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