GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester - II

Course Title: Principles of Textile Chemical Processing
(Course Code: C4322804)

Diploma programmes in which this course is offered	Semester in which offered
Textile Processing Technology	Second

1. RATIONALE

Processing of the textiles is one of the important processes in chemical application technology. This gives the textile required pretreatment, finish, colour and print. The processing is a vast complex area in itself and hence there is a separate branch of engineering known as textile processing. This course provides only basic knowledge about textile wet processing including the chemical technology involved in the wet processing of textiles. This course is therefore a key course for textile processors.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Apply principles of chemistry for various textiles chemical processing**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Apply concepts of fibre structure and mathematical aspects for chemical processing.
b) Choose chemicals based on need of pretreatment of textiles.
c) Prepare a bath for coloration of textiles.
d) Suggest chemicals for finishing of textiles.
e) Relate green solvents and eco-friendly substitutes in textile chemical processing.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of Cos and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain Uos required for the attainment of the Cos.

***Legends:** **L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** – Practical; **C** – Credit, **CA** – Continuous Assessment; **ESE** – End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Cos. *Some of the **PrOs** marked **'*'** (in 2pprox.. Hrs column) are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Calculate requirement of dye and chemicals for various chemical processing of textiles.	I	02
2	Prepare solution for pretreatment of textiles.	II	02
3	Prepare solution and paste for colouration of textiles.	III	04
4	Prepare solution for finishing of textiles.	IV	04
5	Perform market and internet survey for collecting the data related to harmful chemicals and their eco-friendly substitutes.	V	04
	Total Hours		16

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the Cos. The above table is only a suggestive list.*

ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the Cos and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental set-up.	20
2	Performing the experiment.	20
3	Follow safe practices.	10
4	Record observations correctly.	20
5	Interpret the result and conclude.	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Electronic weighing balance	2,3,4
2	Glass-wares: Beaker, Pipette, Glass-rods	2,3,4
3	Water-bath	2,3,4

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned Cos and PrOs. More could be added to fulfil the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Realize importance of green principles involved in chemical processing.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level Uos of *Revised Bloom's taxonomy* that are formulated for development of the Cos and competency. If required, more such higher level Uos could be included by the course teacher to focus on attainment of Cos and competency.

Unit	Unit Outcomes (Uos) (4 to 6 Uos at different levels)	Topics and Sub-topics
Unit – I **Fundamentals of chemical processing**	1a. Differentiate fibre, yarn and fabric 1b. Describe amorphous and crystalline regions of fibres. 1c. Explain the impact of amorphous and crystalline regions on chemical processing of textiles. 1d. Apply mathematical aspects for chemical processing of textiles.	1.1 Difference between fibre, yarn and fabric 1.2 Amorphous and crystalline regions of textile fibres and their impact on chemical processing of textiles. 1.3 Mathematical aspects for textile chemical processing.
Unit – II **Pretreatments of textiles**	2a. Explain necessity of pretreatments for textiles. 2b. Describe emulsification, saponification, suspension, dispersion involved in pretreatments of textiles. 2c. Suggest various chemicals utilized in pretreatments of textiles. 2d. Explain structure, formula and properties of chemicals required in pretreatment of textiles.	2.1. Need of pretreatments of textiles 2.2. Principles involve in pretreatments of textiles 2.2.1. Emulsification 2.2.2. Saponification 2.2.3. Suspension 2.2.4. Dispersion 2.3. Various chemicals used in different pretreatments with their basic structure, chemical formulas, properties, etc.
Unit– III **Colouration of textiles**	3a. Explain necessity of colouration of textiles. 3b. Differentiate colours, dyes and pigments. 3c. Describe adsorption, absorption, fixation, equilibrium involved in	3.1 Need of colouration of textiles. 3.2 Difference between colours, dyes and pigments. 3.3 Important properties of dyes. 3.4 Principles involve in colouration of textiles

	colouration of textiles. 3d. Prepare dye solution and paste for coloration of textiles.	3.4.1. Adsorption or Exhaustion 3.4.2. Absorption or Diffusion 3.4.3. Fixation or Reaction 3.4.4. Equilibrium 3.5 Preparation of dye solution, paste for printing 3.6 Various chemicals used in different colouration process with their basic structure, chemical formulas, properties, etc.
Unit– IV **Finishing of textiles**	4a. Explain necessity of finishing of textiles 4b. Describe conduction, evaporation, condensation, structure stability involved in finishing of textiles 4c. Suggest various chemicals utilized in finishing of textiles. 4d. Explain structure, formula and properties of chemicals required in finishing of textiles	4.1 Need of finishing 4.2 Principles involve in finishing of textiles 4.2.1. Conduction 4.2.2. Evaporation 4.2.3. Condensation 4.2.4. Structure stability 4.3 Various chemicals used in different finishing with their basic structure, chemical formulas, properties, etc.
Unit– V **Green concept of Textile Chemical Processing**	5a. Discuss pollution generation through textile chemical processing 5b. Identify Harmful chemicals and suggest their eco-friendly substitutes 5c. Explain biotechnology concept.	5.1 Impacts of textile chemical processing on Environment. 5.2 Harmful textile chemicals and their eco-friendly substitutes. 5.3 Scope of biotechnology in textile chemical processing.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of chemical processing	08	6	6	2	14
II	Pretreatments of textiles	08	5	7	2	14
III	Colouration of textiles	12	7	7	4	18
IV	Finishing of textiles	08	6	6	2	14
V	Green concept of Textile Chemical Processing	06	4	4	2	10
Total		**42**	**28**	**30**	**12**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the Uos. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare a chart by collecting various samples of fibre, yarn and fabric
b) Prepare list of chemicals required for pretreatment of textiles with their structure, molecular formula, and properties.
c) Prepare list of chemicals required for dyeing of textiles with their structure, molecular formula, and properties.
d) Prepare list of chemicals required for printing of textiles with their structure, molecular formula, and properties.
e) Prepare list of chemicals required for finishing of textiles with their structure, molecular formula, and properties.
f) Give seminar on scope of biotechnology on chemical processing of textiles.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability.
g) Guide students for using data manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more Cos which are in fact, an integration of PrOs, Uos and ADOs. Each student will have to maintain dated

work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro-project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented Cos.

A suggestive list of micro-projects is given here. This has to match the competency and the Cos. Similar micro-projects could be added by the concerned course teacher:

a) **Data sheet:** Prepare a data sheet for various combination of chemicals and their quantities required for various chemical processing of textiles.
b) **Pretreatment:** Collect the data for various pretreatments processes applying industrial survey and internet search.
c) **Dyeing:** Collect the data for various dyeing processes applying industrial survey and internet search.
d) **Printing:** Collect the data for various printing processes applying industrial survey and internet search.
e) **Finishing:** Collect the data for various finishing processes applying industrial survey and internet search.
f) **Green chemicals:** Prepare a report on chemicals currently consumed in textile chemical processing industries and suggest eco-friendly substitute for them.
g) **Biotechnology:** Compile a report related to scope of biotechnology in textile chemical processing.
h) **Pollution:** Prepare a data-sheet on impact of textile chemical processing on environment with standard toxic limits.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Fundamental Principles of Textile processing	Dr. V. A. Shenai	Sevak Publication
2	Basics of Textile Chemical Processing	D Gopalkrishnan	Daya Publishing House ISBN: 978-9351308782
3	Green Chemistry	Stanley E. Manahan	ChemChar Research, INC Publishers IBSN: 0-9749522-4-93

14. SOFTWARE/LEARNING WEBSITES

a) www.nptel.iitm.ac.in
b) https://ndl.iitkgp.ac.in
c) www.textileschool.com
d) www.textileguide.chemsec.com
e) www.textileassociationindia.org
f) https://textilechemrose.blogspot.com

15. PO-COMPETENCY-CO MAPPING

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

Semester II	Principles of Textile Chemical Processing – C4322804						
	Pos						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	Use principles of textile chemical processing in solving branch specific problems						
Course Outcomes CO a) Apply concepts of fibre structure and mathematical aspects for chemical processing.	3	1	-	1	-	1	2
CO b)Choose chemicals based on need of pretreatment of textiles.	3	1	1	2	-	1	2
CO c) Prepare a bath for coloration of textiles.	3	1	1	2	-	1	2
CO d) Suggest chemicals for finishing of textiles.	3	1	1	2	-	1	2
CO e) Relate green solvents and eco-friendly substitutes in textile chemical processing.	3	-	-	-	3	1	2

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Mr. C R Madhu	RCTI, Ahmedabad	9879889712	crm4chemistry@gmail.com
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NITTTR Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
1				
2				