GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: **Analytical Textile Chemistry**
(Course Code: 4362804)

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

1. RATIONALE

In textile process industry, diploma graduate in textile processing, are supposed to test various textile fibres and chemicals for quality parameters. They should therefore have sufficient knowledge and skills to select and carryout requisite tests to ascertain required parameters. This course therefore attempts to provide the detail knowledge of analytical testing aspects of various chemicals. It also provides the clear concept of techniques of identification of various dyes in powder form and on the fibre. The students will also learn about the techniques of identification of various fibres and their blends qualitatively and quantitatively. The students will also get opportunity to use various instruments needed for Analytical testing.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in the students so that they are able to acquire following competency required by the industry:

- **Determine the composition of fibers and textile chemicals such as dyes using analytical testing methods.**

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) Analyse textile chemicals.
b) Analyse textile fibres, their blends and dyes.
c) Perform instrumental analysis techniques.
d) Assess the colour visually.
e) Measure colour values using instruments.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)	Total Credits (L+T+P/2)	Examination Scheme		
		Theory Marks	Practical Marks	Total

L	T	P	C	CA	ESE	CA	ESE	Marks
3	0	4	5	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 pprox.. 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	Find Percentage purity of various inorganic acids (HCl, H_2SO_4)	I	04
2	Find Percentage purity of various organic acids (CH_3COOH, HCOOH, $H_2C_2O_4.2H_2O$)	I	06
3	Find Percentage purity of various alkalis (NaOH, Na_2CO_3, $NaHCO_3$)	I	04
4	Find Percentage purity of various Oxidising agents (H_2O_2, $NaNO_2$, Resist salt)	I	02
5	Find Percentage purity of various chlorinated oxidizing type bleaching agents (Hypochlorite, Bleaching powder, Sodium chlorite)	I	02
6	Find Percentage purity of various reducing agents (Sodium hydrosulphite, Stannous Chloride, Sodium sulphide, Rongalite-C)	I	02
7	Carry out Identification of various textile fibres	II	06
8	Carry out Quantitative analysis of various blended textiles	II	06
9	Carry out Identification of various textile dyes (in powder form)	II	08
10	Measurement of pH of given unknown solutions using pH meter	III	02

11	Measurement of viscosity(flow time) of given solutions/pastes using viscometer	III	02
12	Measure colour strength (K/S) of different dyed sample using the CCM system.	IV V	04
13	Measure the whiteness and yellowness indices of bleach samples	IV V	04
S. No.	**Practical Outcomes (PrOs)**	**Unit No.**	**Approx. Hrs. required**
14	Measure colour difference (batch correction) between standard and reference samples	IV V	04
	Total Hours		56

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.	20
6	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by th4e administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Flasks: 250 ml and Measuring Flask: 250ml	1-6

2	Pipette: 10 ml, 25 ml	1-6
3	Beaker: 100 ml, 250 ml, 500 ml	1-6
4	Measuring Cylinder of capacity 10 ml, 25 ml, 100 ml	1-6
5	Burner	7-9
6	Electric Iron: 230V, 1000W	2-12
7	Glass Test tubes	7-9
8	Digital pH meter	10
9	Viscosity cup, stop watch	11
10	Dye pots, Glass rods	13-14
S. No.	**Equipment Name with Broad Specifications**	**PrO. No.**
11	Laboratory Drying, Curing and Setting Chamber: Temperature upto 220°C, working width - 450mm, length 1.7 meter, heater capacity - 8/16/24 kilo-watt	13-14
12	Laboratory Padding Mangle: Horizontal	13-14
13	Digital weighing balance: 0.02 gm accuracy (100 gm)	1-6, 13-14

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) Practice good housekeeping
c) Maintain tools and equipment.
d) Follow ethical practices.

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 **Analysis of Textile Chemicals**	1a. Describe different methods of analysis 1b. Select method for test analysis of organic and inorganic acid for their percentage purity 1c. Select method for test analysis of alkalis for their percentage purity 1d. select method for test analysis of oxidizing and reducing agent for their percentage purity	1.1 Different methods of analysis: 1.1.1 Types of Titrations: Acid-Base, redox, Iodometry 1.1.2 Choice of indicators for various above titrations. 1.2 Analysis of different textile chemicals: Calculation of equivalent weight of textile chemicals, percentage purity of different textile chemicals such as Organic acids, inorganic acids, alkalis, oxidizing agents, reducing agents etc.
Unit– II	2a. Describe different	2.1 Physical methods of fibre identification:
Analysis of Textile Fibres and Dyes	physical methods of identification of various textile fibres. 2b. Describe different chemical methods of identification of various textile fibres. 2c. Describe the quantitative method of analysis used for various blends. 2d. Identify various dyes in their powder form	2.1.1 Burning test 2.1.2 Microscopic examination 2.1.3 Density or sp. Gravity 2.1.4 Melting point 2.1.5 Moisture regain. 2.2 Identification of fibres by their solubility test using various solvents. 2.3 Different quantitative analysis of various blends 2.3.1 polyester/cotton 2.3.2 cotton/wool 2.3.3 polyester/viscose 2.3.4 polyester/wool 2.3.5 acrylic/cotton 2.4 Identification of various textile dyes in their powder form

Unit– III **Instrumental analytical methods**	3a. Describe various Chromatographic analysis methods. 3b. Describe various spectroscopy analysis methods. 3c. Explain various instruments used in textile chemical analysis.	3.1 Chromatographic analytical techniques : 3.1.1 Paper chromatography 3.1.2 Thin layer chromatography 3.2 Spectroscopy analytical Techniques 3.2.1 UV spectroscopy 3.2.2 Infra red spectroscopy 3.3 Instruments used in textile chemical analysis 3.3.1 Digital pH meter 3.3.2 Red wood viscometer
Unit– IV **Colour Assessment**	4a. Explain Visual assessment 4b. Explain working principle of colour measuring instruments 4c. Describe colour difference equation and chromaticity 4d. Explain Kubelka – Munk theory and its application	4.1 Color Assessment In Textiles 4.4.1.1Variables in visual colour assessment 4.1.2 Visual Colour assessment 4.1.3 Standard conditions 4.1.4 Methods for Visual assessment 4.2 Color Order System 4.2.1 Description of Color 4.2.2 CIE system and Tristimulus values 4.2.3 Whiteness Index and Yellowness Index 4.3 Color difference Measurement 4.3.1 Color Difference and Chromaticity diagram 4.3.2 Color Difference Equation 4.3.3 Acceptability Versus Perceptibility
		4.3.4 Industrial Color Tolerance Limit
Unit– V **Computer Aided Color Matching In Textiles**	5a. Explain CCM techniques for textiles 5b. Describe application of CAD/CAM in Textiles.	5.1 Color Matching Using Single Constant KM theory 5.2 Principles of Color Measuring Instruments 5.2.1 Optical Sensor 5.2.1.1 Spectrophotometer 5.2.1.2 Colorimeter 5.2.2 Signal Processor 5.3 Application of CAD/CAM in textile wet processing. 5.4 Limitations and Drawbacks of Computer Color Matching Techniques

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	Analysis of Textile Chemicals	08	2	4	6	12
II	Analysis of Textile Fibres and Dyes	10	2	4	8	14
III	Instrumental analytical methods	08	4	4	6	14
IV	Colour Assessment	10	4	4	8	16
V	Application of CCM in Wet Processing	06	2	4	8	14
Total		**42**	**14**	**20**	**36**	**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 studentrelated ***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) Survey market for various chemicals available in the market by various companies and with their purity and content.
b) Prepare a table for various indicator used in different titration with their end points and structure.
c) Collect the samples of different blends from textile industries and suggest blend analysis process for the collected samples.
d) Collect the sample of various dyes from textile industries and suggest identification process for the collected samples.
e) Collect the sample of different fibers from textile industries and suggest identification process for the collected samples.
f) Prepare flow chart for visual and computerized colour matching process applied in industries.
g) Prepare a chart suggesting limitation and advantages of CCM techniques.

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) Encourage students to refer different websites for having a deeper understanding of the subject.
g) Assign unit wise assignment to group of 4 to 5 students.
h) Use of video, animations, to explain concepts, facts and application related to printing.

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 **1416** ***(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) **Textile chemical collection:** Visit textile industries/market shops and collect at least 5 various chemicals (10 g). Titrate them against standard solution and find the purity of collected chemicals.
b) **Titration:** Prepare a short video film of titration process of any one chemical from the collected samples.
c) **Dye:** Collect dye powder from textile industries and identify them with qualitative analysis.
d) **Textile fiber:** Visit industries and market shops, collect at least 05 samples of different fibers, and analyze them.
e) **Blend:** Visit industries and market shops, collect at least 05 samples of different blends, and analyze them.
f) **Colour matching:** Collect the dyed samples from industries, dyed own sample and match it with industrial sample using computer colour matching. Suggest whether the sample is pass or fail.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Comprehensive Test Methods - Textile Processing	Bhattacharya I.	Colour Publications pvt. Ltd.,Mumbai, 2008 ISBN: 9788190259439
2	Profiles in Analysis of Chemicals	Desai N. F.	Colour Publication,Mumbai 2nd Edition
3	Textile Testing &Analysis	Vaishnav N. A. Joshi H. D.	Popular Prakashan, Surat
4	Instrumental Colour Measurement and Computer Aided Colour Matching for Textiles	Gandhi, R.S. and H.A. Shah	Mahajan Book Distributor, Latest publication ISBN: 9788185401003
5	Process House Laboratory – A Handbook	Luthara G. Deshpande B.	MANTRA – Surat
6	Textile Testing System & Procedure Part-IV(Chemical)	---	NITRA, Ghaziabad
7	Understanding Computer Colour Matching	Gangakhedkar, N.S.	Rutu Prakashan, Mumbai, Latest publication
8	Industrial Practice in Colour Measurement (with special reference to textile)	Shah, H.A.	Mahajan Book Distributor, Latest publication
9	Computer Colour Analysis (Textile Application)	Sule, A.D.	New Age Publication (P) Ltd, New Delhi

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
g) www.textilelearner.blogspot.com

15. PO-COMPETENCY-CO MAPPING

Semester III	Analytical Textile Chemistry – 4362804						
	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 relevant printing dyes, chemicals and fabric printing equipment for natural fibre fabrics						
Course Outcomes CO a) Analyse textile chemicals	3	2	-	2	-	2	3
CO b) Analyse textile fibres, their blends and dyes	3	2	2	3	-	2	3
CO c) Perform instrumental analysis techniques	3	2	2	3	-	2	3
CO d) Assess the colour visually	3	2	2	3	-	2	3
CO e) Measure colour values using instruments	3	2	2	3	-	2	3

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

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
2	Mr. R D Joshi	RCTI, Ahmedabad	9426387274	rdjrcti@gmail.com