GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Dyeing Technology – II
(Course Code: 4342803)

Diploma program in which this course is offered	Semester in which offered
Textile Processing Technology	4th Semester

1. RATIONALE

The polytechnic graduates are required to supervise operations of fiber, yarn and fabric and their dyeing and printing processes in industry. They should have basic knowledge and skills to handle dyeing and printing processes. This course provides the knowledge regarding basic dyeing technology of synthetic fibre-fabrics. It also provides the clear concept of physical and chemical properties of various dyes and auxiliaries related to the dyeing of synthetic fiber fabrics and newly invented dyes to enable them to apply according to their characteristic.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the following competency,

- **Use relevant dyes, chemicals, dyeing equipment for synthetic fibres and fabrics.**

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) Select dyeing auxiliaries and machineries with the concepts of dyeing technology.
b) Use relevant dyeing method for dyeing of polyamide textiles.
c) Use relevant dyeing method for dyeing of polyester textiles.
d) Use relevant dyeing method for dyeing of acrylic textiles.
e) Use relevant dyeing method for dyeing of various blends and knitted textiles.

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 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. Require
1	Draw Laboratory HTHP dyeing machine	I	02
2	Dye nylon with acid dye	II	02
3	Dye nylon with metal complex dye	II	02
4	Dye nylon with reactive dye	II	02
5	Dye nylon with disperse dye	II	02
6	Dye combination shade on nylon with acid dye	II	02
7	Strip acid dye from dyed nylon fabric	II	02
8	Dye polyester with disperse dye by exhaust method at boil	III	02
9	Dye polyester with disperse dye by exhaust method at boil with carrier	III	02
10	Dye polyester with disperse dye by HTHP method	III	02
11	Dye polyester with disperse dye by thermosol method	III	02
12	Dye combination shade on polyester with disperse dye by HTHP method	III	02
13	Visual matching of shades on polyester material	III	02
14	Strip disperse dye from dyed polyester fabric	III	02
15	Dye cationic dyeable polyester with cationic dye	III	02
16	Dye cationic dyeable polyester with disperse dye	III	02
17	Dye combination shade on cationic dyeable polyester with cationic dye	III	02
18	Dye polyester micro fibre with disperse dye	III	02
19	Strip cationic dye from dyed CDPET fabric	III	02
20	Dye acrylic fabric with cationic dyes	IV	02
21	Dye acrylic fabric with disperse dyes	IV	02
22	Strip cationic dye from dyed acrylic fabric	IV	02
23	Dye combination shade on acrylic fabric with cationic dyes	IV	02
24	Dye polyester/cotton blend with disperse/reactive system	V	02
25	Dye polyester/cotton blend with disperse/vat system	V	02
26	Dye polyester/viscose rayon blend with disperse/reactive system	V	02
27	Dye polyester/viscose rayon blend with disperse/vat system	V	02
28	Visual matching of shades on blend material	V	02
	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	Dye Pots: 250 ml, 500 ml	2-28
2	Glass rod / Steel rod	2-28
3	Beaker: 100 ml, 250 ml, 500 ml	2-28
4	Measuring Cylinder of capacity 10 ml, 25 ml, 100 ml	2-28
5	Water Heating Bath	2, 4-14, 16-23
6	Electric Iron: 230V, 1000W	2-28
7	HTHP Dyeing Machine	2,10,12,24-27
8	Laboratory Drying, Curing and Setting Chamber: Temperature upto 220°C, working width - 450mm, length 1.7 meter, heater capacity - 8/16/24 kilo-watt	2-28
9	Laboratory Padding Mangle: Horizontal	11
10	Digital weighing balance: 0.02 gm accuracy (100 gm)	2-28

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	Topics and Sub-topics
Unit – I **Textile Dyeing and Machineries**	1a. Explain properties of different dyes used for dyeing of synthetic textiles and their classification. 1b. Describe with sketch the procedure to operate the given dyeing machine. 1c. Enlist various faults obtained in dyeing machines and suggest their remedies.	1.1 Acid dyes, direct dyes, reactive dyes, metal complex dyes, chrome dyes and disperse dyes etc. for dyeing of synthetic textiles 1.1.1 Properties 1.1.2 Classification 1.2 Principle, construction and Working Mechanism of Dyeing Machines: 1.2.1 Jet Dyeing Machines (U-Tube, Long Tube & Soft Flow Dyeing Machines) 1.2.2 Beam Dyeing Machine 1.2.3 Merits and Demerits of above dyeing machineries. 1.3 Faults and their remedies for above dyeing machines.
Unit – II **Dyeing of Polyamide Textiles**	2a. Describe the mechanism & procedure for dyeing of polyamide textiles with acid dyes and metal complex dyes with affecting parameters. 2b. Describe the dyeing procedure for polyamide dyeing with miscellaneous dyes. 2c. Describe the after-treatment for the dyed fabric. 2d Identify problems with remedies for the given dyed fabric.	2.1 Dyeing of Polyamide with Acid Dyes and metal complex dyes 2.1.1 Mechanism 2.1.2 Application 2.1.3 Parameters affecting dyeing 2.1.4 Role of auxiliaries used in dyeing 2.2 Dyeing of polyamide with direct dyes, reactive dyes, chrome dyes and disperse dyes 2.3. After treatments: 2.3.1 Washing 2.3.2 Soaping 2.3.3 Stripping 2.4 Faults obtained in dyeing and their remedies

Unit – III **Dyeing of Polyester Textiles**	3a. Describe the mechanism for dyeing of polyester textiles with disperse with affecting parameters. 3b. Describe different dyeing methods for polyester dyeing with disperse dyes. 3c. Describe the after-treatment for the dyed fabric. 3d. Identify problems with remedies for the given dyed fabric. 3e. Describe dyeing of micro denier polyester and CDPET	3.1. Dyeing of Polyester with Disperse dyes 3.1.1 Mechanism 3.1.2 Application 3.1.3 Parameters affecting dyeing 3.1.4 Role of auxiliaries used in dyeing 3.2 Application methods: 3.2.1 Exhaust Dyeing without Carrier 3.2.2 Exhaust Dyeing with Carrier 3.2.3 HTHP Dyeing 3.2.4 Thermo-fixation 3.3. After treatments: 3.3.1 Reduction Clearing Treatment 3.3.2 Stripping 3.4 Faults obtained in dyeing and their remedies 3.5 Difference between regular polyester and micro denier polyester and CDPET and their dyeing procedures with necessary precautions
Unit – IV **Dyeing of Acrylic Textiles**	4a. Describe the mechanism for dyeing of acrylic textiles with cationic dyes with affecting parameters. 4b. Describe the principle for dyeing of acrylic textiles with disperse dyes. 4c. Describe the after-treatment for the dyed fabric.	4.1 Dyeing of Acrylic with Cationic dyes 4.1.1 Mechanism 4.1.2 Application 4.1.3 Parameters affecting dyeing 4.1.4 Role of auxiliaries used in dyeing 4.2 Application of disperse dyes on Acrylic 4.3 After treatments: 4.3.1 Washing & Soaping 4.3.2 Stripping
Unit– V **Dyeing of Various Blends and knitted Textiles**	5a. Concept of blending various fibres and their dyeing. 5b. Describe various dyeing methods for cellulosic fibres and its blend with synthetic fibres with necessary precautions. 5c. Describe dyeing of other blends. 5d. Describe dyeing of various knitted textiles with necessary precautions.	5.1 Blending of Textile Fibres 5.1.1 Necessity and advantages of Blending various textile fibres 5.1.2 Blending of natural and synthetic textile fibres. 5.1.3 Definition: Cross-dyeing, Solid shade, Contrast shade, Two-tone Effect, Reserve Dyeing. 5.2 Dyeing of Polyester/Cotton and Polyester/Viscose Rayon Blends 5.2.1 Different dyes used for dyeing of P/C & P/V Blend. 5.2.2 Single phase & Two phase dyeing of P/C & P/V Blend with flow charts 5.2.3 Batch/Semi-continuous/Continuous dyeing of P/C & P/V Blend. 5.3 Dyeing of Polyester/Wool, Polyester/CDPET

		and Polyester/Lycra Blends. 5.4 Dyeing of knitted textiles 5.4.1 Difference between dyeing of woven and knitted fabrics 5.4.2 Process flow chart for dyeing 5.4.3 Dyeing machines for knitted fabrics

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	Textile Dyeing	10	06	04	04	14
II	Dyeing of Polyamide Textiles	8	02	04	06	12
III	Dyeing of Polyester Textiles	10	04	06	08	18
IV	Dyeing of Acrylic Textiles	4	02	04	04	10
V	Dyeing of Various Blends	10	04	06	06	16
Total		**42**	**18**	**24**	**28**	**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:

- Literature survey of Dyeing Processes for Various Textile Fabrics.
- Collection and Study of various dyed samples for different textile.
- Visit to textile industries to study different dyeing process using on various machineries and prepare reports.
- Group discussion on recent developments in dyeing processes.
- Collection of data of various dyeing processes & Power point Presentation.
- Seminar/Quiz/Presentation on recent developments on dyeing of synthetic 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) 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 is 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 dyeing processes with recipes and dyeing conditions.
b) **Dyeing survey:** Collect the data of various dyeing processes applying industrial survey and internet search.
c) **Dyeing sample collection:** Visit Textile Industries / Market shops and collect dyed sample of different types of textiles.
d) **Dyeing machines:** Prepare a short video of different dyeing machines by visiting industries.
e) **Cost of dyeing:** Calculate the cost of dyeing with respect to price of dye and chemicals of any two dyeing methods for polyester.
f) **Shade matching:** Collect dyed samples from dye house. Using any class of dye match the shade in laboratory. Present the same with recipe.
g) **Dyeing parameters:** Choose any one dyeing process, and change any one dyeing parameter for dyeing process. Prepare a sample report with observations.
h) **Dyeing faults:** Visit industries and collect sample of faulty dyeing and find remedies to rectify the same. Present report.
i) **Sample book:** Prepare a sample book of dyes samples of polyester, nylon and blends with various dyes.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Chemistry of Dyes and Principles of Dyeing (VOLUME-II)	Dr. V. A. Shenai	Sevak Publication
2	Technology of Dyeing (VOLUME-VI)	Dr. V. A. Shenai	Sevak Publication
3	Dyeing of Wool, Silk and Man-Made Fibres	R. S. Prayag	Shree J. Printers, Pune
4	Dyeing and Chemical Technology of Textile fibre	E. R. Trotmann	Hodder Arnold, London
5	Chemical Processing of Cotton and Polyester-Cotton Blends	J. R. Modi & A. R. Garde	The Textile Association (India), Ahmedabad Unit, Ahmedabad
6	Handbook of Textile Processing Machinery	R. S. Bhagwat	Colour Publication PVT. LTD., Mumbai

14. SOFTWARE/LEARNING WEBSITES

a) https://nptel.ac.in
b) www.youtube.com
c) www.fibre2fashinon.com
d) www.textilelearner.net
e) www.textiletutorials.com
f) www.textilefashionstudy.com
g) www.textileschool.com
h) www.textileguide.chemsec.com
i) www.textileassociationindia.org
j) https://textilechemrose.blogspot.com

15. PO-COMPETENCY-CO MAPPING

Semester IV	Dyeing Technology – II – 4342803						
	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 knowledge and skills for identification and removal of impurities and improving quality of Cellulosic, Natural protein and Synthetic textiles for further processing operations.						
Course Outcomes CO a) Select dyes, auxiliaries	3	2	--	2	--	--	3

and machineries with the concepts of dyeing technology.							
CO b) Use relevant dyeing method for dyeing of polyamide textiles.	3	3	2	3	--	2	3
CO c) Use relevant dyeing method for dyeing of polyester textiles.	3	3	2	3	--	2	3
CO d) Use relevant dyeing method for dyeing of acrylic textiles.	3	3	2	3	--	2	3
CO e) Select dyes, auxiliaries and Use relevant dyeing method for dyeing of various blends and knitted textiles.	3	3	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. P. D. Panwala Lecturer	Dr. S. & S. S. Ghandhy College of Engineering & Technology, Surat	7228864435	pavan.panwala@hotmail.com
2)	Mr. R. M. Pandya Lecturer	Dr. S. & S. S. Ghandhy College of Engineering & Technology, Surat	9428409925	ridpandya@gmail.com
3)	Mrs. R. D. Pachauri Lecturer	R. C. Technical Institute, Sola, Ahmedabad	9624106881	2468rashmi@gmail.com