GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Printing Technology - I
(Course Code: 4332804)

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

1. RATIONALE

The polytechnic graduates are required to supervise operations of fibre, yarn and fabric for their dyeing & printing processes in industry. They should have basic knowledge and skills to handle dyeing and printing processes. The course on Printing Technology - I has been designed to provide basic knowledge and skills as well as recent technological developments in the area of dyeing & printing. This course also provides concepts of various thickeners and auxiliaries used for printing as well as methods and styles of textile printing technology.

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 printing dyes, chemicals and fabric printing equipment for natural fibre 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 relevant ingredients and thickener for printing the given fabric.
b) Use relevant printing method and style for the given job.
c) Use relevant printing machine based on the design and production capacity.
d) Develop print on cotton using specified dyes.
e) Produce print on silk and wool using specified dyes.

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	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	Prepare a Thickening Paste for printing	I	04
2 1	Develop tie and dye effect on the given fabric.	II	04
3	Develop batik effect on the given fabric.	II	04
4	Expose the screen with relevant design for screen printing.	III	04
5	Printing of Cotton with Direct dye with direct and discharge style.	IV	08
6	Printing of Cotton with Reactive dye with direct, discharge and resist style. (steaming, curing, alkali padding)	IV	08
7	Printing of Cotton with Vat dye with direct style.	IV	02
8	Printing of Cotton with Solublised dye with direct style.	IV	02
9	Printing of Cotton with Azoic dye with direct style.	IV	04
10	Printing of Cotton with pigments.	IV	04
11	Printing of Acid dyes on Wool/Silk fabric	V	04
12	Printing of Basic dyes on Wool/Silk fabric	V	04
13	Printing of Metal complex dyes on Wool/Silk fabric	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	Dye Pots: 250 ml, 500 ml	All
2	Glass rod	All
3	Beaker: 100 ml, 250 ml, 500 ml	All
4	Measuring Cylinder of capacity 10 ml, 25 ml, 100 ml	All
5	Wooden Screen	5-12
6	Electric Iron: 230V, 1000W	2-12
7	Rubber Squeegee	5-12
8	Laboratory Printing Table	5-12
9	Laboratory Stirrer: 300 to 500 rpm	1, 5-12
10	Laboratory Pressure Steamer: 30 psi and 150°C	5-12
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	2,3,5-12
12	Laboratory Padding Mangle: Horizontal	5,6
13	Digital weighing balance: 0.02 gm accuracy (100 gm)	All

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 **Textile Printing**	1a. Differentiate dyeing and printing processes 1b. Describe various stages involved in printing. 1c. Selects specified print paste ingredients for the given dye. 1d. Classify the thickeners based on the source and chemistry. 1e. Choose relevant thickener based on the given dye/pigment	1.1 Dyeing and Printing : Purpose and differentiation 1.2 Printing stages : 1.2.1 Fabric preparation 1.2.2 Print paste preparation 1.2.3 Printing, drying, fixation of prints 1.2.4 After treatments. 1.3 Print paste: Ingredients and their functions 1.4 Thickeners: 1.4.1 Classification 1.4.2 Advantages and limitations 1.4.3 Election criteria
Unit – II **Methods and Styles of Printing**	2a. Classify the methods of printing. 2b. Describe with sketch the procedure to develop specified printing effects. 2c. Classify the styles of printing. 2d. Choose relevant styles of printing for the given design.	2.1. Methods of printing: 2.1.1 Classification 2.1.2 Tie and dye 2.1.3 Batik printing 2.1.4 Stencil printing 2.1.5 Block printing 2.1.6 Roller printing 2.1.7 Screen printing 2.1.8 Advantages and limitations of above methods. 2.2. Styles of Printing: 2.2.1 Classification 2.2.2 Principles of Direct styles 2.2.3 Principles of Discharge styles 2.2.4 Principles of Resist styles 2.2.5 Dye selection criteria for discharge printing.
Unit– III **Printing Machinery**	3a. Design table for table printing. 3b.Describe with sketch the procedure to print the given design using table printing. 3c. Describe with sketch the procedure to prepare screen for the given printing machine. 3d. Describe with flowchart the procedure to print the given	3.1 Table Printing: 3.1.1 Technical feature 3.1.2 Faults, causes and remedies. 3.2 Screen preparation: 3.2.1 Flat screen, rotary screen, procedure, material required. 3.3 Flat-bed screen printing: 3.3.1 Technical features 3.3.2 Types and sizes of squeezes

	design using specified printing machine.	3.3.3 Advantages and limitations. 3.4 Rotary screen printing: 3.4.1 Technical features 3.4.2 Types and sizes of squeezes 3.4.3 Advantages and limitations.
Unit– IV **Printing of Cotton**	4a. select relevant fixation method and machinery for cotton. 4b. Describe the procedure to develop prints with direct dye on cotton with specified style. 4c. Describe the procedure to develop prints with reactive dye on cotton with specified style. 4d. Describe the procedure to develop prints with vat dye on cotton with specified style 4e. Describe the procedure to develop prints with azoic dye on cotton with specified style 4f. Describe the procedure to develop prints with pigment on the given fabric. 4g. Describe the procedure to produce the specified print effects on the given fabric.	4.1 Print fixation: 4.1.1 Methods – steaming, curing, polymerizing 4.2 Fixation machineries: working and application of 4.2.1 Star ager 4.2.2 Rapid ager 4.2.3 Loop ager 4.3 Printing with direct dye: 4.3.1 Print paste formulation for direct style and discharge style of printing 4.3.2 Process sequence 4.4 Printing with reactive dye: 4.4.1 Print paste formulation for direct style, discharge and resist style of printing 4.4.2 Process sequence 4.5 Printing with vat and solublised vat dye: 4.5.1 Print paste formulation for direct style of printing 4.5.2 Process sequence 4.6 Printing with azoic dye: 4.6.1 Print paste formulation for direct style of printing 4.6.2 Process sequence 4.7 Pigment printing: 4.7.1 Principle, mechanism, print paste formulation 4.7.2 Process sequence of printing 4.7.3 Advantages and disadvantages. 4.8 Special print effect: 4.8.1 Khadi printing 4.8.2 Crimp styles
Unit– V **Printing of Wool and Silk**	5a. Choose relevant preparation process before printing for the given fabric. 5b. Describe the procedure to develop prints with specified dyes on silk with direct style	5.1 Fabric preparation: 5.1.1 Process sequence for wool and silk 5.2 Printing with acid dye: 5.2.1 Print paste formulation for direct style of printing

	5c. Describe the procedure to develop prints with specified dyes on wool with direct style .	5.2.2 Process sequence 5.3 Printing with basic dye: 5.3.1 Print paste formulation for direct style of printing 5.3.2 Process sequence 5.4 Printing with metal complex dye: 5.4.1 Print paste formulation for direct style of printing 5.4.2 Process sequence

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 Printing	06	2	4	4	10
II	Methods and Styles of Printing	06	2	4	4	10
III	Printing Machinery	10	4	4	6	14
IV	Printing of Cotton	12	4	6	12	22
V	Printing of Wool and Silk	08	4	4	6	14
Total		**42**	**16**	**22**	**32**	**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) Survey market for various dyes, pigments, auxiliaries and chemicals. Compare them based in print effects, fastness properties, and ecological aspects and costing.
b) Collect information about novel printing techniques.
c) Prepare table for various ingredients used in printing of cotton with their role in printing paste.
d) Prepare table for various ingredients used in printing of wool with their role in printing paste.
e) Prepare table for various ingredients used in printing of silk with their role in printing paste.

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 **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) **Print sample collection:** Visit textile printing industries/market shops and collect at least 20 to 30 various printed samples of cotton/silk/wool fabrics. Classify them with respect to style and method of printing.
b) **Screen making:** Prepare a short video film of flat-bed screen and rotary screen making by visiting industries, and also collect the sample of screen having various mesh size.
c) **Performance of thickeners:** collect different thickeners used in textile printing industries, and analyze their performance with respect to viscosity, stability under various pH, and colour yield.
d) **Printed design:** Visit industries and market shops, collect at least 20 samples of different varieties, and analyze the design with respect to pattern, number of colours, percent coverage, overlapping, and blotches.
e) **Printing machine:** Prepare a short video film of flat-bed screen and rotary screen printing machine by visiting industries, and also edit the video as per process sequence.
f) **Sample book:** Prepare a sample book of printed samples of cotton with various dyes, and printing styles and printing methods.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Technology of Printing Vol – IV	Dr V.A. Shehnai	Sevak Publications, Mumbai 1990
2	Textile Printing	L.W.C. Miles	Society of Dyers and Colourists, 1981, ISBN: 9780901956330
3	Introduction to Textile Printing	W. Clarke	Wood-head Publishing Ltd., Cambridge, ISBN: 9781855739949
4	Technology of Printing	R. S. Prayag	Shree J. Printers, Pune
5	Principles of Cotton Printing	D. G. Kale	Mahajan Brothers
6	Silk Dyeing, Printing and Finishing	George Henry Hurst	Bell, London Rarebooks Club.com (e-copy) 2012, ISBN: 9781130986525

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
h) www.textileapex.blogspot.com
i) www.zimmer-usa.com
j) www.zeprint.com

15. PO-COMPETENCY-CO MAPPING

Semester III	Technology of Printing – I – 4332804						
	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) Select relevant ingredients and thickener	3	1	-	1	-	1	3

for printing the given fabric							
CO b)Use relevant printing method and style for the given job	3	2	1	3	-	1	3
CO c) Use relevant printing machine based on the design and production capacity	3	1	1	3	-	1	3
CO d) Develop print on cotton using specified dyes	3	2	1	3	3	2	3
CO e) Produce print on silk and wool using specified dyes.	3	2	1	3	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

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