GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Printing Technology - II
(Course Code: 4342804)

Diploma programmes 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 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 - II has been designed to provide basic knowledge and skills as well as recent technological developments in the area of printing for synthetic textiles. This course also provides concepts of various thickeners and auxiliaries used for printing as well as methods and styles of textile printing technology for synthetic textiles.

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 synthetic 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, thickener, fixation method and styles for printing of polyester and CDPET fabric.
b) Use relevant printing styles, dyes, ingredients for printing the nylon and acrylic.
c) Use relevant printing method, style, dyes, and pigments for printing the synthetic and blended fabric.
d) Select transfer printing machine as per the design to print on the fabric.
e) Use relevant ink, inkjet printing technology to print the fabric.

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	Printing of polyester with disperse dye by direct style applying various fixation method.	I	04
2	Printing of polyester using discharge and resist style.	I	08
3	Printing of nylon with acid, metal complex and disperse dye by direct style.	II	06
4	Printing of acrylic and CDPET with basic, and disperse dye by direct style	I II	04
5	Printing of nylon using discharge style.	II	08
6	Printing of Polyester/Cotton blend with disperse-reactive dye with one phase and two phase method by direct style.	III	06
7	Printing of Polyester/Cotton blend with polystyrene dye by direct style.	III	04
8	Printing of Polyester/Acrylic, Polyester/Wool blend with direct style.	III	04
9	Printing of paper for transfer printing.	IV	02
10	Printing of polyester with transfer printing technology.	IV	02
11	Preparation of printing ink for inkjet/digital printing.	V	04
12	Printing of synthetic fabric with digital printing during industrial visit.	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

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
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 **Printing of Polyester and CDPET**	1a. hoose preparatory process for polyester before printing. 1b. elect appropriate ingredients for preparing printing paste. 1c. escribe the printing procedure for polyester and CDPET fabric with various styles. 1d. elect fixation method for development of prints. 1e. xplain importance of after treatment of printed polyester fabric.	1.1 Preparation of polyester fabric for printing 1.2 Printing of polyester: 1.3.1 Print paste formulation for Direct, discharge and resist style of printing 1.3.2 Process sequence 1.4 Fixation method: 1.4.1 Pressure Steaming 1.4.2 High temperature steaming 1.4.3 Thermofixation 1.5 After treatment: Reduction clearing 1.6 Printing of CDPET: 1.3.1 Print paste formulation for Direct style of printing 1.3.2 Process sequence
Unit – II **Printing of Nylon and Acrylic**	2a. elect preparatory process for nylon and acrylic before printing. 2b. hoose ingredients for preparing printing paste. 2c. escribe the printing procedure for nylon and acrylic with various styles. 2d. elect fixation method for development of prints. 2e. xplain importance of after treatment of printed nylon and acrylic fabric.	2.1 Preparation of Nylon and acrylic fabric for printing 2.2 Printing of Nylon: 2.2.1 Printing of nylon with acid, metal complex, and disperse dye with paste formulation for direct, and discharge style of printing 2.2.2 Process sequence 2.3 Printing of Acrylic: 2.3.1 Printing of acrylic with basic and disperse dye paste with formulation for direct style of printing 2.3.2 Process sequence
Unit– III	3a. Select relevant dye and ingredients for printing of various	3.1 Printing of Polyester/Cotton blend: 3.1.1 Printing with disperse

Printing of Synthetic and its blends	blended fabric. 3b.Describe printing procedure for polyester/cotton, polyester/wool, and polyester/acrylic blend fabric. 3c. Choose dye system and combination for printing of various blend. 3d. select fixation method for development of prints.	reactive system: Single phase method, two phase method. 3.1.2 Printing with disperse vat system 3.1.3 Single dye application: Polystyrene dye 3.1.4 Process sequence 3.2 Printing of Polyester/Wool and Polyester/Acrylic blend: 3.2.1 Printing paste formulation for Polyester/wool and Polyester Acrylic blend printing. 3.2.2 Process sequence
Unit– IV **Transfer Printing**	4a. Select relevant transfer printing technique to print the given fabric. 4b. Select relevant transfer printing paper to print the given fabric. 4c. Choose relevant dye or ink to print the given material for transfer printing. 4d. Select relevant transfer printing machine to print the given fabric. 4e. Describe with sketch, working of the given transfer printing machine.	4.1 Transfer Printing: Concepts, Types, Melt transfer, Film release transfer, Semi-wet transfer, Vapour transfer 4.2 Transfer printing paper: Characteristics 4.3 Transfer printing ink: Characteristics of dyes and inks 4.4 Transfer printing machine: 4.4.1 Flat bed press transfer 4.4.2 Continuous transfer 4.4.3 Vacuum transfer
Unit– V **Digital/ Inkjet Printing**	5a. Describe with sketch, working of the given inkjet/digital printing technology. 5b. Select relevant inkjet/digital printing technology to print given textile material. 5c. Choose relevant dye or ink to print the fabric. 5d. Distinguish between the inkjet/digital and conventional printing processes.	5.1 Digital/Inkjet printing: Concept, Classification, types of nozzles. 5.2 Continuous inkjet printing: 5.2.1 Binary deflection inkjet printing 5.2.2 Multi-level deflection inkjet printing 5.3 Drop on demand inkjet printing: 5.4 Ink for inkjet: 5.4.1 Characteristic of ink, dye for printing 5.5 Comparison between inkjet/digital printing and conventional printing.

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	Printing of Polyester and CDPET	10	4	6	6	16

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
II	Printing of Nylon and Acrylic	10	4	6	8	18
III	Printing of Synthetic and its blends	10	4	6	6	16
IV	Transfer Printing	06	2	4	4	10
V	Digital/ Inkjet Printing	06	2	4	4	10
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 polyester, nylon and acrylic with their role in printing paste.
d) Prepare table for various ingredients used in printing of synthetic and itsblends with their role in printing paste.
e) Survey market for digital/inkjet and transferred printed textile demand and popularity.

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 polyester/nylon/acrylic and their blend fabrics. Classify them with respect to style and method of printing.
b) **Digital/Inkjet and Transfer printing:** Prepare a short video film of digital/inkjet printing by visiting industries, and also collect the samples.
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) **Sample book:** Prepare a sample book of printed samples of synthetic textiles 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

S. No.	Title of Book	Author	Publication with place, year and ISBN
5	Digital Printing of Textiles	H. Ujiie	Wood-head Publishing Ltd., Cambridge, ISBN: 9781855739512
6	Ink Jet Textile Printing	Christina Cie	Wood-head Publishing Ltd., Cambridge, ISBN: 9780857092304

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	Printing Technology – II – 4342804						
	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, thickener, fixation method and styles for printing of polyester and CDPET fabric	3	2	-	2	-	2	3
CO b) Use relevant printing styles, dyes, ingredients for printing the nylon and acrylic	3	2	2	3	-	2	3
CO c) Use relevant printing	3	2	2	3	-	2	3

method, style, dyes, and pigments for printing the synthetic and blended fabric							
CO d) Select transfer printing machine as per the design to print on the fabric	3	2	2	3	3	2	3
CO e) Use relevant ink, inkjet printing technology to print the fabric.	3	2	2	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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