

**GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)**

**Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)**

Semester - III

**Course Title: Screen Printing Process**

(Course Code: 4335805)

Diploma programme in which this course is offered	Semester in which offered
Printing Technology	Third

**1. RATIONALE**

This course will provide skills in the screen-printing process and it will cover different technical aspects like copy preparation, mesh selection, frames, stencil systems, printing techniques, ink, substrate compatibility, reclamation of the screen, and use of the screen-printing process for print and finishing. Acquisition of technical skills through practice will help students to set up their own enterprise and get jobs in the field of screen printing.

**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:

- **Print, given job using screen printing process on various substrates.**

**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:

- Select the tools and materials required for a given job.
- Prepare the stencil as per job requirements.
- Execute the job according to requirement and print it.
- Analyze the printing defects and suggests remedies.

**4. TEACHING AND EXAMINATION SCHEME**

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			C	CA	ESE	CA	ESE	
0	0	2	1	00	00	25*	25	50

*(\*): For this practical only course, 25 marks under the practical CA has two components i.e. the assessment of micro-project, which will be done out of 10 marks and the remaining 15 marks are for the assessment of practical. This is designed to facilitate the attainment of COs holistically, as there is no theory ESE.*

**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. *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 screen frame by the hand-cut method	III	02
2	Prepare screen by direct emulsion method	III	02
3	Prepare screen by indirect emulsion method	III	02
4	Perform printing operation with screen prepared by the hand-cut method	IV	02
5	Perform printing operation with screen prepared by direct Screen method	IV	02
6	Perform printing operation with screen prepared by indirect screen method	IV	02
7	Perform screen printing operation on irregular shapes like containers, mugs, pens, etc.	IV	02
8	Perform screen printing operation on cloth.	IV	02
9	Perform screen printing operation on non absorbent stock.	IV	02
10	Print visiting cards with the screen-printing process.	IV	02
11	Perform screen printing operation with any two specialty Color	V	02
12	Perform screen printing operation with process color	V	02
13	Perform screen printing operation on circuit board.	V	02
14	Use screen printing process for spot coating.	V	02
15	Use screen printing Process for texture coating.	V	02
16	Identify the problem in the given job and give suitable remedies.	V	02
<b>Minimum Practical Hours</b>		<b>28</b>	

### 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	Preparation of practical setup	20

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
2	Operate the equipment setup	20
3	Question and answers	20
4	Cleanliness and quality	20
5	Interpret the result and conclude.	20
<b>Total</b>		<b>100</b>

## 6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These 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.	Screen Processing Tools Max Frame Size 16" x 16" OD to 34" x 40" OD Max Exposing Area 22" x 28" Power Supply 220 V AC Dimension (In feet) 10.5' W x 4.5' D x 7.0' H Mechanical Stretcher/Tension Meter Max. Tension Permitted 16 to 20 Newton (Depending on Fabric) Emulsion Coating Stand & Trough Coating Trough Length with 2 End Cover 27" Screen Dryer Auto Switch-off Timer 1 to 60 minutes Exposure Exposing Lamp Metal Halide - 400 Watts Power	1 to 14
2.	Semi-Automatic Screen-Printing Machine Max size 10"x15" Vacuum bed 19.6"x 17.7" Vacuum bed movement for registration $\pm 7$ mm Maximum screen frame size 26"x 20" Minimum screen frame size 20"x 12" Max off contact 5 mm Max substrate thickness 3mm Screen frame thickness 1" to 1.5" Squeegee holder 17" Flood coater 19" Power consumption 220 V ac	4 to 14
3.	Screen Printing Machine Table Top Max size 25"x 30" Maximum screen frame size 22"x 28" Manual machine	4 to 14
4.	Screen Printing Machine for Container This Machine can print any type of Round Object like Bottles, CFL, Capacitor, Automobile Parts, Glass, Food containers, etc. 1000 impression per Hours Print up to 5" Dia. Manual type machine	9

5.	Drying Rack Open type storage, Usage application: drying Material: mild steel Size: 32" x 42" Number of shelves: 30	4 to 14
6.	Screen Dryer Voltage 220 V Setting: 3 heat speed Cord length: 1.5 m	1 to 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 fulfill the development of this course competency.

- Work as a leader/a team member.
- Follow safety practices while stretching and making screen frame
- Practice Good housekeeping
- Follow ethical practices
- Realize importance of green energy.

The ADOs are best developed through 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:

- 'Valuing Level' in 1<sup>st</sup> year
- 'Organization Level' in 2<sup>nd</sup> year.
- 'Characterization Level' in 3<sup>rd</sup> year.

## 8. UNDERPINNING THEORY

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

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
<b>Unit – I Introduction to screen printing</b>	1a. Describe the basic principle of the screen-printing process 1b. Identify the workflow of the screen-printing process 1c. Compare screen printing process with other printing processes 1d. Justify screen printing is the most recommended process for printed electronics and industrial application	1.1 Introduction to the screen-printing process 1.2 History and development of the screen-printing process. 1.3 Comparison with other printing processes 1.4 Merits and demerits of the screen-printing process 1.5 Application of screen-printing process like Graphics, Packaging, Automotive, and printed electronics

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
<b>Unit – II Materials for screen printing</b>	1e. Identify the mesh according to product requirement 1f. Justify the necessity of flood coater 1g. Compare liquid emulsion and dry emulsion 1h. Select suitable squeegee and frames according to product requirement 1i. Suggest the substrate and ink according to product requirement	2.1 Screen mesh: composition, physical fabrics properties, elongation characteristics of polyester fabrics, mesh count, mesh opening 2.2 Flood coater: working, stroke speed, angle 2.3 Photo emulsion: liquid emulsions and dry emulsions, direct photo stencil, indirect photo stencil, bichromate based emulsions, diazo based emulsions, photopolymer emulsions, dual cure emulsions 2.4 Squeegees: Materials, blade profile, durometer, sharpening and maintenance, instrumentation and tools, shore A hardness tester 2.5 Frames: materials used for the frame, frame size, factors affecting selection of frame 2.6 Substrate and inks: types of substrate and, types of inks
<b>Unit – III Mesh stretching and screen preparation method</b>	2a. Identify various types of stretching techniques 2b. Enlist requirement of film element for screen preparation 2c. List stages in screen preparation 2d. List type of stencil methods 2e. Select stencil preparation method according to a requirement	3.1 Mesh stretching: hand stretching, mechanical stretching, pneumatic stretching, the need of mesh stretching monitoring, instrumentation, and tools, screen tension meters 3.2 Pre-press and films: Evaluating film quality, density, and image quality, Resolution, screen angle 3.3 Steps in screen preparation: mesh stretching, degreasing, drying, emulsion coating, drying coated mesh, exposure, development, inspection of the screen, computer to screen 3.4 Stencils: hand-cut, direct, indirect, direct, and indirect, comparison between all types of stencil
<b>Unit– IV Screen printing machines and equipment</b>	3a. Compare manual and automatic screen printing 3b. Selection of screen-printing machine according to need 3c. Selection of different equipment according to need	4.1 Different configurations of screen-printing machines like, manual, semi-automatic, automatic, rotary, carousel, etc. 4.2 Advantages and limitations of various configuration 4.3 Type of clamps: g clamp, c clamp etc. 4.4 Types of dryers: racks, wicket dryers, flatbed dryers, UV dryers
<b>Unit– V Press set</b>	4a. List parameters 4b. Explain the relation between ink	4.1 Press parameter: color sequence, off-contact distance, three-point

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
<b>up and operations</b>	deposition and press parameters 4c. Explain the need for dust free environment 4d. Identify causes of failure and their remedies for a given job	registration, transparent flap overlay registration 4.2 Controlling ink deposit using press controls, squeegee speed, angle, and pressure 4.3 Press work condition: dust free and temperature-controlled environment 4.4 Troubleshooting: causes and remedy
<b>Unit– VI Handling Print Waste</b>	5a. Explain about different inks and chemicals used by the screen-printing industry and its potential hazards 5b. Describe different methods of disposing of chemicals and inks used in screen printing. 5c. Suggest methods of handling different hazardous materials 5d. Suggest the waste disposal method for the given printing process.	5.1 Hazardous materials used by the screen-printing process. 5.2 Methods of disposing hazardous screen-printing waste 5.3 Rules and regulations of disposing of hazardous materials 5.4 Recirculation systems 5.5 Water filtration

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
<b>Not Applicable</b>						

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

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the 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 perform the following activities in groups and prepare reports of about 5 pages for each activity. They should also collect/record physical evidence for their (student's) portfolio which may be useful for their placement interviews:

- a) Visit screen printing press and study the workflow of it
- b) Prepare a list of newer industrial applications of the screen-printing process.
- c) Collect the technical brochures of the different screen-printing machines and allied products.
- d) Collect the technical brochures of the different specialty inks used for screen printing from the local market

- e) Observe the safety procedures at work in the screen-printing press.
- f) Visit the screen-printing press and identify the quality parameter inspected during screen printing.
- g) Observe the waste management approach used by the major screen-printing firm

## 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.

## 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, integration of PrOs, UOs, and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions 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) Collect the information of mesh used for screen printing and present the report.
- b) Collect the information on automation in the screen-printing field and write a report.
- c) Collect the information of squeegee rubber manufacture and their different grades and write a report
- d) Collect the information about dry emulsion film and write its technical specifications.
- e) Collect various samples printed by screen printing and make sample book.

- f) Prepare a report on technical specifications for equipment and machine used for screen printing machine.
- g) Visit the screen-printing press and record a minimum of twenty process variables for the screen-printing process
- h) Identify print defects relevant to the screen-printing process and write a report.
- i) Identify the process control tools used for screen printing and write report.
- j) **Enlist hazardous chemicals used in the screen printing industry**
- k) **Visit different dyeing units and see their waste disposal method**
- l) **See the GPCB site and prepare a report for screen printing press regarding different hazardous chemicals used and their disposal.**
- m) **Observe the waste disposal technique of different dyeing units for cloth and prepare a report on it.**

### 13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with the place, year, and ISBN
1	Screen Printing Technology Hand Book	NIIR Board	Asia Pacific Business Press Inc., India Published in 2003, ISBN: 8178330539
2	The Print and Production Manual	Sean Smyth	Pira International Limited, Randalls Road, Leatherhead, Published in 2008, ISBN-13 : 978-1858025148
3	Handbook of Print Media	Helmut Kipphan Ed.	Heidelberg Druck maschinen AG, Springer Heidelberg, Published in 2001 ISBN 978-3-540-29900-4
4	The Complete Book of Silk Screen Printing Production	J. I. Biegleisen	Dover Publications, INC, New York , published in 2000 ISBN-10 : 0486211002

#### Other Learning Resources

- i. Screen Print India: a monthly magazine

### 14. SOFTWARE/LEARNING WEBSITES

- Screen frame making: <https://www.youtube.com/watch?v=UcuTX770Z0g>
- Screen by hand cut method: <https://www.youtube.com/watch?v=ND1AUJhdUZc>
- Screen prepared by direct emulsion method:  
<https://www.youtube.com/watch?v=6gGwTUQXbEw>
- Screen prepared by indirect stencil method:  
<https://www.youtube.com/watch?v=Ualjvfjx1v8>
- Two color screen printing:  
<https://www.youtube.com/watch?v=v4p-rr6J4hQ>
- Process color printing by screen printing process:  
<https://www.youtube.com/watch?v=juEZGM3Z0sU>

- Screen printing on irregular shapes:  
<https://www.youtube.com/watch?v=sU12QZmtTb8>
- Screen printing on cloth: <https://www.youtube.com/watch?v=MDDE8VvViFo>
- Screen printing on visiting card: <https://www.youtube.com/watch?v=jrXMIJdBMoI>
- Screen printing on PCB: <https://www.youtube.com/watch?v=8-WGaAmpfOU>
- Spot coating by screen printing: <https://www.youtube.com/watch?v=ZeqbsSknNGE>

## 15. PO-COMPETENCY-CO MAPPING

Semester II	Screen Printing Process(Course Code:4325802)						
	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
<b>Competency</b>	<b>Print, given job using screen printing process on various substrates.</b>						
<b>Course Outcomes</b>	3	2	-	3	2	-	-
CO a) Select the tools and materials required for given job	3	2	-	3	2	-	-
CO b) Prepare the stencil as per job requirement.	3	2	-	3	2	-	-
CO c) Execute the job according to requirement and print it.	3	2	-	3	2	-	-
CO d) Analyse the printing defects and suggests remedies.	3	2	-	3	2	-	-

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	S. D. Gohel	R. C. Technical Institute, Sola, Ahmedabad	8460609775	sandy_printmedia@yahoo.com
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