GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

VI– Semester

Course Title: **Decorating and Finishing of Plastic Products**

(Course Code: 4362302)

Diploma programme in which this course is offered	Semester in which offered
Plastics Engineering (Sandwich Pattern)	Sixth

1. RATIONALE

The changing demands of consumers with respect to aesthetic & visual appeal, properties, branding & identity, enhanced functionality, applications, information sharing and protection led the plastic engineers for developing various kinds of decorating and finishing processes. A diploma plastic engineer has to select appropriate process, machine and monitor operations of decorating and finishing machineries. This competency requires the knowledge of decorating process, assembling of plastic parts, use of fastening techniques and application of painting and printing. Hence the course has been designed to develop these competencies and its associated cognitive, practical and affective domain learning outcomes.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Select appropriate decorating and finishing process to satisfy end user requirement.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) Select suitable assembling and joining technique.
b) Apply proper surface treatment method.
c) Apply appropriate painting and coating process.
d) Perform suitable printing process.
e) Select appropriate hot transfer method for decoration.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+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 thesub-components of the COs.*Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Prepare any one product using mechanical fastening technique.	I	8
2	Perform adhesive bonding technique on different types of plastic products.		4
3	Perform solvent cementing process.		4
4	Perform hot gas welding process.		4
5	Perform ultrasonic welding technique.		4
6	Perform corona discharge and flame treatment on plastic products.	II	4
7	Perform spray painting method on plastic product.	III	4
8	Perform fluidized bed coating process on plastic product.		4

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
9	Perform screen printing method.	IV	8
10	Perform pad printing method.		4
11	Perform electroplating process.	V	4
12	Perform hot stamping process.		4
	TOTAL		**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 setup.	20
2	Perform process.	30
3	Follow safe practice measures.	10
4	Record observations correctly.	20
5	Interpret the result and conclude.	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specificationsfor 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	Acrylic cutter, solvent and brush	1,2,3
2	Hot air gun	4,6
3	Ultrasonic welding machine	5
4	Corona treater	6
5	Spray gun	7
6	Fluidized bed coater	8
7	Screen printing machine	9
8	Pad printing machine	10
9	Electroplating Tank	11
10	Hot stamping machine	12

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) Follow ethical practices.
c) Practice environmental friendly methods and processes to avoid metal waste.

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

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. 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 Application and above level)	*Topics and Sub-topics*
Unit – I Joining and Assembling Techniques	1a. Identify suitable mechanical fasteners 1b. Apply proper cementing technique 1c. Select proper adhesive bonding technique 1d. Identify various thermal bonding processes 1e. Compare various thermal bonding processes 1f. Select appropriate thermal bonding processes	1.1 MECHANICAL FASTENERS • Function, Advantages, Disadvantages & Applications of : ➢ Self taping screws – Thread forming and thread cutting ➢ Post molded and molded-in inserts ➢ Rivets 1.2 SOLVENT CEMENTING • Basic principle of solvent bonding • Factors to be considered for good cementing • Type of solvents • Methods for applying solvents 1.3 ADHESIVE BONDING • Basic principle of adhesive bonding • Type of adhesives use for plastics • Methods of applying adhesives • Application of adhesive bonding 1.4 THERMAL BONDING • Introduction of plastic welding • Basic principle, equipment, working, Advantages, Disadvantages & applications of : ➢ Hot gas welding ➢ Hot plate welding ➢ Ultrasonic bonding ➢ Ultrasonic spot welding ➢ Vibration welding ➢ Spin welding/Friction welding

Unit	*Unit Outcomes (UOs)* (4 to 6 UOs at Application and above level)	*Topics and Sub-topics*
		➢ Induction welding ➢ Induction Cap sealing ➢ Heat Sealing- Heated Tool welding, Dielectric heat sealing • Applications of thermal bonding
Unit – II **Surface Treatment**	2a. Identify need for surface treatment 2b. List various surface treatment processes 2c. Compare various surface treatment processes 2d. Apply proper surface treatment process	2.1 Significance of surface treatment 2.2 Plastic materials which require surface treatment 2.3 Factors Affecting Ink Adhesion on Film/Molded surfaces 2.4 Types of surface treatments 2.4.1 Washing and cleaning 2.4.2 Mechanical abrasion 2.4.3 Chemical etching 2.4.4 Priming 2.4.5 Flame treatment 2.4.6 Corona discharge 2.4.7 Plasma treatment 2.4.8 UV/Ozone treatment
Unit – III **Painting and Coating**	3a. List various painting processes 3b. Apply appropriate painting process 3c. List various coating processes 3d. Apply appropriate coating process	3.1 PAINTING • Types of paint materials-Lacquers and Enamels • Process, Equipment and Applications of : ➢ Conventional spray ➢ Electrostatic spray ➢ Roller coating 3.2 COATING • Materials for powder coating • Process, Equipment and Applications of : ➢ Fluidized bed coating ➢ Electrostatic deposition ➢ Powder coating

Unit	*Unit Outcomes (UOs)* (4 to 6 UOs at Application and above level)	*Topics and Sub-topics*
Unit – IV Printing	4a. Identify need for printing methods 4b. List various printing processes 4c. Compare various printing processes 4d. Apply suitable printing process	4.1 Process, Advantages, Disadvantages &Applications of : • Screen printing • Pad printing • Offset printing • In-mold Labelling • Flexography printing • Rotogravure printing • Laser Marking/Engraving
Unit – V Hot Transfer Process	5a. Identify various hot transfer process 5b. Compare various hot transfer process 5c. Select suitable hot transfer process	Process, Advantages, Disadvantages & Applications of : • Electroplating • Vacuum Metalizing • Hot Stamping • Labels and decals • Water transfer process • Flocking • Embossing and Surface Texturing

***Note**: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

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
I	Joining and Assembling Techniques	14	9	8	5	22
II	Surface Treatment	7	4	4	2	10
III	Painting and Coating	7	6	4	4	14
IV	Printing	7	5	3	2	10
V	Hot Transfer Process	7	6	4	4	14
Total		**42**	**30**	**23**	**17**	**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:

1. Students will prepare chart of various mechanical fasteners.
2. Students will prepare application list of various thermal bonding processes.
3. Students will prepare list of plastic product which require surface treatment.
4. Students will collect products with painting and coating application.
5. Students will prepare chart of various printing processes.
6. Students will collect products decorated with various hot transfer processes.

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.11***, 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.
g) Visit to nearby plastic industries performing decorative techniques.
h) Video/animation of decorating and finishing techniques.

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. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, 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 total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student 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:

1. Students will prepare plastic article using adhesive bonding.
2. Students will prepare screen for screen printing process.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1.	The Complete Part Design Handbook	Campo, E.	Hanser Publications, Ohio, 2006, 9783446412927
2.	Plastic Materials & Processes	Schwartz S.S. & Goodman S.H.	Van Nostrand Reinhold, 1982, 9780442227777
3.	Plastic Engineering Handbook	Berins M.L	Van Nostrand, 1991, 9780412991813

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
4.	Plastics Engineering Handbook	Frados J	Van Nostrand, 1976, 9780442224691
5.	Plastics Finishing and Decoration	Donatas S.	Van Nostrand, 2008, 9780442280628
6.	Decoration and Assembly of Plastic Parts	Muccio E. A	ASM International, 1999, 9780871706348
7.	Decorating Plastics	Margolis J.M	Hanser Publications, 1986, 9780029475805

14. SOFTWARE/LEARNING WEBSITES

1. https://www.jcfasteners.com
2. https://skill-lync.com/blogs/technical-blogs/design-dfma-types-of-plastics-joining-methods
3. https://youtu.be/GKYOoj0Z2uY
4. https://youtu.be/ozcv2zekPPw
5. https://youtu.be/5fAJ6Mc_8EE
6. https://www.dukane.com/resources/our-processes/vibration-welding
7. https://www.rapiddirect.com/blog/plastic-welding/
8. https://www.masterbond.com/resources/surface-preparation-plastics
9. https://www.uniquepadprinting.com/plastic
10. https://youtu.be/Gyp7eB7D1nY
11. https://youtu.be/ctL6Oc0STUU
12. https://www.plasticweldingtools.co.nz/how-to-weld-plastics/

15. PO-COMPETENCY-CO MAPPING

Semester VI	Decorating and Finishing of Plastic Products (Course Code: 4362302)									
	POs and PSOs									
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	PSO 1 An ability to apply principles of material selection, product & mold/die design and development in plastic engineering.	PSO 2 An ability to conduct safe and environment friendly manufacturing and recycling of plastic products.	PSO 3 (If needed)
Competency **Select appropriate decorating and finishing process to satisfy end user requirement.**	2	1	2	2	2	1	1	3	2	-
Course Outcomes										
1. Select suitable assembling and joining technique.	2	2	2	2	2	1	2	2	1	-
2. Apply proper surface treatment method.	2	1	2	1	2	1	1	2	1	-
3. Apply appropriate painting and coating process.	2	1	2	1	2	1	1	3	2	-
4. Perform suitable printing process.	2	1	2	1	2	1	1	3	2	-
5. Select appropriate hot transfer method for decoration.	2	1	2	1	2	1	1	3	2	-

Legend: '**3**' for high, '**2**' for medium, '**1**' for low or '**-**' for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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