GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)
Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
VI– Semester
Course Title: **Secondary Processing Techniques**
(Course Code: 4362305)

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

1. RATIONALE

The changing demands of end users with respect to products led the plastic engineers for developing various kinds of processes. A plastic diploma engineer has to monitor operations of many specialized processes. This competency requires the knowledge of these specialized processes. Hence the course has been designed to develop this competency 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:

- **Develop plastic products using appropriate specialized (secondary processes) techniques.**

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) Troubleshoot Calendaring plant.
b) Perform Casting and Encapsulation process.
c) Select appropriate technique for FRP products.
d) Select suitable vinyl dispersion process for coating and moulding.
e) Select suitable process for a cellular product.

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 the sub-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	To Prepare Raw Material for Calendering process.	1	08
2	To set process variable of Calendering Process for web.	1	04
3	To Select Suitable Calendar Roll arrangement for given product.	1	08
4	To prepare a product utilizing Casting process.	2	04
5	To prepare a product utilizing Encapsulation (Potting) Process.	2	04
6	To Prepare FRP Product using Hand lay-up process.	3	08
7	To Prepare FRP Product using Filament Winding process.	3	08
8	To Prepare hand gloves using Dip coating process.	4	08
9	To prepare product using slush molding process.	4	08
10	To prepared PU foam using RIM process.	5	04
	Total		**64**

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 of experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices measures	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This 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	Ribbon or High speed Mixer	1
2	Banbury Mixer	1
3	Calendering machine	2,3
4	Casting mould	4
5	Encapsulation machine	5
6	FRP Mould	6
7	Filament Winding Machine	7
8	Dip coating mold	8
9	Slush Mold	9
10	Reaction Injection Molding Machine	10

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 Calendering Process	1a. Identify And Select Raw Material Composition 1b. Select Suitable Calendar Arrangement. 1c. Compare Similar Processes.	1.1 Introduction 1.2 Raw Material Selection And Types of Additives 1.3 Material And Material Preparation (Premix, Blending, Gelation) 1.4 Roll Construction 1.5 Types Of Rolls – Cored And Drilled Rolls 1.6 Types Of Calenders • Superimposed Calenders • Offset Calenders • Z Calenders 1.7 Heating And Lubrication Systems For Calendar Rolls 1.8 Calendaring Process With Plant Layout 1.9 Start-Up And Shut-Down Procedure 1.10Trouble Shooting 1.11Post Calendaring Processes 1.12Compare With Sheet Extrusion. 1.13Applications 1.14Advantages And Disadvantages
Unit – II Casting And Encapsulation	2a. Identify various materials for casting 2b. Select Appropriate Material for Casting 2c. Identify various materials for Encapsulation 2d. Select Appropriate Material for Encapsulation	2.1Casting • Introduction • Casting Material And Additives • Casting Mold Materials • Casting Process • Casting Applications • Advantages And Disadvantages 2.2Encapsulation • Materials For Encapsulations • Encapsulation Process • Applications

Unit	*Unit Outcomes (UOs)* (4 to 6 UOs at Application and above level)	*Topics and Sub-topics*
UNIT III Fiber Reinforced Plastics	3a. Select Suitable Fiber and Material. 3b. Analyze Suitable Processes 3c. Select Proper Process 3d. Compare with other Processes.	3.1 Introduction 3.2 Material Selection Criteria 3.3 Introduction of various resins use in Composite 3.4 Fibers – Classification, Properties and Applications 3.5 Release Agents – Internal And External 3.6 Gel Coat Preparation and Its Application 3.7 Molding Compounds a. DMC/BMC b. SMC c. TMC d. Prepags 3.8 Mould Materials 3.9 FRP Processes a. Hand Lay Up and Spray Lay Up b. Vacuum & Pressure Bag c. Filament Winding d. Pultrusion e. Resin Transfer Molding f. Foam Reservoir Molding g. Centrifugal Molding 3.10 Trimming and Finishing 3.11 Applications 3.12 Advantages And Disadvantages
UNIT IV: Vinyl Dispersion	4a. Identify various vinyl dispersion process 4b. Distinguish Vinyl Dispersion Processes. 4c. Identify various molding processes 4d. Select appropriate molding process	4.1Introduction 4.2Resin Selection Criteria 4.3Plastisol Preparation 4.4Vinyl Dispersion Process a. Knife Coating b. Roll Coating c. Fabric Coating 4.5Molding Process a. Dip Coating And Dip Molding b. Hot And Cold Molding c. Slush Molding

Unit	*Unit Outcomes (UOs)* (4 to 6 UOs at Application and above level)	*Topics and Sub-topics*
		d. Rotational Molding 4.6Applications
UNIT V: Foam Processes	5a. Classify Blowing Agents. 5b. Identify Suitable Blowing Agent. 5c. Analyze Various Foam Materials. 5d. Select Proper Foam Material.	5.1Introduction 5.2General Production Methods 5.3Blowing Agents – Physical and Chemical 5.4Cellular Structure and Properties 5.5Flexible And Rigid Foam of a. Polyurethane (PU) b. Poly Vinyl Chloride (PVC) c. Polystyrene (PS) d. Polyethylene (PE) e. Epoxy and Silicone 5.6Applications 5.7Advantages And Disadvantages

***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 QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Calendering Process	10	5	5	5	15
II	Casting And Encapsulation	05	4	4	3	11
III	Fiber Reinforced Plastics	12	6	6	6	18
IV	Vinyl Dispersion	08	4	4	6	14
V	Foam Processes	07	4	4	4	12
Total		**42**	**23**	**23**	**24**	**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 collect information related to the experiment through internet.
2. Students will visit nearby FRP process and calendering process industry.
3. Students will collect different types of foam material.

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 industries/workshops
h) Video/animation films on Principle of Calendering, Casting & Encapsulation processes.
i) Video/animation films on various FRP processes.

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. 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:

a) Prepare a chart for different types of calendering roll arrangement.
b) Prepare a chart for plant lay-out of calendering plant.
c) Prepare chart for various types of Mixers.
d) Collect products made by Encapsulation Process.
e) Collect products made by calendering Process.
f) Collect various types of foamed product.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1.	Plastic Materials and Processes	S. S. Schwartz & S. H. Goodman	Van Nostrand Reinhold Company, 1992, 9780442227777
2.	Plastic Engineering Handbook	J. L .Fredoz	Van Nostrand Reinhold Company, 1991, 978-1461576068
3.	SPI Plastic Engineering Handbook	M. Bearins	Springer, 2012, 9781461576068
4.	Calendering of Plastics	Elden & Swan	American Elsevier Publishing Company, 1971, 9780592054391
5.	FRP Technology	R. G. Weatherhead	Applied Science Publisher, 1980, 978-9400987234

14. SOFTWARE/LEARNING WEBSITES

1. https://www.youtube.com/watch?v=KSwqKPgaLqs
2. https://www.youtube.com/watch?v=1vrLXTzS9lo
3. https://www.youtube.com/watch?v=RyEiIJB6asM
4. https://www.youtube.com/watch?v=_m29-u37TI8
5. https://www.youtube.com/watch?v=nwHgRGdjqOQ
6. https://www.youtube.com/watch?v=y2HICMOe5p4
7. https://www.youtube.com/watch?v=wRIEl-5_uBE
8. https://www.youtube.com/watch?v=7iITFBVA_0w

15. PO-COMPETENCY-CO MAPPING

Semester VI	Secondary Processing Techniques (Course Code: 4362305)									
	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 **Develop plastic products using appropriate specialized (secondary processes) techniques.**	2	2	2	2	2	2	2	2	2	-
Course Outcomes 1. Troubleshoot Calendaring plant.	2	3	1	1	1	1	1	1	3	-
2. Perform Casting and Encapsulation process.	2	2	2	2	2	2	2	2	2	-
3. Select appropriate techniques for FRP products.	2	1	2	2	2	1	1	2	2	-
4. Select suitable vinyl dispersion process for coating and moulding.	2	1	2	2	2	1	1	2	2	-
5. Select suitable process a cellular product.	2	1	2	2	2	1	1	1	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

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