

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT****COURSE CURRICULUM  
COURSE TITLE: SECONDARY PROCESSING TECHNIQUES  
(COURSE CODE: 3362305)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
Plastics Engineering	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 course should be taught and curriculum should be implemented with the aim to develop required skills in the students so that they are able to acquire following competency:

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

**3. COURSE OUTCOMES (COs)**

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Identify needs of specialized fabrication techniques.
- Compare specialized fabrication techniques
- Identify manufacturing requirements of various processes.
- Analyse and compare various processes.
- Select suitable process for production of articles.
- Carry out different secondary processes on plastic products

#### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	4	7	70	30	40	60	200

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit  
ESE - End Semester Examination; PA - Progressive Assessment.

#### 5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
<b>Unit – I Calendering Process</b>	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 a. Superimposed Calenders b. Offset Calenders c. 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 1.10 Trouble Shooting 1.11 Post Calendaring Processes 1.12 Compare With Sheet Extrusion. 1.13 Application 1.14 Advantages And Disadvantages
<b>Unit – II Casting And Encapsulati on</b>	2a. Select Appropriate Material For Casting And Encapsulation 2b. Compare Similar Processes	2.1 Casting 2.1.1 Introduction 2.1.2 Casting Material And Additives 2.1.3 Casting Mold Materials 2.1.4 Casting Process 2.1.5 Casting Applications 2.1.6 Advantages And Disadvantages 2.2 Encapsulation 2.2.1 Materials For Encapsulations 2.2.2 Encapsulation Process 2.2.3 Applications

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
<b>Unit – III Fiber Reinforced Plastics</b>	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 <ul style="list-style-type: none"> <li>a. DMC/BMC</li> <li>b. SMC</li> <li>c. TMC</li> <li>d. Prepags</li> </ul> 3.8 Mould Materials 3.9 FRP Processes <ul style="list-style-type: none"> <li>a. Hand Lay Up</li> <li>b. Spray Lay Up</li> <li>c. Vacuum &amp; Pressure Bag</li> <li>d. Filament Winding</li> <li>e. Pultrusion</li> <li>f. Match Die Molding</li> <li>g. Resin Transfer Molding</li> <li>h. Foam Reservoir Molding</li> <li>i. Centrifugal Molding</li> <li>j. Vacuum Impregnation And Injection</li> </ul> 3.10 Trimming And Finishing 3.11 Applications 3.12 Advantages And Disadvantages
<b>Unit – IV Vinyl Dispersion</b>	4a. Distinguish Vinyl Dispersion Processes. 4b. Select Molding Process.	4.1 Introduction 4.2 Resin Selection Criteria 4.3 Plastisol Preparation 4.4 Vinyl Dispersion Process <ul style="list-style-type: none"> <li>a. Spread Coating</li> <li>b. Knife Coating</li> <li>c. Roll Coating</li> <li>d. Fabric Coating</li> <li>e. Film Casting</li> </ul> 4.5 Molding Process <ul style="list-style-type: none"> <li>a. Dip Coating And Dip Molding</li> <li>b. Hot And Cold Molding</li> <li>c. Slush Molding</li> <li>d. Rotational Molding</li> <li>e. Strand Coating</li> </ul> 4.6 Applications

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
<b>Units-V Foam Processes</b>	5a. Classify Blowing Agents. 5b. Identify Suitable Blowing Agent. 5c. Analyze Various Foam Materials. 5d. Select Proper Foam Material.	5.1 Introduction 5.2 General Production Methods 5.3 Blowing Agents a. Physical b. Chemical 5.4 Cellular Structure And Properties 5.5 Flexible And Rigid Foam of a. Polyurethane (PU) b. Poly Vinyl Chloride (PVC) c. Polystyrene (PS) d. Polyethylene (PE) e. Epoxy f. Silicone g. Urea Formaldehyde (UF) 5.6 Applications 5.7 Advantages And Disadvantages

#### 6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (Theory)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
<b>I</b>	Calendaring Process	09	5	5	5	<b>15</b>
<b>II</b>	Casting and Encapsulation	06	4	4	3	<b>11</b>
<b>III</b>	Fiber Reinforced plastic	12	6	6	6	<b>18</b>
<b>IV</b>	Vinyl Dispersion	08	4	4	6	<b>14</b>
<b>V</b>	Foam Processes	07	4	4	4	<b>12</b>
<b>TOTAL</b>		<b>42</b>	<b>23</b>	<b>23</b>	<b>24</b>	<b>70</b>

**Legends:** R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

**Note:** This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

## 7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical. However, if these practical are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

*Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.*

S. No.	Unit Number	Practical/Exercise	Approx. Hours Required
1	I	Demonstrate calendering process.	4
2	I	Demonstrate composition, heating and lubrications of Calendering rolls.	4
3	I	Demonstrate types of calender arrangements.	4
4	II	Manufacture product utilizing casting process.	4
5	II	Demonstrate encapsulation process.	4
6	III	Demonstrate various moulding compounds for FRP.	8
7	III	Prepare FRP product using contact moulding.	4
8	III	Demonstrate filament winding process for making FRP products.	8
9	IV	Demonstrate various Vinyl Dispersion preparation processes.	4
10	IV	Demonstrate moulding processes for Vinyl Dispersion.	4
11	V	Demonstrate general production methods of Foam plastics.	4
12	V	Demonstrate production method of expandable PS Foam.	4
<b>TOTAL</b>			<b>56</b>

## 8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Collect information about various FRP products and their manufacturing processes.
- ii. Collect information about industries related to these secondary processes by exploring internet.
- iii. Visit nearby processing industries.
- iv. Survey market and collect different plastic items and discuss in class the material and advanced processes used in making it.

## 9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Arrange expert lectures by inviting engineers from related industries
- ii. Arrange visit to nearby plastic processes industry having state of art machines.
- iii. Show video/animation of different machining/fabrication operation
- iv. Give students (in group of 3 to 4) mini project on different special/secondary processes and ask them to collect information from internet/nearby industries and present in a class seminar.

## 10. SUGGESTED LEARNING RESOURCES

### (A) List of Books:

Sr. No.	Title of Book	Authors	Publication
1	Plastic Materials and Processes	S. S. Schwartz & S. H. Goodman	Van Nostrand Reinhold Company
2	Plastic Engineering Handbook	J. L. Fredoz	Van Nostrand Reinhold Company
3	SPI Plastic Engineering Handbook	M. Bearins	Springer
4	Calendering of Plastics	Elden & Swan	American Elsevier Publishing Company
5	FRP Technology	R. G. Weatherhead	Applied Science Publisher

### (B) List of Major Equipment/Instruments

- (i) Models/Charts of various special/secondary processes.
- (ii) Sample of plastic items manufactured using advance/secondary processes

### (C) List of Software/Learning Websites:

- i. [en.wikipedia.org](http://en.wikipedia.org)
- ii. [http://www.appropedia.org/Polymer\\_Calendering](http://www.appropedia.org/Polymer_Calendering)
- iii. [http://www.moldedfiberglass.com/sites/default/files/docs/MFG\\_Selecting\\_FRP\\_Composite\\_for\\_Projects.pdf](http://www.moldedfiberglass.com/sites/default/files/docs/MFG_Selecting_FRP_Composite_for_Projects.pdf)

- iv. <http://www.reichhold.com/corrosion/docs/Materials%20Selection%20Guide%20Final%20Version.pdf>
- v. [http://www.lindeus.com/internet.lg.lg.usa/en/images/1776E\\_Foaming\\_with\\_inert\\_gases\\_brochure\\_hires138\\_74264.pdf](http://www.lindeus.com/internet.lg.lg.usa/en/images/1776E_Foaming_with_inert_gases_brochure_hires138_74264.pdf)

## **11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**

### **Faculty Members from Polytechnics:**

- **Prof. A.S.Amin**, LPE, Government Polytechnic, Ahmedabad.
- **Prof. J.R.Desai**, LPE, Government Polytechnic, Valsad.
- **Prof (Smt.) S.R.Shah**, LPE, Government Polytechnic, Valsad.
- **Prof. M.K.Thakarar**, LPE, Government Polytechnic, Valsad.
- **Prof. B.I.Oza**, LPE, Government Polytechnic, Ahmedabad.
- **Prof. N.C.Suvagya**, LPE, Government Polytechnic, Chhotaudepur.

### **Coordinator and Faculty Members from NITTTR Bhopal**

- **Dr. Shashi Kant Gupta**, Professor and Coordinator for State of Gujarat
- **Dr. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering