

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

COURSE TITLE: BLOW ROTATIONAL AND THERMOFORMING PROCESS (Code: 3342301)

Diploma Programme in which this course is offered	Semester in which offered
Plastic Engineering	4 th Semester

1. RATIONALE

In almost every plastic plant or industry dealing with the production of hollow and thin walled plastic products, Blow moulding, Rotational moulding and Thermoforming processes have to be performed. A diploma plastic engineer has to understand and operate the machines, perform processes troubleshoot, deal with processing problems and finally produce a moulded product. Hence the course has been designed to develop this competency and its associated cognitive, practical and affective domain learning outcomes in the students.

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:

- **Plan and supervise the blow, rotational and thermoforming process.**

3. COURSE OUTCOMES

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

- i. Design various moulding process.
- ii. Select appropriate material for different moulding process.
- iii. Operate blow moulding process.
- iv. Operate rotational and thermoforming.
- v. Differentiate between blow moulding, rotational and thermoforming.
- vi. Troubleshoot processing problems in blow moulding, rotational and thermoforming.
- vii. Apply the safety rules.

4. TEACHING AND EXAMINATION SCHEME

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

Legends: L -Lecture; T -Tutorial/Teacher Guided Student Activity; P -Practical; C - Credit; ESE-End Semester Examination; PA -Progressive Assessment

5. DETAILED COURSE CONTENTS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
UNIT I: Blow Moulding	1a. Describe basic principle Blow moulding processes. 1b. List types of Blow moulding process 1c. Compare Injection Blow moulding & Extrusion Blow moulding 1d. State the Advantages & disadvantages of process Applications of Blow moulding process	1.1 Blow Moulding Process 1.1.1 Basic principle of Blow moulding 1.1.2 Types of Blow moulding Process Injection Blow Moulding Extrusion Blow moulding- intermittent & continuous 1.1.3 Compare Injection Blow moulding & Extrusion Blow moulding 1.1.4 Advantages & disadvantages of process 1.1.5 Applications of Blow moulding process
	1e. List the Polymer selection criteria 1f. State the various types of materials 1g. Various types of materials for blow moulding	1.2 Materials For Blow Moulding 1.2.1 Polymer selection criteria 1.2.2 Various types of materials
	1h. Explain various parts of Blow moulding machine. 1i. Describe the Extruder & its requirements	1.3 Blow Moulding Machine 1.3.1 Extruder & its requirements 1.3.2 Die head & parison die 1.3.3 Die orifice and mandrel design
	1j. List the Parison blowing systems 1k. Describe the calibration steps of Mandrel inflation-Top mandrel, Bottom mandrel systems 1l. Explain parison blowing systems. 1m. Describe the Control of parison wall thickness by programming	1.4 Parison 1.4.1 Parison formation 1.4.2 Parison blowing systems 1.4.3 Needle inflation 1.4.4 Mandrel inflation-Top mandrel, Bottom mandrel, Top mandrel with calibration 1.4.5 Parison programming and Parison wall thickness control
	1n. Describe the various process parameters for Blow moulding process 1o. List the effects of process variables such as raw material, parison die, air entrance, mould cooling & parison wall thickness control 1p. Describe Post moulding operations	1.5 Processing Parameters 1.5.1 Various Blow moulding processing parameters 1.5.2 Effects of process variables such as raw material, parison die, air entrance, mould cooling & parison wall thickness control 1.5.3 Post moulding operations 1.5.4 Trouble shooting

	1q. List the fault in Blow Moulding 1r. Describe the Solutions for Blow Moulding processing problems	
UNIT II: Rotational Moulding	2a. Describe Rotational moulding process. 2b. State the Advantages and disadvantages of Rotational moulding 2c. List the Applications of Rotational moulding	2.1 Rotational Moulding Process 2.1.1 Process steps 2.1.2 Advantages and disadvantages of Rotational moulding 2.1.3 Applications of Rotational Moulding
	2d. List Types of moulding materials 2e. Describe Moulding material requirements 2f. Select the appropriate material for Rotational moulding	2.2 Materials 2.2.1 Moulding material requirements 2.2.2 Types of moulding materials
	2g. Identify various parts of Rotational moulding machine	2.3 Rotational Moulding Machine 2.3.1 Rock and roll machine 2.3.2 Clamshell 2.3.3 Vertical machine 2.3.4 Shuttle machine 2.3.5 Fixed arm Carousel type machine 2.3.6 Independent arm type machine 2.3.7 Oil jacketed machine 2.3.8 Electrically heated machine
	2h. Describe the steps of Design of various Rotational moulds 2i. List the Mould materials 2j. State the importance of Heating & cooling of mould	2.4 Rotational Moulds 2.4.1 Rotational molds design 2.4.2 Mould materials 2.4.3 Heating & cooling of mould
	2k. Set processing parameters 2l. Solve processing problems in Rotational moulding 2m. Differentiate the blow moulding and rotational moulding	2.5 Part Design 2.6 Process Variables 2.7 Trouble Shooting 2.8 Comparison With Blow Moulding
	UNIT III Thermo Forming	3a. Classify the Thermoforming processes. 3b. Describe the Various stages of thermoforming process 3c. Explain various methods of forming 3c.1 Vacuum Forming 3c.2 Pressure forming 3d. State the Advantages and disadvantages of thermoforming 3e. List the applications of thermoforming process

	3f Select the appropriate material for Thermoforming	3.2 Materials 3.2.1 Material requirements 3.2.2 Types of material
	3g List the types of thermoforming machines 3g.1 Describe various Thermoforming machines	3.3 Thermoforming Machines 3.3.1 Single-stage sheet fed machine 3.3.2 Multiple stage sheet fed machine 3.3.3 In-line sheet fed machine 3.3.4 Continuous roll fed machine 3.3.5 Packaging machines
	3h Explain processing requirements for thermoforming	3.4 Processing Requirements 3.4.1 Heating methods 3.4.2 Temperature control 3.4.3 Vacuum/air pressure 3.4.4 Cooling 3.4.5 Trimming
	3i Set various process parameters for Thermoforming process 3j Solve processing problems in Thermoforming 3k Differentiate the blow, rotational and thermoforming process.	3.5 Process Variables 3.6 Trouble Shooting 3.7 Comparison With Blow And Rotational Molding

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
I	Blow Moulding	18	18	10	07	35
II	Rotational Moulding	14	08	06	06	20
III	Thermoforming	10	07	04	04	15
	Total Hrs	42	33	20	17	70

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

Notes:

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/exercises 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/exercises. However, if these practical/exercises 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/Exercises (Outcomes' in Psychomotor Domain)	Approx Hours Req'd.
1	I	Demonstrate the constructional details of a blow moulding machine.	02
2	I	Determine cycle time for a given product for blow moulding process.	04
3	I	Set process parameters on a blow moulding machine.	04
4	I	Control wall thickness of parison by parison programming system.	04
5	I	Identify problem associate with Blow moulding process.	04
6	II	Demonstrate the constructional details of a rotational moulding machine.	02
7	II	Determine cycle time for a given product for rotational moulding process.	04
8	II	Set process parameters on a rotational moulding machine.	04
9	II	Identify various problems during Rotational moulding process.	04
10	II	Prepare comparison chart for blow moulded and rotational moulded products.	02
11	III	Demonstrate the constructional details of a Thermoforming machine.	02
12	III	Determine cycle time for a given product for Thermoforming process.	04
13	III	Set process parameters on a Thermoforming machine.	04
14	III	Identify various problems during Thermoforming process.	04
15	I	Plan preventive maintenance schedule for blow moulding machine	04
16	II	Plan preventive maintenance schedule for rotational moulding machine	04
TOTAL			56

Notes:

- a. It is compulsory to prepare log book of exercises. It is also required to get each exercise recorded in logbook, checked and duly dated signed by teacher.
- b. Term work report must not include any photocopy/ies, printed manual/pages, litho, etc. It must be hand written / hand drawn by student only.
- c. Term work report content of each experience should also include following.
 - i. Experience description / data and objectives.
 - ii. Drawing of experience / setup with labels/nomenclature to carry out the experience.
 - iii. The specifications of machines / equipments / devices / tools /instruments /items/elements which is / are used to carry out and to check experience.
 - iv. Process parameters / setup settings' values applied to carry out experience.
 - v. Steps / Process description to execute experience.

- d. Mini project and presentation topic/area has to be assigned to the student in the beginning of the term by batch teacher. This may be assigned individually or in the group of maximum 2 to 3 students.
- e. For ESE, students are to be assessed for competencies achieved.

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

- i. Students will collect Blow moulded, Rotational moulded and Thermoformed products like bottle, jar, jerry can disposable dish etc. and would comment on their quality.
- ii. Students will collect information related to the experiment through internet.
- iii. Students will visit nearby industry having blow, rotational and thermoforming operations.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Visit to nearby plastic industries engaged in Blow, Rotational and Thermoforming.
- ii. Video/Animation films on working of different type of Blow, Rotational and Thermoforming process may be shown.
- iii. Mini project may be given to students on different defects in the various Blow, Rotational and Thermoforming products, reasons for these defects and possible remedies.

10. SUGGESTED LEARNING RESOURCES

(A) List of Books:

Sr no.	Title of Books	Author	Publication
1.	Blow Moulding of Plastics	E. G. Fisher	The Plastics Institute
2.	Blow Moulding Handbook	Rosato & Rosato	Hanser Publishers
3.	Plastic Blow Moulding Handbook	Norman Lee	Van Nostrand Reinhold Company
4.	Rotational Moulding	Glenn Beall	Hanser verlag
5.	Rotational Moulding of Plastics	R.J.Crawford	Plastics Design Library William Andrew Publishing
6.	Moulding of Plastics	Norbert Bikales	Wiley Interscience
7.	Handbook of Plastic Technology	Allen & Baker	CBS Publishers & Distributors
8.	Plastic Materials and Processes	S.S.Schwartz & S.H.Goodman	Van Nostrand Reinhold Company
9.	Plastic Engineering Handbook	J.L.Frados	Van Nostrand Reinhold Company
10.	SPI Plastic Engineering Handbook	M Berins	Springer
11.	Technology of Thermoforming	J.L.Throne	Hanser Publishers
12.	Thermoforming- A Plastics Processing Guide	G.Gruenwald	Technomic Publishing AG

B. List of equipments:

- i. Blow moulding machine with parison programming system
- ii. Rotational moulding machine
- iii. Thermoforming machine with heating system for sheet
- iv. Scrap grinder

- v. Weighing scale
- vi. Stop watch

C. List of Software/Learning Websites:

- i. <http://www.bpf.co.uk/>
- ii. <http://www.youtube.com>
- iii. <http://www.technologystudent.com/>
- iv. <http://www.notesandsketches.co.uk/Index.html>
- v. <http://www.paulsontraining.com>
- vi. <http://www.traininteractive.com>
- vii. <http://www.tecni-form.com/moulding-animation.php>
- viii. http://www.rotomolding.net/rotomolding_demo.html
- ix. http://en.wikipedia.org/wiki/Rotational_molding
- x. <http://rotomolding.blogspot.in/2007/09/great-rotational-molding-animation.html>
- xi. <http://people.bath.ac.uk/en3hl/blow.html>
- xii. <http://www.kenplas.com/project/pet/petblow.aspx>
- xiii. <http://www.4spe.org/online-store/ten-fundamentals-thermoforming-videodvd-program>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics:

- **Prof. A. S. Amin**, Lecturer in Plastic Engineering, Govt. polytechnic, Ahmedabad
- **Prof. J. R. Desai**, Lecturer in Plastic Engineering, Govt. polytechnic, Valsad
- **Prof. M. K. Thakarar**, Lecturer in Plastic Engineering, Govt. polytechnic, Valsad
- **Prof. B. I. Oza**, Lecturer in Plastic Engineering, Govt. polytechnic, Ahmedabad
- **Prof. N. C. Suvagya**, Lecturer in Plastic Engineering, G.P., Chhotaudepur

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Abhilash Thakur**, Associate Professor, Department of Applied Sciences
- **Dr. Bashirullah Shaikh**, Assistant Professor, Department of Applied Sciences