GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: DESIGN FOR BLOW AND THERMOFORMING MOULDS
(COURSE CODE: 3362301)

Diploma Programme in which this course is offered	Semester in which offered
Plastic Engineering	Sixth

1. RATIONALE

The changing demands of customers with respect to shape and dimensions of containers and disposable items led the plastic engineers for developing various kinds of moulds. A Plastic Diploma engineer has to monitor operations and maintenance of Blow and Thermoforming moulds. This competency requires the knowledge of constructional details of Blow and Thermoforming Moulds. Hence the course has been designed to develop this competency and its associated cognitive, practical and affective domain learning outcomes.

2. COMPETENCIES

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-

- **Design and manufacture blow and thermoforming moulds based on requirements.**

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.

i. Select suitable mould materials.
ii. Explain design considerations for blow moulds.
iii. Use Mould cooling channels for various sections of mould and ancillary elements for blow mould.
iv. Employ thermoforming mould materials for prototype and production tooling.
v. Design thermoforming moulds for different shaped 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	200
3	0	4	7	70	30	40	60	

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	Topics and Sub-topics
Unit – I **Blow Mould Materials**	1a. Identify blow mould materials requirements 1b. Classify mould materials	1.1 Introduction of Blow Mould 1.2 Mould Material Selection Requirements : 1.3 Types of Mould Materials
Unit- II **Blow Mould Design Considerations**	2a. Design injection blow mould. 2b. Design Extrusion blow moulds. 2c. Describe Flash removal methods 2d. Describe Mould cleaning methods .	2.1 Injection Blow Mould 2.1.1 Mould Construction, Injection Blow Mould Design, Core rods/Parison Stick Design 2.2 Extrusion Blow Mould 2.2.1 Design procedure of Extrusion Blow Mould. 2.2.2 Mould Cavity Design 2.2.3 Method for deciding clamping force 2.2.4 Design consideration for mould parting line 2.2.5 Mould finish and Mould Venting 2.2.6 Cavity surface considerations 2.2.7 Welding edges & flash pockets in pinch-off 2.2.8 Neck insert design considerations 2.2.9 Radii and corner edge designs 2.2.10 Moulded holes and handle design 2.2.11 Shrinkage considerations 2.2.12 Blow and swell ratio 2.2.13 Moulds for undercut products (moving section moulds) 2.2.14 Flash removal methods 2.2.15 Mould cleaning methods
Unit – III **Blow Mould Cooling and Ancillary Elements**	3a. Draw cooling channels for various sections of mould. 3b. Describe ancillary elements for blow mould.	3.1 Mould Cooling 3.1.1 Significance of mould cooling. 3.1.2 Cooling designs for neck, pinch-off and main body. 3.2 Ancillary Elements 3.2.1 Base plates 3.2.2 Alignment pins 3.2.3 Striker plates 3.2.4 Ejection Methods
Unit – IV **Thermoforming Mould Materials**	4a. Describe thermoforming mould materials requirements 4b. Classify mould materials for prototype and production tooling	4.1 Thermoforming Mould Materials 4.1.1 Introduction of Thermoforming Moulds 4.1.2 Mould Material requirements 4.1.3 Types of mould materials for prototype and production tooling
Unit – V **Thermoforming Mould Design**	5.a. Describe various components of thermoforming moulds.	Design criteria for thermoforming moulds. Design Considerations 5.1 Vent Holes/Vacuum Holes-Number of vents ,Size, Position and types

Unit	Major Learning Outcomes	Topics and Sub-topics
Considerations	5.b. Design thermoforming mould. 5.c. Describe Mould cooling designs. 5.d. Describe mould ejection techniques. 5.e. Describe application of Mould Releasing Agents. 5.f. Describe Multi-impression Moulds methods.	5.2 Shrinkage and Draft Angle Considerations 5.3 Plug Design (For Plug Assist Mould)- Plug material, Shape of plug, Plug design concepts 5.4 Sheet clamping mechanisms 5.5 Draw ratios and its importance 5.6 Chamfers and radii 5.7 Surface treatments 5.8 Surface texture 5.9 Mould cooling designs 5.10 Use of moving elements - collapsing cores, `Unscrewing devices, cammed sections and slides 5.11 Ejection techniques 5.12 Application of Mould Releasing Agents 5.13Moulds for undercuts 5.14 Multi-impression Moulds, factors to be considered for deciding correct impression layout, method of determining the number of impressions for a given forming platform size and product size, Design and draw thermoforming mould for multi-impressions.

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 Mould Materials	4	2	4	0	**6**
II	Blow Mould Design Considerations	16	6	6	14	**26**
III	Blow Mould Cooling and Ancillary Elements	6	3	4	3	**10**
IV	Thermoforming Mould Materials	4	2	4	0	**6**
V	Thermoforming Mould Design Considerations	12	4	4	14	**22**
TOTAL		**42**	**17**	**22**	**31**	**70**

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 No.	Practical/Exercise (outcomes in psychomotor domain)	Approx Hours Required
1	II	Design and draw sectional elevation, plan and inverted plan of blow moulds. (For different shapes to be casted, number of sheets would depend upon complexity of shapes. Faculty should give enough number of sheets to students to justify the time allocated)	28
2	II	Draw detail drawings of mould drawn in above.	14
3	V	Design and draw sectional elevation, plan and inverted plan of Thermoforming mould. (For different shapes to be casted, number of sheets would depend upon complexity of shapes. Faculty should give enough number of sheets to students to justify the time allocated)	14
		TOTAL	**56**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

i. Collect different shaped blow moulded articles and analyze the type of mould suitable for that product.
ii. Collect different shaped thermoformed articles and analyze the type of mould suitable for that product.
iii. Collect information related to mould technology through internet.
iv. Visit nearby mould making industry.
v. Prepare journals based on practical performed in laboratory.

9. SPECIAL INSTRUCTIONAL STRETEGIES (If any)

i. Arrange expert lectures.
ii. Arrange visit to nearby mould making industry.
iii. Show relevant video/animations.
iv. Give as many mould drawing exercises as possible.

10. SUGGESTED LEARNING RESOURCES

(A) List of Books:

SR. NO.	TITLE OF BOOK	AUTHORS	PUBLICATION
1	Blow Moulding Handbook	Rosato/Rosato	Van Nostrand Reinhold
2	Plastic Blow Moulding Handbook	Norman Lee	Van Nostrand Reinhold
3	Blow Moulding	Fisher	Butterworth & Co.
4	Technology of Thermoforming	James L. Throne	Hanser Gardner Publications
5	Fundamentals of Plastics Thermoforming	Peter Klein	Morgan & Claypool Publishers

(B) List of Software/Learning Websites:

i. http://www.custom-pak.com/product-design-development/blow-moulding-design-guide/#d
ii. https://techcenter.lanxess.com/scp/americas/en/docguard/Part_and_Mould_Design_Guide.pdf?docId=77015
iii. http://www.plastiglas.com.mx/images/content/PLASTIGLAS_INST/uploads/1168103546998Thermoforming.pdf
iv. http://www.thermoform.com/tempsite/profileFlip/PP_designguide.pdf
v. http://www.multifab-inc.com/guidelines.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**.**
- **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. Abhilash Thakur,** Associate Professor, Department of Applied Sciences.