GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering
Level: Under Graduate
Branch: Plastics Engineering
Subject Code: BE05053011
Subject Name: Plastic Injection Moulding Technology

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Core Course

Prerequisite:	□ Knowledge of thermoplastics, thermosets, and their basic processing properties. □ Basic understanding of common polymer processing methods. □ Understanding of machine components such as screws, barrels, heaters, and clamping systems.
Rationale:	The Injection molding process is a versatile technique for manufacturing of finished plastic products. The course designed here will help the students to understand basic principle of Injection molding machine and its technology. It will help them to operate injection molding machine and troubleshoot the faults arising during processing.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Understand the Injection Moulding process.
02	Understand different constructional feature of Injection Machine Component.
03	Set up the different parameters of Injection Moulding machine.
04	Operate Injection Moulding Machine.
05	Trouble shoot Injection Moulding Defects

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL	TH		ESE (E)	PA (M)	PA/ (I)	PBL (I)	ESE (V)	
45	00	30	45	120	04	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End- Semester Examination, PA = Progressive Assessment

Course Content:

Unit No.	Content	No. of Hours	% of Weightage

1.	**Introduction to Injection Moulding** • Overview of Injection Moulding Process • Injection Moulding Machines • Injection Machine Operation • Basic Principles of Reciprocating Screw Injection Machine • Basic Principles of Plunger Type Injection Machine • Injection Moulding Cycle • Cycle Time Estimation • Types of Injection Moulding Machines	5	10
2.	**Constructional Features of Injection Moulding Machine** **Injection Unit:** • Hopper and Feeding System • Barrel Types (Bimetallic Barrel, Grooved Barrel, Nitrided Barrel, Vented Barrel) • Thermocouples and Heating System • Screw Design and Types • Screw Characteristics and Screw Conveying • Screw Output and Melt Mechanism • Screw Tip Assemblies • Screw Drive System • Nozzle Types (Standard, Needle Type, Nylon Nozzle) • Injection End Specifications **Clamping Unit:** • Clamp Mechanisms • Clamp End Specifications • Toggle Clamp System • Hydraulic Clamp System • Comparison: Hydraulic vs Toggle Clamps • Other Clamp Mechanisms (Vertical/Horizontal Clamp, Long Stroke Clamp, Lock and Block Clamp) • Clamping Tonnage Calculations • Projected Area Calculation	12	25
3.	**Process Details of Injection Moulding** • Machine Start-up Procedure • Machine Shutdown Procedure • Injection Moulding Process Steps • Process Variables (Temperature, Pressure, Time, Speed) • Pressure Profile in Mould Cavity • PVT (Pressure–Volume–Temperature) Diagram	7	20

	• Advantages of Injection Moulding • Limitations / Disadvantages of the Process		
4.	**Injection Moulding of Thermosetting Plastics** • Overview of Thermoset Injection Moulding • Process Operations (Start-up, Running, Shutdown) • Process Considerations • Materials Used in Thermoset Injection Moulding • Part Design Considerations • Cold Runner Moulding • Troubleshooting in Thermoset Moulding • Influence of Major Injection Machine Variables	8	15
5.	**Auxiliary Equipment for Injection Moulding** • Hopper Dryers • Ovens • Hopper Loaders / Auto Loaders • Granulators / Regrinders • Mould Temperature Regulators • Material Conveying Systems / Conveyors	5	15
6.	**Faults and Correction (Trouble Shooting)** Brittleness -Bubbles and voids-Crazing-Discoloration-Flashing-Flow marks-Silver Streaks-Nozzle Drooling--Short Shots-Sink Marks-Sprue Sticking-Cavity Sticking-Surface Sticking-Warping-Weld Lines	8	15
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	25	10	5	5	5

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Injection Moulding- Irwin I. Rubin
2. SPI Plastics Engineering Handbook of the Society of the Plastics Industry - Michael L. Berins
3. Thermosetting Plastics: Moulding Materials and Processes by John F Monk
4. Injection moulding M/c by Whelan,

5. Plastics Engg. Handbook by Jeol Frados.
6. Plastics material and Processes by Schwartz and Goodman.
7. Injection moulding machine by Johannaber.
8. A Guide to Injection Moulding of Plastics by Bolur

(b) Open source software and website:

- https://nptel.ac.in/courses/112107221/9
- https://nptel.ac.in/courses/112107221/10
- https://nptel.ac.in/courses/112107086/17
- https://nptel.ac.in/courses/112107221/20
- https://nptel.ac.in/courses/107103012/module2/lec4.pdf
- https://nptel.ac.in/courses/112107085/module4/lecture5/lecture5.pdf
- https://nptel.ac.in/courses/103103029/module7/lec38/7.html
- http://www.pitfallsinmolding.com/

Suggested Course Practical List:
Practical based on above topics.

List of suggested activities for Term-Work / Self-Learning:

S. No.	Activity	No. of Hours	Total Hours Claimed	Evaluation Criteria
1	Industry / Research laboratory visit	Visit = 5 h, Report preparation = 5 h	10	Based on report submitted
2	Poster / chart / power point preparation on technical topics	Duration = 10 h	10	Based on Poster / Chart / PPT preparation and presentation skills
3	Assignment writing	5 assignments of 2 h each	10	Based on the assignment submitted
4	Technical Video based learning related to the subject	Duration of video = 5 h Report preparation = 5 h	10	Report / presentation based on the video learning outcomes
5	Group Discussion on emerging / trending technical topics based on subject	Duration = 1 h each	-	Based on performance in group discussion, technical depth, knowledge, etc.
6	Attending Expert Lecture / Webinar / Seminar	Duration = 1 h each	-	Based on Short report
7	Self-learning on-line course	Minimum duration of the course should be 10 h	10	Examination based assessment at the end of course. Based on the

				certificate produced
8	Exhibition / Conference / Trade Fair / Industrial exposure for 2-3 days	Visit = 15 h, Report preparation = 5 h	20	Based on learning, observations and short report
9	Working model on technical topics	Working = 15 h	15	Based on design, understanding & presentation of the model
10	Non-working model on technical topics	Non-working = 5 h	5	Based on design, understanding & presentation of the model
11	Videos on Industrial safety aspects based on subject	Duration of video = 5 h Report preparation = 5 h	10	Based on report submitted

- Above activities are suggestive, faculty can choose any of these activities and cover up the rest of the 45 Self Learning Hours.
- The number of hours is suggestive.
- Faculty can sub-divide the number of hours based on the activity. However, the total number of hours is fixed.

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