GUJARAT TECHNOLOGICAL UNIVERSITY

PLASTIC TECHNOLOGY (23)
INJECTION MOLDING TECHNOLOGIES
SUBJECT CODE: 2152301
B.E. 5th SEMESTER

Type of course: Core

Prerequisite: NA

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	3	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction: Injection moulding, Machine types : : Hand , Semi Automatic and Fully Automatic, History of Injection Moulding , PLUNGER AND TOGGLE TYPE MACHINES, Reciprocating type machines, Process Steps, Theory of injection Moulding , Significance of cycle time, injection pressure ,injection speed, hold on pressure , cooling time, refill time, etc. Process description & variables, Applications.	**05**	**10**
2	**RAW MATERIALS FOR INJECTION MOULDING:** Material selection criteria, grades available, MFI, Rheological aspects of materials for injection moulding, etc.	**05**	**10**
3	CONSTRUCTIONAL FEATURES : Injection unit • Design features of various types of Nozzle and internal heated nozzle, Screw and screws for elastomers, Screw L/D RATIO, Compression ratio, Significance of Helix angle, flight depth, root diameter, overall diameter, effective screw length, pitch, etc. • Thermocouples and various types used on injection moulding machines. • Auxiliaries for Injection End, Material of Screws and barrel, hydraulic system, • Clamping Unit Hydro mechanical clamping, Full electrical clamping unit, Accessories for clamping unit, Tonnage calculations.	**15**	**25**

4	**PROCESS DETAILS :** The inside story of injection moulding, Determination of injection rate, Determination of power requirement, Pressure requirement for injection, Hydraulic pump, Trimming the process, Switching system and process variables, Mechanical system and process variables, Independence of process variables. **Understanding the injection molding process:** Melt temperature, Plasticizing, Screw rpm, Reaction pressure, Mould feeling speed profile, Switch over pressure profile, Optimization of process, Over packing, Injection time, Mould temperature, Optimization of heat flow in mould, Cooling time, Various polymers with chemical names and mfg. Orientation. Screw conveying-basic principles, screw conveying considerations, raw material selection criteria, Effect of process variables on product, Orientation and its importance in moulding, Measurement and control of orientation, How orientation can be used to advantage, Non-oriented conditions and internal stresses, Trouble shooting in detail: Shrinkage, warpage, short shots, etc. **Close loop and open loop control in injection moulding.** **Pressure profile in cavity and PVT diagram**	**15**	**25**
5	**Importance of Microprocessor in Inj. Moulding Machine:** • Hydraulic control valves - Proportional valves for pressure and flow control-Hydraulics in IMM - Microprocessor control - Stroke control - Temperature control. • Close loop and open loop control-Multi micro processor system-Capabilities of FM microprocessor control system-Quality monitor-Trades in IMM control. • Quick change system-QMC system-After sales services through modems Various trend reports-Process data acquisition. • Control unit : Microprocessor, PLC,ETC. Explanation on working of control systems, Operations synchronization, etc.	**10**	**10**
6	**Injection moulding for Thermo set** • Requirements of Injection Moulding machine for Thermosets • Characteristics of materials • Thermo set IMM process steps • Types and Features of machines • Troubleshooting	**05**	**10**
7	**NEWER DEVELOPMENTS** : Tiebar less machines, Metal Injection Moulding, Gas Injection Moulding, Fully Electric machines with applications , construction features, advantages and disadvantages.	04	**10**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**15**	**20**	**15**	**10**	**--**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's 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.

Reference Books:

1. Injection moulding theory and practice by I. Rubin—
2. Injection moulding M/c by Wheelen, -Plastics Engg. Handbook by Jeol Frados.
3. Plastics material and Processes by Schwartz and Goodman.
4. Injection moulding machine by Johannaber.
5. A Guide to Injection Moulding of Plastics by Bolur

Course Outcome:

After learning the course the students should be able to:

1. Understand the Injection Moulding process and trouble shoot the problems
2. Set up and start an Injection machine
3. Work effectively in Injection Moulding unit as Manager

List of Experiments (Laboratory Work):

1. To Study Injection Moulding cycle and process
2. To determine process parameters for LDPE material.
3. To estimate the cycle time
4. To study the hydraulic circuit
5. To study the Electrical circuit
6. To determine and establish the process parameters for processing of plastic composites
7. To study METAL INJECTION MOULDING.
8. To Study all Electric machines
9. To study GAS Injection Moulding.
10. To Estimate the cycle time for Processing of Engg.Thermoplastics

Design Based (DP)/Open Ended Problems:

To Design a Pneumatic circuit for Injection Moulding operations

Major Equipment:

1. Injection Moulding Machines: Hand, Semi Automatic, Fully Automatic

List of Open Source Software/learning website:

www.wikipedia.org

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.