GUJARAT TECHNOLOGICAL UNIVERSITY

PLASTIC ENGINEERING (24)

PLASTICS MOULD & PRODUCT DESIGN SIMULATIONS

SUBJECT CODE: 2712408

M.E. 1st SEMESTER

Type of course: Theoretical + Practical (Regular)

Prerequisite: Basic knowledge of elements of engineering graphics, and engineering drawings

Rationale: Design of moulds

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
4	0	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Injection Mould Design: Introduction: Concept of design – mould design principles – layout of impression - mould venting - mould alignment – mould location – mould clamping. Selection of machines: Specifications of machines – types of machines - shot capacity – shot weight - plasticizing capacity – nozzle details – minimum daylight – maximum daylight – projected area – Injection pressure – Locking force – shut height – ejection arrangement – dry cycle time – methodical approach to mould design - deciding number of impressions – determination of economical no. of cavities. Parting line/Parting surface: Types of parting surface - plain – stepped – irregular – local stepped and profile parting surface – complex edge form. Ejection system: Types of ejection – pin ejection – stepped pin - part pin –"D" pin – blade ejection – sleeve ejection – stripper ejection – air ejection – double ejection – delayed ejection - calculation of ejection force required. Mould temperature control: Types of cooling – Bolster cooling – integral cooling core/cavity – Insert cooling-core/cavity – Baffle cooling – Bubbler cooling – Deep chamber design - spiral cooling – cooling through heat pipes – capillary tubes- heat rods – mould temperature – melt temperature – heat removal rate – calculation of cooling time.	14	30
2	Feed System: Sprue, Runner And Gate – Determination Of Runner-Gate - Size And Cross Section- Layout Of Runners – Balancing Of Runners – Types Of Gates – Application Of Gates To Various Products/Materials – Gate Balancing. Types Of Moulds: Two Plate Mould – Single Impression – Multi Impression – Three Plate Mould – Multi Day-Light Mould – Stack Mould – Runnerless Mould – Hot Runner And Insulated Runner	10	30

	Mould - Split Moulds – External Undercut – Internal Undercut – Finger Cam, Dog Leg Cam And Cam Track Actuation – Spring - Hydraulic Actuation - Split Cavities – Split Cores – Threaded Inserts – Internal And External – Standard Mould Bases – Calculation Of Strength Of Cavities – Strength Of Guide Pillar And Support Pillar Requirements - Mould Design Check List. Blow Mould Design & Extrusion Die Design Types Of Blow Moulds – Extrusion – Injection And Stretch Blow Moulds – Blow Ratio – Parison Design – Pinch Off Design – Parting Line – Clamping Force – Mould Venting, Mould Cooling – Mould Alignment – Mould Clamping. Extrusion Die Design: Basic Concepts		
3	Compression & Transfer Mould Design: Types Of Compression Mould - Open Flash - Semi-Positive Type - Positive -Displacement Moulds - Types Of Loading Chambers - Bulk Factor - Flash Thickness - Pot Design – Depth Of Loading Chamber Calculation - Projected Area – Compression Pressure - Clamping Force – Deciding No. Of Impression By Technological Method - Heating System - Types Of Heaters - Heat Losses - Heat Requirement & Heater Capacity- Advantages And Disadvantages Of Compression Mould. Types Of Transfer Moulds - Integral Pot Transfer Mould – Top & Bottom Plunger Design - Auxiliary Ram Transfer Mould - Transfer Pot Design - Projected Area – Transfer Pressure - Clamping Force - Pressure Pad Design - Design Of Sprue Runner And Gate – Calculations - Advantages And Disadvantages Of Transfer Mould. Plunger Transfer & Screw Transfer Moulding Techniques – Moulding Cycle – Specification – Merits And Demerits Of Transfer Moulding – Theoretical Calculation Of Pressures – Line Pressure, Injection Ram Pressure – Trouble Shooting.	8	20
4	Plastics Product Design: Concepts – size, shape and function – form and function – Aesthetics, Ergonomics – Shrinkage, Flash lines. Undercuts – External & Internal - Wall thickness – variances in wall thickness – suggested wall thickness for thermoplastics and thermosetting materials – steps in product design - emphasize on designing with engineering plastics - Taper or draft - Fits & Tolerances – Designing with plastics for load bearing applications like gears, bearing, etc. Design of radii, fillets, ribs and bosses - Design for flow and shape -Moulded Holes – through holes – blind holes – threaded holes – side holes – holes parallel to draw – nearness of holes to each other and side wall – moulding holes not parallel to draw – drilled and tapped holes – moulded threads – moulded lettering – surface treatment.	6	10
5	Types of Inserts: – Materials – selection of metal for inserts – minimum wall thickness of material around inserts – anchorage – relieving moulding stresses around inserts – location of inserts in the part – moulded in inserts – pressed in inserts -Design of integral hinges, hinges and snap fits for boxes and assembly of moulded parts – Designed mismatch for part assembly. Quality and economy – tooling aspects on product design – process variables vs product design – product design appraisal - Product design limitations – shrinkage vs tolerance –end use requirements with case studies – product design tips - prototype development – rapid prototyping techniques – stereo lithography.	4	10

Reference Books:

1. R.G.W. PYE, Injection Mould Design for Thermoplastic, Affiliater East-West Press P. Ltd., New Delhi, 1989.
2. Fischer (EG), Blow moulding of plastics, Newnus Butter Worths, London, 1976.
3. MV Soshi, Dies for Plastics Extrusion, S.G. Wasant for Macmillan India Ltd., Madras, 1992.
4. DYM, Injection Mould Design, Van Nostrand Reinhold Company, New York, 1987.
5. Neil L. Hancox, Design Data for Reinforced Plastics, Chapman & Hall, London, 1994.
6. Beck, Plastic Product Design, Yan Nostrand Reinhold Company, London, 1970.
7. Norman Lee, Blow Mould Design, Hanser Publishers, Munich, 1998

Course Outcome:

After learning the course the students should be able to: designing of mould in order to develop traditional as well as new article/product. Learn details of moulds and its geometry

List of Experiments:

1	Ejection system
2	Cooling system
3	Feed System
4	Compression mould
5	Transfer mould
6	Concept of Product design & steps
7	Rapid prototyping techniques
8	Types of molds for injection moulding

Open Ended Problems:

1. Calculations to determine number of cavities and runner balancing system in mould.
2. Design two plate mould
3. Design three plate mould
4. Design the runner less mould
5. Design the compression mould- flash type, positive and semi-positive type mould
6. Design of transfer mould.

Major Equipments: to manufacture mould following machineries are major used.

Lathe and CNC Lathe, Milling and CNC Milling, Drilling machine, Grinding machine, Polishing Machine, EDM, Wire cut EDM,