

GUJARAT TECHNOLOGICAL UNIVERSITY

PLASTIC TECHNOLOGY (23) ADVANCE PLASTICS PROCESSING SUBJECT CODE: 2162308 B.E. 6th SEMESTER

Type of course: Core

Prerequisite: Basic Plastic Processing

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<p>Reaction injection molding</p> <p>A. Introduction: Definition, various terms in RIM, requirements, raw material as monomers like polyols, polyester, Isocyanates, chemistry of monomers, chemical system, concept of equivalent wt. Pre polymers hydroxyl analysis, index, additives and auxiliary materials like surfactants, catalyst, additives, expanding agents, water, harder, cross linkers, storage and handling of polyols and isocyanates. Advantages and limitations as compared to cast urethane technology, comparison with injection molding, applications.</p> <p>B. Process: Formulations, selection of process, process steps in detail from storage to shipment, process variables as mat., process, polymer property, index, density, post curing, advantages & disadvantages. instrumentation & control, gas loading, measuring the gas loading & fillers, process control, structure of micro cellular parts, process adv. & disadv., dimensional characteristics of rim parts, reinforced rim elastomers, other rim processes like nyrim etc., summary of feature of rim process, applications in various fields, PU like rigid & soft foams.</p> <p>C. Machine: Basic machine types, characteristics of ideal machine, basic components of rim machine with auxiliary equipments, description & function of individual components of rim machine like metering units with different types of pumps. Mixing unit as screw mix head & injection mix head & compounds as monomer tanks, liquid level controllers, aeration, backup pumps, fillers, drive motors, shut off controllers, pressure gauges, hoses, automatic calibration & clamping unit with classification as universal</p>	08	20%

	clamp design. Introduction of color additives in rim machine & head/lay.		
2	CALENDERING : Calendaring - Basic process, material and products, calendaring plant, types of calendars, roll construction, roll configurations, drives, heating system, film and sheet lines, laminating and embossing lines, various parameters, control and their effect on quality, defects, causes and remedy. Calendaring lines – General purpose line, pre-calender and post-calender train, special lines and arrangements, calendered flooring lines, lamination with calender. Analysis of calendaring – (through put), pressure profile through calendar, flow and pressure generation at calendar nip, roll separation forces and methods of compensation, roll bending, roll deflection, methodologies to take care of roll bending & deflection, sheet gauge thickness control.	07	15%
3	ROTATIONAL MOULDING : Rotational moulding - Basic process, materials and products parameters, temperature, speed, cooling, effect on product quality, control system, bubble formation of rotational molding, methods of bubble removal, effect of internal pressure in rotational molding, multilayer rotational moulding, rotational moulding of nylon, polyethylene etc., rotational moulding of liquid polymer. Rotational moulding equipments, drive, batch type and continuous type machines. Rotational moulding process analysis - mould temperature rise, heat and melt flow in rotational moulding, cycle time calculations.	07	15%
4	BLOW MOULDING : Blow moulding – Fundamentals of the process, complete blow moulding operation, accumulator based machines, extrusion blow moulding, injection stretch blow moulding, Blow moulding machines, start-up and shut-down procedures, process control, blow moulding plants, parisan wall thickness control, parisan swell, parisan inflation, cutting devices, process parameters and their effect on product quality control, moulding defects - causes and remedy.	10	15%
5	FOAM PROCESSES: Introduction to foam process, general production method, various definition {terminology}, foam classification; rigid - Flexible, structural. Rigid: Manufacturing foam as PU, polyester cellular, CA, thermosetting foam, epoxy resin, phenolics, UF. Flexible: Foamed vinyl, open\closed cell vinyl foam cellular poly ethylene, XLPE, ethylene copolymer monomer, silicone foam, expandable PE.	08	15%
6	Miscellaneous process: Casting, Encapsulation, Coloring, Coating, Decoration, Finishing, Machining, Printing, foil embossing, Metalisation, Electroplating.	07	10%
7	Plastic Coatings: Formulations, Applications mainly in Automobile, appliances, furniture, electronics, eyeglasses. Explanation of surface tension, modulus, coefficient of thermal expansion, structure & conformation. Types of Adhesion & Wetting	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	0

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. Blow Moulding Handbook, Ronald Rosato & Dominick Rosato, Hanser Publication, 1989.
2. Principles of Polymer Processing, John Wiley N.Y. Tadmor Z. Gogos C.G., A Wiley – Interscience Publication, 1979
3. Fundamentals of Polymer Processing, Stanley Middleman, McGraw Hill Education, 1977
4. Plastics Engineering, J. Crawford, Butterworth –Heinemann, [3rd edition], 2006
5. Introduction to RIM: Swaneoy P. 7. Reaction Injection Molding: Walter Backer 8. Fundamentals of RIM: Christopher W. M., Hanser publications
6. Calendaring of plastics - R.A. Elden, A.D. Swan London Iliffe books., 1971
7. Plastic materials & process: Schwartz & Goodman

Course Outcome:

After learning the course the students should be able to:

1. Have thorough knowledge of various processing operations.
2. Be able to start and operate a processing machine for practical production.
3. Trouble shoot problems in processing

List of Experiments:

1. Extrusion blow moulding of PP/HDPE/PVC.
2. Study of injection stretch blow molding of PET.
3. Study of effect of process parameters on blow moulding.
4. Rotational moulding of various materials.
5. Effect of process parameters (temperature, speed ratio of the two axes, cooling etc.) on the quality of a rotationally moulded product.
6. Demonstration & study of screen printing on plastics.
7. High frequency welding of PVC and study of other methods of welding.
8. Machining of plastics. (e. g. acrylics etc.)
9. Rotational moulding of liquid polymers.
10. Study of decorative methods for plastics.

Design based Problems (DP)/Open Ended Problem:

1. Study of Pad Printing and design of machine.
2. Ultrasonic Welding of Plastics – Design of machine
3. Design and build simple decorating machines for plastic materials

List of Open Source Software/learning website:

1. www.wikipedia.org
2. www.sciencedirect.com
3. www.mit.edu

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.