

# GUJARAT TECHNOLOGICAL UNIVERSITY

## PLASTIC TECHNOLOGY (23)

APPLIED MATHEMATICS IN PLASTIC INDUSTRY

SUBJECT CODE: 2142302

B.E. 4<sup>th</sup> SEMESTER

**Type of Course:** Core

**Prerequisite:** NA

**Rationale:** NA

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	2	0	5	70	20	10	30	0	20	150

**Content:**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	FLOW OF PLASTIC MATERIALS : General Behaviour of plastic melts, Isothermal flow in channels [ Non Newtonian Fluids] ,Shear stress v/s. Shear rate , Pressure drop calculations, Elastic Behaviour , Swelling ratios due to shear stress / tensile stresses, Experimental methods to obtain flow data[ Cone and plate viscometer , Concentric Cylinder Viscometer , Ram Extruder] , Pressure drop calculations in Injection Moulding, Extrusion, Compressions Moulding, Rotational Moulding operations, etc. Numericals on Pressure drop calculations.	10	18
2	Heat Transfer Phenomena in Plastic Processing Operations : Fourier number , Temperature Gradient, Calculations on melt temperature in Injection moulding , Calculations on time taken by moulding to solidify ,flow length of power law fluid, Enthalpy calculations for Injection moulding , Blow moulding and Extrusion operations.	14	22
3	ACTUAL POLYMER CHAINS : radius of gyration of a linear ideal chain , radius of gyration of rod polymer, radius of gyration of an ideal branched polymer[ kramers theorem] , Distribution of end to end vectors , size of chain : chain length and contour length calculations, etc. Mayer f-function and excluded volume , Flory theory of a polymer in good solvent, calculations on polydispersity index , Weight average and number average molecular weight calculations for polymers, Poisson 's number fraction distribution.	10	20
4	<u>Visco Elastic Behaviour and Mechanical Properties</u> : Stress Strain behaviour of plastic materials, long term and short term tests, creep behaviour , Design methods for plastics using Deformation Data, Isometric and Isochronous graphs , Pseudo elastic design method, beam calculations, Apparent viscosity , Power law index, Mathematical Models of Viscoelastic Behaviour i.e. Maxwell Model, Kelvin Voigt Model , Numerical related to these models.Creep Curves, Calculatios of Modulus, strength of composites for Fiber reinforced materials.	10	20

5	Applications of Mathematics in Processing Operations : Calculations of Drag flow, Pressure flow and Leakage flows in Single and Twin Screw Extruder Machines, Extruder Volumetric Efficiency, Power requirements calculations, Pressure drop calculations in Extrusion process, Pressure losses in runners, and gate in injection moulding, Analysis of Blow moulding operation, Force calculations in compression moulding operation, etc.	10	20
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**Suggested Specification table with Marks (Theory):**

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

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. "Plastics Engineering" by R.J.Crawford [ 2<sup>nd</sup> Ed.] , Pergamon Press.
2. "Polymer Physics" by Micheal Rubinstein and Ralph H. Colby , Oxford University Press.
3. "Textbook of Polymer Science" by Billmeyer , 2<sup>nd</sup> Ed. , Wiley , New York
4. "Principles of Polymer Engineering" , 2<sup>nd</sup> Ed., by N.G.McCrum, C.P.Buckley and C.B.Bucknall , Oxford Science Publications [ INDIAN EDITION]

**Course Outcomes:**

After successful completion of the course students should be able to:

1. Work out the flow characteristics of plastic melts.
2. Do output and pressure drop calculations for various processing operations

**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.