GUJARAT TECHNOLOGICAL UNIVERSITY
Plastic Technology
B. E. SEMESTER: VI

Subject Name: **Reaction Engineering & Rheology**
Subject Code: **162304**

Teaching Scheme				Evaluation Scheme		
Theory	**Tutorial**	**Practical**	**Total**	**University Exam (Theory) (E)**	**Mid Sem Exam (Theory) (M)**	**Practical (I)**
3	0	2	5	70	30	50

Sr. No.	Course Contents	Total Hrs
1.	**Plastic Reaction Engineering:** • Elements of Polymer Reaction Engineering • Introduction to Kinetics of homogenous Reaction • Interpretation of Batch Reactor Data • Single Ideal Reactor • Mechanism and kinetics of polymerization • Polymerization Reaction Engineering • Reactors for various commodity plastics • Reactors for different polymerization technique	12
2.	**Plastic Rheology:**	
	2.1 Introduction to Rheology • Types of mechanical deformation • Elastic materials – Viscous materials – Viscoelasticity • Effect of rate of strain, temperature and time on mechanical behavior of polymeric materials – creep – stress relaxation • Boltzman principle – time temperature super position principle • WLF equation.	6
	2.2 Models to represent behavior of Polymer Liquids • Mechanical models – stress strain response of spring and dashpot Viscoelastic models – Maxwell element – Voigt Oelvin element – response to creep and stress relaxation – four-parameter model – dynamic mechanical properties – behavior of Maxwell element and relaxation spectra	6

	2.3 Fluid flow: • Types of fluid flow – time dependant fluids, shear rate dependant fluids, Newtonian and Non Newtonian fluids • Viscosity of polymer melts – shear thinning and shear thickening – zero-shear rate viscosity • Laminar flow of Newtonian fluids – power law equation • General treatment of isothermal viscous flow in tubes – entrance and exit effects – elastic effects in polymer melt flow – die- swell and melt fracture • Weissenberg effect – normal stress difference – Elongational viscosity.	4
	2.4 Flow Analysis of Polymer Liquids Through Various Geometries	3
	2.5 Measurements of Rheological properties • capillary rheometer • melt flow index • cone and plate viscometer • Torque rheometer • Mooney viscometer, cure meters Rheo-optical methods – birefringence.	6
	2.6 Analysis of Polymer Melt in Extrusion & Injection Molding Process	5
	2.7 Analysis of Rheological Parameters of Calendering, Rotational Molding & Fibre Spinning	6
	2.8 Analysis of mold temperature rise, heat & melt flow, recycling, other processing Options i.e. dip coating, slush molding, solid phase forming etc.	6

Text Books:

1. Octave levelspiel-Chemical Reaction Engineering 2nd Ed.
2. J.A.Brydson, Flow properties of Polymer Melts, life books, London.
3. Anil Kumar and Santosh gupta-fundamentals of polymer science engineering, tata McGraw hill publishing company

Reference Books:

1. Polymer Reaction engineering by K.H.Reichert
2. P.N.Cogswell, Polymer Melt Rheology, A guide for Industrial Practice, GeorgeGodwin.
3. Richard C. Progelhof and James L. Throne, Polymer Engineering Principles, Hanser Publishers, New York, 1993.
4. John M. Dealy and Kurt F. Wissburn, Melt rheology and its role in plastics processing, Chapman, London, 1995.
5. R.S. Lenk, Polymer Rheology, Applied Science, London,
6. R.J. Crawford, Plastics Engineering, Butterworth – Heinemann, Oxford, 1998.
7. J.D. Ferry, Viscoelastic Properties of Polymers, john Wiley & Sons, New York,
8. Chang Dae Han. Rheology in Polymer Processing, Academic Press, New York