

# GUJARAT TECHNOLOGICAL UNIVERSITY

## RUBBER ENGINEERING (40) RUBBER PROCESSING EQUIPMENT DESIGN SUBJECT CODE: 2714009 SEMESTER: I

**Type of course:** Core-II (M.E.Rubber Technology)

**Prerequisite:** --

**Rationale:** --

**Teaching and Examination Scheme:**

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

**Content:**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction: Rubber processing equipments for mixing, extrusion, molding, fabrication and curing, importance of rheology of rubber for design.	7	10
2	Twin screw extruder: history and development of the co-rotating twin screw extruder, geometry of co-rotating twin screw extruder-conveying and kneading, pressure generation and energy inputs, mixing and dispersing, degassing, screw elements.	8	15
3	Computational fluid dynamics: introduction, applications for design.	7	15
4	Rubber Extruder die design : fundamentals, thermodynamic and rheological material data for design, computation of viscous press losses, formulas for isothermal computations, approaches to non-isothermal computations, estimations of the peak temperature, consideration of the elastic behavior of the material, design of distributor die and slotted die, pressure losses, extrudate swelling.	8	15
5	Mechanic design of extrusion die: Design of a breaker plate, design of a die with axially symmetrical flow channels, design of a slit die, general design rules, and materials for extrusion dies.	8	15
6	Cure of Rubber in Mold : Rubber–Mold Relation, Process of Heating and Cure, Mathematical Treatment, Numerical Treatment of the Problem, Effect of the Position of the Heating System, Mold–Rubber System, Results Obtained for the Cure of the Rubber Sheet, Effect of the Thickness of the Rubber Sheet, Effect of the Enthalpy of Cure, Effect of the Temperature on the Cure, Effect of the Kinetic Parameters of the Cure, Effect of the Order of the Overall Reaction, Effect of the Activation Energy, Effect Post cure of a	8	15

	Rubber Sheet, Cure of Rubber–Metal Sandwiches, Theoretical Study of the Process of Cure, Theoretical Approach of the Process.		
7	Cure of Rubber with Injection Molding: Principles of the Technique, Evaluation of the Operational Conditions in the Injection System, Theory, Heating Stage in the Reservoir before Injection, Injection Stage of the Rubber in the Mold, Results for the Heating Stage in the Reservoir, Heating Stage and Cure in the Mold, Theoretical for the Stage of Cure in the Mold, Results by Calculation, Conclusions on Injection Molding.	8	15

**Reference Books:**

1. Extrusion Dies for Plastics and Rubber: Design and Engineerin Computations by Walter Michaeli.
2. Rubber Curing and Properties by Jean-Maurice Vergnaud and Iosif-Daniel Rosca .
3. Co-rotating twin screw extruder: fundamental technology and Applications by Hanser

**Course Outcome:**

After learning the course the students should be able to:

1. Understand the importance of rheology of rubber for design.
2. Develop the co-rotating twin screw extruder.
3. Apply the Computational Fluid dynamics.
4. Design the Extruder Die according to thermodynamic and rheological material data.
5. Develop the relationship between Rubber & Mold.
6. Theoretical Study of the Process of Cure.
7. Theoretical Approach of the Process.
8. Evaluation of the Operational Conditions in the Injection System for Injection Molding Machine.

**List of Experiments:**

Tutorials/Presentation/Practicals based on above topics

**Open Ended Problems:**

1. Role of Twin Screw Extruder for rubber mixing.
2. Heat Transfer in Twin Screw Extruder.
3. New Technology for mold cleaning

**Major Equipments:**

Mixing Mill, Extruder, Press

**List of Open Source Software/learning website:**

- <http://www.crcpress.com>
- <http://www.taylorandfrancis.com>
- The American Synthetic Rubber Research Program. Philadelphia: University of Pennsylvania Press.