

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. SEMESTER: V RUBBER TECHNOLOGY

Subject Name: **Rheology of Rubber**

Subject Code: **152604**

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 content
1.	Viscosity and the Mechanism of Momentum Transport : Newton's Law of viscosity, Non-Newtonian fluids.
2.	Velocity Distribution in Laminar Flow: Shell Momentum Balances, Boundary conditions, Flow of a falling film, Flow through a circular tube, Flow through an annulus.
3.	Rheology & Boundary conditions Studies of Elastomers and their compounds.
4.	Kinetics of Flow and Stress Responses: Kinematics & continuity and elongation flow.
5.	Stress Tensor and Stress Responses: Stress Tensor: Cauchy Laws of Motion, Stress responses to flow, Early investigations of flow properties of elastomer.
6.	Shear Flow Instruments for Rheological Characterization of Elastomers: Sandwich rheometer, Biconical rheometer, Shearing disc (Mooney) rheometer, Capillary rheometer, Cone and plate viscometer, Cup and bob viscometer, General purpose viscometer, Gallen kamp, Plunger and other viscometers.
7.	Oscillatory Flow Instruments
8.	Elongation Flow Instruments : Uniaxial extension, Bubble inflation.
9.	Compression Flow Instruments: Parallel plate viscometer, Differential plasimeter.
10.	Quality Control Instrumentation: Rotational rheometers, Capillary rheometers, Compressional rheometers, Stress relaxation instrument.

11.	Experimental Studies of Rheological Behaviour: Steady shear flow, Elongation flow, Oscillating flow, Stress relaxation, Temperature dependence, Processability, Test & dependence upon polymer structure.
12.	Experimental Studies of Rheological Behaviour of Compounds, Steady Shear Flow : Elongational viscosity, Oscillating flow, Stress relaxation.
13.	Shear Flow Boundary Conditions and Spillage.
14.	Flow induced Degradation & Mechanochemistry.
15.	Rheological Models for Elastomers & Compounds and Approaches to Flow Analysis.
16.	One Dimensional Rheological Models for Gum Elastomers: One dimensional rheological models for Gum Elastomers, Newtonian fluid, Small strain viscoelastic fluid models: Maxwell Model, Boltzmann Superposition Integral, Non-linear shear viscosity.
17.	One Dimensional Rheological Models for Rubber Compounds: Plastic viscous model, Plastic viscoelastic model, Thixotropic model
18.	Equation of Motion and Dimensional Analysis of Non-Newtonian Fluids: General, Viscoelastic fluids, Plastic fluids.
19.	Energy Equation & Non Isothermal Flow: Energy equation, Dimensional analysis.
20.	Classification of Flows: Internal & External Flow, Hydrodynamic Lubrication Theory.
21.	Rheology of Polymer Materials: Hook's law (Spring Model), Newton's law (Dashpot Model), Maxwell model, Voight model, Burger model, Relaxation & retardation (Creep).
22.	Variable Influencing the Rheology of Rubbers: Effect of temperature, Effect of pressure, Effect of molecular weight & molecular structure.

Practical and Term Work:

Based as per the syllabus prescribed.

Reference Books:

1. Rubber Engineering, IRI.
2. Rubber Processing, by James L. White.
3. Rheology of Rubber, by Dr. Tripathi.
4. Science & Technology of Rubber, by J. Mark, B. Erman, F. Eirich.
5. Polymer Science, by V. R. Gowarikar.
6. Transport Phenomena, by R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot.