

# 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.	<b>Viscosity and the Mechanism of Momentum Transport :</b> Newton's Law of viscosity, Non-Newtonian fluids.
2.	<b>Velocity Distribution in Laminar Flow:</b> Shell Momentum Balances, Boundary conditions, Flow of a falling film, Flow through a circular tube, Flow through an annulus.
3.	<b>Rheology &amp; Boundary conditions Studies of Elastomers and their compounds.</b>
4.	<b>Kinetics of Flow and Stress Responses:</b> Kinematics & continuity and elongation flow.
5.	<b>Stress Tensor and Stress Responses:</b> Stress Tensor: Cauchy Laws of Motion, Stress responses to flow, Early investigations of flow properties of elastomer.
6.	<b>Shear Flow Instruments for Rheological Characterization of Elastomers:</b> 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.	<b>Oscillatory Flow Instruments</b>
8.	<b>Elongation Flow Instruments :</b> Uniaxial extension, Bubble inflation.
9.	<b>Compression Flow Instruments:</b> Parallel plate viscometer, Differential plasimeter.
10.	<b>Quality Control Instrumentation:</b> Rotational rheometers, Capillary rheometers, Compressional rheometers, Stress relaxation instrument.

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