

# GUJARAT TECHNOLOGICAL UNIVERSITY

## B.E Semester: 3 Rubber Engineering

Subject Code 132601  
Subject Name BASIC RUBBER SCIENCE

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Sr.No	Course contents
1	<b>Rubber Science:</b> Introduction of science of large molecule, Classification of polymers, Forms of polymers, Tacticity, Functionality, types of polymers, Polymerization, Degree of Polymerization, Types of polymerization, polymerization Techniques, Thermosetting & Thermoplastics polymers, Properties & uses, Crystallinity, Strengthening of polymers, Rubber Vulcanizates, Structure of Rubber Vulcanizates, Structure/Property Relations in Rubbers, Conditions for Rubber like Elasticity in Polymers, Molecular Motion in Rubbers, Characteristic Properties of Rubbers, Various states in Rubber Goods Manufacture, Classification of Rubbers, Chain Structure & Chemical Reactivity of Rubbers, Molecular Masses & Sizes , General rules for Polymer Solubility
2	<b>Rubber Physics:</b> Density, Archimedes Principle, Laws of Flotation, Elastic Behavior of Bodies, Young's Modulus, Shear Modulus, Bulk Modulus, The four Elastic Constants, Elastic Strain Energy, Difference between Rubbery & Elastic Deformations, The Theory of Rubber Elasticity, Elastic collisions, Viscous Flow of Liquids, Measurement of Viscosity, Surface Tension, Surface Tension Measurement, Friction, Static, Sliding & Rolling Friction, Sliding Friction of Rubber, Rolling of Rigid bodies down Rubber tracks.
3	<b>Energy &amp; The Electromagnetic Spectrum:</b> Electromagnetic Radiation & its Properties, Absorption & Scattering of Light, Critical Angle & Total Internal Reflection, Refraction through a Parallel-sided Block, Refraction through a Triangular Prism, The Refractive Index of a liquid, Polarization, Refractive Index of Polymers, Magnification (Optical & Electro Microscope) Pigments
4	<b>Vibrations &amp; Waves:</b> Velocity & Absorption of Elastic Waves, Resonant Frequency & Transmissibility in Steady-state Forced Vibration, Transmissibility of Oscillations, Effect of Compounding on Transmissibility, Mechanism of Damping, Ultrasonic Applications in Rubber
5	<b>Mass Transfer Fundamentals:</b> Definitions of Concentrations & Velocities, Fluxes & their relationships, Fick's First Law of Diffusion, Microscopic Material Balance, Similarity with Heat Transfer, Simple Applications, Mass Transfer Coefficients, Definitions, Analogy between Heat & Mass Transfer

6	<p>Heat Transfer:</p> <p>Principles involved in establishing Temperature Scale, International Temperature Scale, Measurement Principles, Electrical Resistance Thermometers, Thermoelectric Thermometers, Temperature Indicator Patches, Infrared Thermometers, Expansion of Solids &amp; Gases, Polytropic Change, Gauge Pressure, Effects of Temperature change on Gas Pressure at Constant Volume, Vapor Pressure, Heat Transfer by Conduction, Determination of Thermal Diffusivity, Effect of Materials &amp; Processing Variables on Thermal Properties, Thermal Conductors in series &amp; Parallel, Concept of Film Heat Transfer Coefficient &amp; Overall Coefficient of Heat Transfer, Conducting through Cylinders, Steam, Energy Sources: Calorific Values, Convection Boundary Conditions, Heat Transfer by Radiation, Prediction of State of Cure, Time-Temperature-Fractional Conversion Charts, Combined Heat Transfer &amp; Fluid Flow, Heat Flow through High Viscosity Polymer &amp; Rubber melts during Processing</p>
7	<p>Viscous Flow :</p> <p>Introduction, Viscosity, Polymer Shapes in Solution, Effect of Concentration &amp; Molecular Weight, Effect of Temperature &amp; Pressure, Normal Stress Differences in Shear, Models for Non-newtonian Flow, Viscometry, Rheometry, Turbulent Flow etc</p>
8	<p>Viscoelasticity of Rubber:</p> <p>Time-Temperature Equivalence, Molecular Model of Viscoelasticity, Creep, Stress Relaxations</p>
9	<p>Colloid Science :</p> <p>Colloidal Dispersions, Stability of Colloidal Dispersions, Potential Energy Curves, General Properties of Colloidal Dispersions, Brownian Motion, Osmosis, Dialysis, Effect on Freezing &amp; Boiling Point, Electrical Properties, Electrophoresis of Polymer Latexes, Scattering of Radiation, Sedimentation &amp; Creaming, Preparation of Colloidal Dispersions, Association Colloids, Gels, Emulsions,</p>
10	<p>Rubber Elasticity:</p> <p>Basic Concepts &amp; Behaviour, Introduction, Elasticity of a single molecule, Elasticity of a Three-Dimensional Network of Polymer Molecules, Comparison with Experiment, Continuum Theory of Rubber Elasticity, Second-order Stresses, Elastic Behaviour under Small Deformations, Some unsolved problems in Rubber Elasticity</p>

### Reference Books:

1. Science & Technology of Rubber, by James E. Mark, Burak Erman, Frederick R. Eirich
2. Principles of Polymer Systems, by Ferdinand Rodriguez
3. Rubber Engineering, IRI