GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3724008
Semester – II
Subject Name: Physics of Rubber Elasticity

Type of course: Program Elective-IV (M.E.Rubber Technology)

Prerequisite:

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr.No	Course Content	Total Hrs
1.	General Physical Properties of Rubber: Chemical constitution of rubbers, Early theories of Rubber Elasticity, The Kinetic theory of Elasticity, Cross-Linking and Vulcanisation: network theory, The glass-rubber transition, Crystallization in raw rubber, Crystallization in the stretched state, Photoelastic Properties of Rubbers etc.	**7**
2.	Internal Energy and Entropy Changes on Deformation: Stress-temperature relations, Thermodynamic analysis, Application to experimental data, Interpretation of thermoplastic data, Thermal effects of extension.	**8**
3.	The Elasticity of Long-Chain Molecules: Statistical Properties of Long-chain molecules, Statistical form of Long-chain molecule, The randomly jointed chain, Properties of Gaussian functions, The distribution of r-values, Equivalent random chain. The entropy of a single chain, the tension on a chain.	**7**
4.	The Elasticity of a Molecular Network: The nature of the problem, Detailed development of the theory, Significance of theoretical conclusions, The principal stresses, Significance of single elastic constant, The elastic properties of a swollen rubber, Development of the theory by James and Guth, Network imperfections :'loose end' corrections.	**8**
5.	Experimental Examination of The statistical Theory: Introduction, Particular stress-strain relations, Experimental examination of stress-strain relations, Derivations from theory: Mooney equation, Non-Gaussian Chain Statistics and Network Theory, Thermodynamic Analysis of Gaussian Network etc.	**8**
6.	Swelling Phenomena: Introduction, General Thermodynamic Principles, Significance of thermodynamic quantities, Statistical treatment of Swelling, The Swelling of Cross-linked polymers, Relation between swelling and modulus, The Cohesive-energy density, The	**8**

	dependence of swelling on strain, Swelling under torsional strain , etc.	
7.	Cross linking and Modulus: Introduction, The experiments of Moore and Watson and of Mullins, Effect of entanglements etc.	**8**

Reference Books:

- The Physics of Rubber Elasticity by L.R.G.Treloar.
- Viscoelastic Properties of Polymers by John D.Ferry

Course Outcome:

Sr. No.	CO Statement	Marks % weightage
CO-1	Understand the Chemical constitution of rubbers.	15
CO-2	Learn the Kinetic theory of Elasticity.	15
CO-3	Able to establish the Stress-temperature relations.	20
CO-4	Identify the Statistical Properties of Long-chain molecules of Rubber.	15
CO-5	Learn about the elastic properties of a swollen rubber.	15
CO-6	Establish the relation between swelling and modulus and identify the effect of entanglements	20

List of Experiments:

Tutorials/Presentation/Practicals based on above topics.

Major Equipments:

Mixing Mill, Press, Tensile Testing Machine etc.

List of Open Source Software/learning website:

- **http://www.crcpress.com**
- **www.citycollegiate.com**

www.rubberchemtechnol.org/doi/abs/10.5254/1.3546653