

# GUJARAT TECHNOLOGICAL UNIVERSITY

## RUBBER TECHNOLOGY (26)

NATURAL RUBBER SCIENCE & TECHNOLOGY

SUBJECT CODE: 2142602

B.E. 4<sup>th</sup> SEMESTER

**Type of course:** B.E. (Rubber Technology)

**Prerequisite:** Nil

**Rationale:** Nil

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	3	6	70	20	10	20	10	20	150

**Content:**

Sr. No.	Content	Total Hrs	% Weightage
<b>1</b>	<b>Natural Rubber:</b> Introduction, Preparation of Dry Rubber, Technically Specified Rubber, Constant-Viscosity and Peptized Rubber, Specialty Natural Rubber, Structure ,Properties, Mastication Behavior, General Chemical Reactivity, Solubility and Swelling, Burning Behavior, Natural Rubber Ebonite,, the Status of Natural Rubber, Gutta-parcha, Balata and Related Materials, Epoxidized Natural Rubber.	<b>6</b>	<b>10</b>
<b>2</b>	<b>Chemical Modification of Natural Rubber :</b> Introduction ,Modification Research, Chemical Reactivity of Natural Rubber, Simple Addition Reactions of the olefinic double bond, Electro cyclic Reactions, Degradation Reactions, Epoxidation Chemistry, Properties and Applications of ENR.	<b>6</b>	<b>15</b>
<b>3</b>	<b>Graft Copolymers from Natural Rubber :</b> Introduction ,Thermoplastic Rubber, Grafting Chemistry, Physical Properties of Polystyrene Graft Copolymers, Grafting to other backbones, Graft Chains other than Polystyrene, Alternative Grafting Chemistry, Heveaplus MG & Related Materials.	<b>6</b>	<b>10</b>
<b>4</b>	<b>Diffusion of Liquids and Solids in Rubber :</b> Introduction ,Diffusion Theory, Experimental Methods, Diffusion of Hydrocarbon Liquids and Oils, Blooming of Waxes, Diffusion of Water in Rubber Practical Relevance.	<b>6</b>	<b>15</b>
<b>5</b>	<b>Low Temperature Crystallization of Natural Rubber :</b> Crystallization in Natural Rubber, Theories, Experimental Techniques, Tensile Strain, Compression ,Shear, Crystallization in Bridge Bearings, Characterization of Engineering Vulcanizates.	<b>6</b>	<b>10</b>

<b>6</b>	<b>Engineering Use of Natural Rubber :</b> Introduction ,Force-Deformation Behaviour, Load-deflection Characteristics of Bonded Rubber Components, Dynamic Properties, Transmissibility of Rubber Components, Effects on Transmissibility due to component Design, Environmental Factors, Flexible Rubber, Steel Laminates.	<b>6</b>	<b>10</b>
<b>7</b>	<b>Liquid Rubbers:</b> Introduction, Classes of commercially established Liquid Elastomers, Model studies using Terminally Functional Polybutadiene, Practical considerations affecting the development of Telechelic Polymers as General purpose Elastomers, Additional Terms in Telechelic Elastomer Research & Development, Counseling Remarks.	<b>6</b>	<b>10</b>
<b>8</b>	<b>Powdered Rubbers :</b> Introduction, Conventional Mixing, Powdered Polymer Technology, Effect of Powder Technology on Mixing cycle times, Power consumption & Plant maintenance costs, Continuous Production and other advantages related to products.	<b>6</b>	<b>10</b>
<b>9</b>	<b>Reclaim Rubbers :</b> Introduction, Types of Reclaim Rubbers, Different Manufacturing Processes of Reclaim Rubbers, Applications of Reclaim Rubbers.	<b>6</b>	<b>10</b>
	<b>Total Hours</b>	<b>45</b>	<b>100%</b>

**Suggested Specification table with Marks (Theory):**

<b>Distribution of Theory Marks</b>				
R Level	U Level	A Level	N Level	E Level
14	14	14	14	14

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

**Reference Books:**

1. Natural Rubber Science and Technology, by Roberts
2. Handbook of Rubber Projects, Technology and Product Formulations, by SBP Consultants & Engineers (P) Ltd.
3. Rubber Materials and their components, by J. A. Brydson
4. Rubber Technology : by Maurice Morton

**Course Outcome:**

After learning the course the students should be able to:

- Understand the structure, properties, mastication behaviour of Natural Rubber.
- Know about chemical reactivity of Natural Rubber.
- Learn about Chemical Modification of Natural Rubber.
- Study about Grafting Chemistry and its importance for the properties of Natural Rubber.
- Compare Characterization of Engineering Vulcanizate.
- Learn about the Crystallization in Natural Rubber.
- Able to identify and justify the Engineering Use of Natural Rubber.

- Learn about the classes of commercially established Liquid Elastomers.
- Understand the importance of Powdered Rubber and its technology.
- Learn the different manufacturing process for reclaim rubber.
- Able to develop and apply green technology in Black (Rubber)industry.

### **List of Experiments:**

Tutorials/Presentation/Practicals based on above topics

### **Design based Problems (DP)/Open Ended Problem:**

- Chemical Modification of Natural Rubber by Phosphorus addition .
- Modification of Natural Rubber by Grafting with Hydrophilic Vinyl Monomers.
- Modification of Natural Rubber Latex with Peracetic Acid.

### **Major Equipment:**

Ph meter, Density Meter, Flame Tester, Weighing balance, Hot Plate , Muffle Furnace etc

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

- [www.sciencedirect.com/science/book/9780857096838](http://www.sciencedirect.com/science/book/9780857096838)
- [www.hindawi.com/journals/isrn/2012/168798](http://www.hindawi.com/journals/isrn/2012/168798)
- [link.springer.com/content/pdf/10.1007/978-1-4613-2205-4\\_21.pdf](http://link.springer.com/content/pdf/10.1007/978-1-4613-2205-4_21.pdf)

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.