GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3142602
Semester – IV
Subject Name: Natural Rubber Science & Technology

Type of course: Basic Science
Prerequisite:

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	4	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Natural Rubber:** Introduction, Processing of Latex for Dry Rubber Production, Technically Specified Rubber, Advantages of TSR over conventional grades, Other forms of Natural Rubber, Properties of raw Natural Rubber, Non-rubber substances, Physical properties, Structure of Natural Rubber, Solubility and Swelling, the Status of Natural Rubber, Gutta-parcha, Balata and Related Materials.	08
2	**Chemical Modification of Natural Rubber :** Introduction, Modification Research, Chemical Reactivity of Natural Rubber, Simple Addition Reactions of the olefinic double bond, Simple substitution reactions of the olefinic double bond, Electro cyclic Reactions, Degradation Reactions, Epoxidation Chemistry, Properties of ENR, Applications of ENR.	07
3	**Graft Copolymers from Natural Rubber :** Introduction, Thermoplastic Rubber, A method for NR, Grafting Chemistry, Physical Properties of Polystyrene Graft Copolymers, Grafting to other backbones, Graft Chains other than Polystyrene, Alternative Grafting Chemistry, Heveaplus MG & Related Materials.	07
4	**Diffusion of Liquids and Solids in Rubber :** Introduction, Diffusion Theory, Experimental Methods, Diffusion of Hydrocarbon Liquids and Oils, Blooming of Waxes, Diffusion of Water in Rubber, Practical Relevance.	06
5	**Low Temperature Crystallization and Engineering use of Natural Rubber :** Crystallization in Natural Rubber, Experimental Techniques, Tensile Strain, Compression, Shear, Force-Deformation behaviour, Environmental Factors, Flexible Rubber-steel Laminates.	07

6	**Liquid Rubbers:** 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.	**06**
7	**Powdered Rubbers :** Introduction, Preparation of powdered rubbers, Partitioning agents, Preparation of powdered rubber compounds, Mixing, Processing on Open mills, Powdered Mastication principle, Advantages of powdered and particulate rubbers.	**06**
8	**Reclaim Rubbers :** Introduction, Different Manufacturing Processes of Reclaim Rubbers, Types of Reclaim Rubbers, Testing and evaluation of Reclaimed Rubber, Properties of Reclaimed Rubber as a compounding ingredient, The advantages of using Reclaimed Rubber, Major uses of Reclaim Rubber, Rubberized Asphalt, Applications, Economics.	**07**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
14	**14**	**14**	**14**	**14**	**14**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create 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:

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

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Course Outcomes:

After learning this course students will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Identify the different types of natural polymer	15
CO-2	Modify the natural rubber by different technique	20
CO-3	Apply the fundamentals of diffusion of liquid and solid in natural rubber	20
CO-4	Solve the problem related to environmental factors	10
CO-5	Compare the liquid and powdered rubber	20
CO-6	Evaluate the properties and performance of reclaimed rubber	15

List of Experiments:

Tutorials/Presentation/Practicals based on above topics.

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
- www.hindawi.com/journals/isrn/2012/168798
- link.springer.com/content/pdf/10.1007/978-1-4613-2205-4_21.pdf