GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Rubber Technology

Subject Code: ME02088091

Subject Name: Thermosetting Resins & Silane Technology

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Basic knowledge of rubber technology , its characteristics and processing and compounding
Rationale:	The rationale for exploring these topics in detail is to provide a comprehensive understanding of hydrocarbon and related resins, their chemistry, manufacturing processes, properties, and applications in various industries. Resins play a pivotal role in enhancing the performance of rubber and polymer-based materials, influencing aspects such as reinforcement, tack, durability, and processing characteristics. The topics outlined address both the foundational and advanced concepts critical to mastering the subject. This structured approach ensures a comprehensive understanding of resin systems and their applications. It bridges the gap between theory and practice, empowering learners to design, optimize, and apply resins effectively in various industries such as rubber technology, composites, coatings, and adhesives. This knowledge is essential for innovations in materials science and engineering.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
C01	Explain the different types of resin and describe the correlation between silane chemistry and its mode of action.
C02	Recall the importance of using resin in rubber product manufacturing.
C03	Examine the role of resin during the rubber processing phase.
C04	Correlate the chemistry, characteristics, manufacturing process, and properties of various types of resin.
C05	Assess the impact of silane on both rubber compounds and rubber processing efficiency.

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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
03	00	02	04	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction:** History of Hydrocarbon Resins, Reinforcing Effect, Petroleum Resins, Polyterpene Resins, Aliphatic Resins, Cyclopentadiene Resins, Resinex Resins, Miscellaneous Resins etc.	4	8
2.	**Compounding:** Different types of elastomers, tackifiers, fillers, plasticizers, softeners, antioxidants, curing agents and sequestering agents etc.	4	8
3.	**Requirements:** Glass transition Temperature, Viscosity Change, Resin Action, Obtaining Tack, Function of Tackifiers	4	8
4.	**Hydrocarbon Resin:** Color, Compatibility, stability, observation, Effect on applications, etc. Resin Manufacturing, Molecular Weight Distribution, Different Testing Methods , Properties etc.	4	10
5.	**Phenolic Resin:** Chemistry, Manufacture, Properties , Applications etc.	4	10
6.	**Amino Resin :** Chemistry, Characteristics, Manufacturing, Catalysts and Hardeners, Properties , Applications etc	4	10
7.	**Thermoset Resins Composites:**	4	8

	Introduction, Interface and processing, analysis and testing and properties of composites.		
8.	**Toughened Thermoset Resins:** Toughening of thermoplastics and thermosets, Liquid rubber toughening and toughening of various resins.	4	8
9.	**Unsaturated Polyester Resins:** Composition of Reinforced Polyester Systems, Formulation, Fabrication, Laminating, Molding, Filament Winding, Pultrusion, Properties, Applications etc.	4	10
10.	**Polyurethanes & Epoxy Resins:** Epoxy Resins: Chemistry of preparation and Curing, Properties, Applications etc. Polyurethanes: Urethane Chemistry, Flexible and Rigid Foams, RIM Urethanes etc.	4	10
11.	**Silane – Coupling Agent:** Definition of Silane, Importance, Benefits, Silane Chemistry, Silane description, Mode of action, Filler Treatment, Applications etc.	5	10
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	10	20	10	10	10

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Resins in Rubber by Gardner L. Brown
2. Handbook of Adhesives by Irving Skeist.
3. Textbook of Polymer Science by Fred W. Billmyer
4. Handbook of Thermoset Resins by Debdatta Ratna

(b) List of Open Source Software/learning website:

- https://www.threebond.co.jp/en/technical/technicalnews/pdf
- http://www.crcpress.com

- www.academicjournals.org

Suggested Course Practical List: If any
Practical based on above topics.

Suggested Project List:

1. Study of the Reinforcing Effect of Different Hydrocarbon Resins in Elastomer Systems
2. Development of Hydrocarbon Resin-Based Elastomers with Improved Thermal Stability
3. Investigating the Function of Tackifiers in Hydrocarbon Resin-Based Adhesives
4. Effect of Color and Compatibility on the Performance of Hydrocarbon Resins
5. Synthesis and Application of Phenolic Resins in Adhesive Systems
6. Catalyst and Hardener Effects in Amino Resin Curing Systems
7. Application of Silane Coupling Agents in Filler Treatment for Enhanced Composite Performance
8. Study of Epoxy Resins: Curing, Properties, and Applications in Aerospace
9. Study of the Mechanical Properties and Applications of Unsaturated Polyester Resin Composites
10. Development and Testing of Liquid Rubber Toughened Thermoset Resins

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