# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Master of Engineering**

**Level: Post Graduate**

**Branch: Rubber Technology**

**Subject Code : ME02088031**

**Subject Name : Specialty Elastomers & its Technology**

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

| | |
|---|---|
| **Prerequisite:** | Basic knowledge of rubber technology, reaction mechanisms, processing techniques and composite materials, |
| **Rationale:** | This subject provides insights into chemical modifications, composite formation, and novel processing techniques, enabling innovations in material performance and sustainability. The study of modified rubbers and elastomers is critical for developing materials with enhanced mechanical, thermal, and chemical properties tailored for industrial applications. The exploration of modified rubbers and advanced elastomers bridges the gap between basic material science and industrial innovation. This knowledge fosters the development of materials with tailored properties for specific applications, contributing to advancements in technology, sustainability, and product performance. |

**Course Outcome:**

After Completion of the Course, Student will able to:

| No | Course Outcomes |
|---|---|
| C01 | Analyze the effects of short fiber reinforcement in rubber composites and evaluate the impact of fiber mixing. |
| C02 | Describe the significance of fiber orientation in determining the mechanical properties of rubber composites. |
| C03 | Interpret the vulcanizate properties and applications of tetrafluoroethylene-propylene rubber in industrial contexts. |
| C04 | Develop processes for the production of acrylic-based elastomers for specific applications. |
| C05 | Explain the processing techniques and physical properties of crosslinked polyethylene. |

**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. | **Modified natural rubber:** Hydrogenated natural rubber, chlorinated natural rubber, hydro halogenated natural rubber, cyclized natural rubber, resin-modified natural rubber, poly(methylmethacrylate)-grafted natural rubber, enpcaf-modified natural rubber, liquid natural rubber. | 7 | 10 |
| 2. | **Chemical modification of synthetic elastomers:** Hydrogenation, cyclization, isomerization, halogenation and hydrohalogenation and recent developments | 7 | 15 |
| 3. | **Short fiber-filled rubber composites:** Introduction to rubber composites, methods for the analysis of fiber orientation, mixing effects. | 7 | 15 |
| 4. | **Tetrafluoroethylene-propylene rubber:** Introduction, manufacturing, polymer structure and fundamental properties, compounding and vulcanization, vulcanizate properties and applications. | 6 | 15 |
| 5. | **Carboxylated rubber:** Introduction, preparation of carboxylic rubbers, composition of carboxylated emulsion polyfvlers, vulcanization of carboxylated rubbers, scorch, and bin storage stability of carboxylic elastomers, compounding ingredients for carboxylated elastomers, physical properties, applications for carboxylated elastomers | 6 | 15 |
| 6. | **Acrylic-based elastomers:** Introduction, basic structure, methods of production, compounding techniques, processing characteristics, vulcanization methods, physical properties, applications. | 6 | 15 |
| 7. | **Crosslinked polyethylene:** Introduction, basic structure, compounding and mixing of polyethylene, processing, physical properties of crosslinked polyethylene, applications of crosslinked polyethylene. | 6 | 15 |
| | **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. Handbook of Elastomers edited by Ani1 K. Bhowmick and Howard l. Stephens.
2. Handbook of Specialty Elastomers by Robert C. Klingender.


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

- **http://www.crcpress.com**
- **http://journal.ippi.ac.ir/**
- **http://www.expresspolymlett.com/**

**Suggested Course Practical List: If any**

Practical based on above topics.

**Suggested Project List:**

1. Development of Cyclized Natural Rubber for Adhesive Applications
2. Resin-Modified Natural Rubber in Tire Manufacturing
3. Production and Application of Liquid Natural Rubber
4. Hydrogenation of Synthetic Elastomers for Improved Weatherability
5. Recent Advances in Halogenation of Synthetic Elastomers
6. Applications of Tetrafluoroethylene-Propylene Rubber in Extreme Environments
7. Applications of Carboxylated Elastomers in Coatings and Seals
8. Production and Processing of Acrylic Elastomers for Automotive Applications
9. Physical Property Analysis of Crosslinked Polyethylene for Industrial Use
10. Cyclization of Synthetic Elastomers for Enhanced Elasticity

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