GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Rubber Technology

Subject Code : ME02088101

Course / Subject Name: Elastomeric Gel & Polymer Clay

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

Prerequisite:	Basic knowledge of rubber technology, different types of polymers, liquid elastomers and their structure and properties.
Rationale:	The rationale for exploring the listed topics is rooted in the significant advancements in polymer science and its vast applications across various industries. This curriculum aims to provide a comprehensive understanding of the chemistry, properties, preparation methods, and applications of advanced polymers, gels, and clays, focusing on their unique functionalities and industrial relevance. This structured framework emphasizes the multidisciplinary nature of advanced polymers, gels, and clays. It prepares learners to explore these materials from a chemical, physical, and application-oriented perspective, fostering innovation in fields like healthcare, energy, soft robotics, and environmental sustainability.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
C01	Recall the importance and applications of electrically conductive and photonic polymers.
C02	Describe and differentiate between various types of gels based on their composition and properties.
C03	Explain the principles and mechanisms of magnetically activated polymers and ferroelectric polymers.
C04	Compare & Categorize polymer gels into ionic and non-ionic types, based on their ionic behavior and properties and explain the processes involved in working with polymer clay and metal clay.
C05	Develop formulations for liquid crystal elastomers and dielectric elastomers, incorporating appropriate design and material considerations.

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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:** Electrically Conductive & Photonic Polymers, Magnetically Activated Polymers, Ferroelectric Polymers, Liquid Crystal Elastomers, Dielectric Elastomers, Ionic and Nonionic Polymer Gels,	6	10
2.	**Ionic Polymeric Gel :** Introduction, PAPMS Gels, Gel Preparation, Gel Application etc	6	10
3.	**Ionic Polymers :** Engineering, Industrial and Medical Applications etc.	6	15
4.	**Silicone Gel :** Manufacturing, Properties, Applications Comparison, Correlation etc.	5	10
5.	**PAMPS Gel :** Introduction, PAMPS Gel, Gel Preparation, Gel Application etc	5	15
6.	**Polymer/ Rubber Clay :** Introduction, Preparation & Properties, Effect of Vulcanisation ingredients etc.	6	15
7.	**Working with Polymer Clay :** Conditioning, Storage, Sizing Clay, Polymer Clay Tools, Curing, Finishing, Mixing Clay Colors	6	10
8.	**Working with Liquid Polymer Clay & Metal Clay** : Introduction, Metal Clay Tools, Processes, Applications etc.	5	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. Polymer Clay Mixed Media Jewelry by Shirley Rufener
2. Artificial Muscles- Applications of Advanced Polymeric Nanocomposites by Mohsen Shahinpoor, Kwang J .Kim, Mehran Mojarrad.
3. Advanced Rubber Composites by G.Heinrich

(b List of Open Source Software/learning website:

- **http://www.np.phy.cam.ac.uk/**
- **http://www.crcpress.com**
- **http://www.ijastnet.com/**
- **http://www.te.com/**

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

Study of Curing and Finishing Techniques for Polymer Clay ProductsSuggested Project List:

1. Development of Electrically Conductive Polymers for Sensors and Wearable Devices
2. Magnetorheological Properties of Magnetically Activated Polymer
3. Ferroelectric Polymer Films for Energy Harvesting Applications
4. Design and Synthesis of Liquid Crystal Elastomers for Soft Actuators
5. Fabrication and Testing of Dielectric Elastomers for Energy Conversion Applications
6. High-Performance Dielectric Elastomers for Soft Robotics Applications
7. Preparation and Characterization of Ionic Polymer Gels for Water Treatment

8. Nonionic Polymer Gel-Based Controlled Drug Delivery Systems
9. Development of Ionic Polymers for Use in Soft Robotics and Wearable Sensors
10. Manufacturing and Characterization of Silicone Gel for Medical Applications
11. Techniques for Conditioning and Mixing Polymer Clay for Sculptural Applications
12. Study of Curing and Finishing Techniques for Polymer Clay Products
13. Techniques for Sculpting and Curing Liquid Polymer Clay for Jewelry Design
14. Design and Fabrication of Metal Clay Jewelry Using Polymer Clay Tools
15. Effect of Vulcanization Ingredients on the Properties of Polymer/Rubber Clay Composites

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