GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering
Level: Under Graduate
Branch: Rubber Technology
Subject Code: BE05026071
Subject Name: Synthetic Rubbers

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Core Course

Prerequisite:	None
Rationale:	This course provides comprehensive knowledge of major synthetic elastomers widely used in tyre, automotive, sealing, electrical, medical, and specialty rubber industries. Understanding the chemistry, structure, polymerization methods, grading systems (IISRP), structure–property relationships, compounding, processing, and applications enables students to correlate molecular design with performance characteristics. The inclusion of SBR, PBR, IR, EPDM, Butyl, CR, NBR, Silicone rubbers, and Rubber Blends ensures coverage of general-purpose, oil-resistant, weather-resistant, heat-resistant, gas-impermeable, and specialty elastomers. Emphasis on manufacturing techniques (emulsion/solution polymerization), grade variations, curing systems, and processing behavior develops practical industrial competence. The study of rubber–rubber blends and morphology enhances understanding of performance optimization and cost-effectiveness through material modification. Overall, the course equips students with the technical foundation required for rubber product design, compound development, process selection, and industrial problem-solving, thereby strengthening employability and industry readiness in the field of Rubber Technology.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	Marks % weightage
C01	Differentiate between Natural & Synthetic rubbers	20
C02	Identify chemistry & manufacturing process of different Synthetic rubbers	25
C03	Classify different grades of Synthetic rubber and its importance	20
C04	Develop various rubber products according to application	20
C05	Design the different rubber blend formulation according to application	15

Teaching and Examination Scheme:

Teaching/Learning Scheme in hrs/semester					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Practical			
L	T	P	PBL*	TH	TH/30	ESE (E)	PA (M)	PA (I)	PBL(I)	ESE (V)	
60	0	30	30	120	4	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

*** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Styrene-Butadiene Rubber (SBR) : Introduction, Preparation, Structure and Variations of Emulsion SBRs, Structure and Variations of Solution SBRs, IISRP Numbering System, General Properties, Comparison of Solution and Emulsion SBRs, Compounding, Processing, Applications, Evaluation of physical and mechanical properties as per relevant BIS test methods (IS 3400 series).	06	15
2.	Polybutadiene Rubber (PBR) : Manufacture, Structure and Properties of Polybutadienes, IISRP Numbering System, Classifications, Processing and Applications.	05	10
3.	Synthetic Polyisoprene (IR) Rubbers: Preparation of Synthetic Polyisoprene (IR) Rubbers, Properties, IISRP Numbering System, Processing, Applications	03	10
4.	Ethylene-Propylene Rubbers (EPM & EPDM): Introduction, Manufacture, Structure and Properties, Variables between Grades, General Vulcanizate Properties, Processing, and Compounding.	05	10
5.	Isobutene-Isoprene (Butyl) Rubbers : Introduction, Manufacture, Structure-Property Relationships, Grades, General Vulcanizate Properties, Processing, Compounding, Applications of Unmodified Butyl Rubbers, Halobutyl Rubbers, Vulcanization, Applications, Cross-linked Butyl Rubbers.	06	15
6.	Chloroprene Rubber (CR) : Introduction, Production of Polychloroprene, Structure of CR & Structural Variables, Classification ,Structure & Properties, Processing, Compounding (Curing Systems & other additives),Applications.	05	10
7.	Acrylonitrile Butadiene (Nitrile) Rubbers: Introduction, Preparation, Structure & Properties General Vulcanizate Properties, Processing, Compounding (Blends with other polymers) Special Grades of Nitrile Rubber, Applications	05	10
8.	Silicones/Silicone Rubber : Introduction, Nomenclature of Organosilicone Compounds & Elastomers, Manufacture of Silicone Elastomers, Structure & Properties of Silicone Elastomer Polymers, General Properties, Compounding (Curing Systems, Fillers, Other additives), Processing,	05	10

	Liquid Silicone Rubbers, Room Temperature Vulcanizing Rubbers (RTV), Applications		
9.	Rubber-Rubber Blends: Introduction, Morphology, Analytical methods for Blend Characterisation, Preparation of Rubber Blends, Properties of Rubber Blends	05	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. Synthetic Rubbers, their Chemistry and Technology, by D. C. Blackley.
2. Handbook of Elastomers: New Development & Technology by Anil K. Bhowmick, Howard L. Stephenes
3. Rubber Technology, by Maurice Morton
4. Rubbery Materials & their Compounds, by J. A. Brydson

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

- http://chemwiki.ucdavis.edu/
- http://pubs.acs.org/
- https://www.crcpress.com/

Suggested Course Practical List: If any

Practical based on above topics.

Overall SDG Mapping

The course on Synthetic Elastomers (SBR, PBR, IR, EPDM, Butyl, CR, NBR, Silicone) and Rubber Blends contributes primarily to **SDG 9 (Industry, Innovation & Infrastructure)** by developing core competencies in elastomer synthesis, compound design, processing, and industrial product applications. It supports **SDG 12 (Responsible Consumption & Production)** through material optimization, blending strategies, efficient compounding, and sustainable manufacturing practices. The course also contributes to **SDG 13 (Climate Action)** by addressing energy-efficient processing, low rolling resistance tyre compounds, and reduced carbon footprint materials. Additionally, it indirectly supports **SDG 7 (Affordable & Clean Energy)** through fuel-

efficient rubber products, **SDG 3 (Good Health & Well-being)** via safe and medical-grade elastomers, and **SDG 11 (Sustainable Cities & Communities)** through durable infrastructure and automotive applications.

Activities suggested under problem based learning:

Sr No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Online Course	Minimum duration of the course should be 20 h.	Based on assignment submitted and certificate produced.
2.	Virtual /Industry Trip	Duration of hours-5h Report preparation- 5h Total -10 h	Based on report submitted. Report should contain manufacturing process, flow chart.
3.	Assignments	Completion of five independent tasks, each designed for a 3-hour engagement. Total = 15h	Based on assignment submitted.
4.	Case Study Analysis related to subject	Duration of data collection -6 h Report preparation – 4h Total- 10 h	Based on Problem identification, depth of analysis, technical insight, application relevance
5.	Technical Article/Video Reviews related to subject	Duration of Review -6h Report preparation -4h Total-10h	Relevance of content, clarity of summary, insights drawn, conceptual understanding
6.	DIY Experiments	5 hours including report preparation	Based on report submitted. Report should contain experiments performed which have Creativity, relevance to rubber properties, observation documentation, safety awareness.
7.	Course Seminar	Duration -10h	Based on technical Content & Understanding, Analysis, literature review, Quality of report and presentation.
8.	Mini/ Micro Project	Duration -10h	Based on Technical Analysis, literature review, methodology, innovation/sustainability aspect, Quality of report and presentation.
9.	Complex Problem solving	Duration -5h	Evaluation is based on problem complexity & clarity, analytical approach, design/experimental methodology, use of modern tools, sustainability considerations,

			innovation, result validation, and feasibility of solution.
10.	Videos focusing on industrial safety topics relevant to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based report submitted. Report should contain all safety aspects explaining its importance.
11.	Visual presentation of technical content through posters, charts, or PowerPoint slides	Duration = 10 h	Based on quality of poster/chart preparation, creativity, accuracy and effectiveness of presentation skills.

****