GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Under Graduate

Branch: Rubber Technology

Subject Code : BE05026111

Subject Name : Polyurathene Technology

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Elective Course - 1

Prerequisite:	None
Rationale:	This course provides comprehensive knowledge of polyurethane (PU) chemistry, raw materials, processing techniques, foam technologies, and performance evaluation. It covers chemical principles, structure–property relationships, flexible and rigid foam applications, and industrial processing systems, enabling students to understand PU formulation and manufacturing practices. The course also emphasizes material characterization, environmental impact, industrial hygiene, and safety aspects associated with polyurethane production and applications. Overall, it equips students with technical and practical competence in polyurethane technology, product development, quality control, and sustainable industrial practices.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	Marks % weightage
C01	Relate the Principles of Polyurethane Chemistry and processing	20
C02	Identify the different raw materials and its importance	20
C03	Differentiate the flexible and Rigid Polyurethane foam	20
C04	Analyze the raw materials and End product properties of Polyurethane	20
C05	Solve the problems related to compounding, mixing and environment	20

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)	
45	0	30	15	90	3	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.	Introduction: The development of the Polyurethanes, The Market of the Polyurethanes	05	10
2.	Chemical and Physical-Chemical Principles of Polyurethane Chemistry: Chemical Principles, Important Building blocks for Polyurethanes, Preparation methods for Polyurethanes, Recent developments, Perceptions on the physical chemistry of the structure of Polyurethanes	06	10
3.	Raw Materials: Introduction, Polyols: Polyether &Polyester, Isocyanates, Conversation Products of Raw Materials, Additives and Auxiliary Materials, Industrial Hygiene of PU Raw Materials, Additives	06	15
4.	Polyurethane Processing: Basics, Design Principles for Polyurethane Processing Equipments, Steps of the Polyurethane Processing like Delivery and storage of the raw materials, Preparation of components, Metering, Mixing, Pouring, Process Controls.	06	15
5.	Flexible Foams: Introduction, Slab stock Foams, Carpet Backing, Flexible Polyurethane Molded Foam, Semi-rigid Polyurethane Molded Foam	05	15
6.	PU Rigid Foam: Introduction, Chemistry and Raw Materials, Manufacturing, Properties, Relationship between Production Methods and Properties, Applications, Consolidation of Coal and surrounding Strata	05	10
7.	Determination of the Composition and Properties of Polyurethanes: Introduction, Determination of the Chemical Composition, Determination of Material Properties, Suitability Determination through End-Product Testing, Combustibility Testing and Rating as per IS standard	06	15
8.	Polyurethane and the Environment: Introduction, Industrial Hygiene in Manufacturing and Processing, Ecology of Polyurethanes, Polyurethanes as Foodstuffs-Commodities, Flammability and Flammability Risk etc	06	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**
12	12	16	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. Polyurethane Handbook By: Dr. Gunter Oertel

2. Handbook of Thermoplastic Elastomer, Edited by Benjamin M. Walker
3. Thermoplastic Elastomers: A Comprehensive Review, Edited by N. R. Legge, G. Holden, H. E. Sehroeder
4. Rubber Materials & Their Compounds, by J. A. Brydson

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

- **http://americanurethane.com/polyurethane-properties.html**
- **http:// www.crcpress.com**
- **http://www.polyurethanes.covestro.com/**

Overall SDG Mapping:

The Polyurethane Technology course primarily supports **SDG 9** through advanced material innovation and industrial processing systems. It contributes to **SDG 12** by promoting efficient resource utilization and controlled manufacturing practices, and supports **SDG 13** and **SDG 7** through energy-efficient insulation applications. The course also aligns with **SDG 3** by emphasizing industrial hygiene and safe chemical handling practices.

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.

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