GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Rubber Technology

Subject Code : BE03026021

Subject Name: Rubber Engineering & its Economics

w. e. f. Academic Year:	2024-25
Semester:	3
Category of the Course:	PCC

Prerequisite:	None
Rationale:	The Rubber Engineering & Its Economics subject plays a vital role in the education of engineering students specializing in polymer technology, rubber manufacturing, and industrial processes. This subject integrates the technical aspects of rubber processing with the economic and organizational principles necessary to operate efficiently in an industrial environment. The inclusion of machinery, safety standards, and economic principles provides a comprehensive understanding of the rubber industry, enabling students to work effectively in various rubber-related sectors, including automotive, construction, healthcare, and consumer goods. On the economic side, students learn how to manage costs, allocate resources efficiently, and organize production processes to improve profitability and competitiveness in the market. Industrial organization and economic principles provide a holistic understanding of how rubber manufacturing operates as part of a larger industrial ecosystem, helping students balance production efficiency with market demand and sustainability. This blend of technical expertise and economic understanding prepares students for leadership roles in the rubber and polymer industries, enabling them to innovate, optimize, and manage production in a way that balances performance, cost, and safety.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Identify and explain the different components of rubber equipment and the organizational structures involved in rubber manufacturing.
02	Compare various molding techniques used in rubber product manufacturing, and select appropriate vulcanizing equipment based on product specifications and requirements.
03	Apply proper safety measures and devices for rubber machinery to ensure safe and efficient operations during the production process.
04	Analyze the relationship between Reliability, Availability, and Maintainability (RAM) and their impact on the economics and productivity of rubber manufacturing.

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA/ (I)	PBL (I)	ESE (V)	
45	0	30	45	120	04	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.	Mixing Mill: Open mill mixer-internal mixer-semi continuous & automatic mixing equipment, single geared & double geared mills, energy & economic consideration, Kneaders, Transfer mix, Banbury mixer, Tandem mixing, new developments.	06	10
2.	Calenders: Types & sizes of typical machines, roll configurations, roll cambering, single trip & double rip arrangements for sheeting, equipments for coating of textile fabrics, friction coating, axis crossing devices, roll bending etc.	06	10
3.	Extruders: Ram type & screw type extruders, hot & cold feed extrusion direct powder extruders, effects of screw length/dia. ratio, temp. control & ancillary equipment, extruder drives & power rating, machine selection. New developments.	06	10
4.	Molding Machine: Molding, Review of Molding Methods, Compression Molds, Transfer Molds, Injection Molds, Materials handling & Mold Stripping, Mold lubricants, Surface treatments & Cleaning Deflashing & Finishing of Moldings, Blank preparation for molding, Blank heating methods, injection molding machine, types, screw & ram type machines, vertical injection molding machines ejection techniques, compression molding machines, transfer molding machine. New developments.	06	10
5.	Hand Building & Forming Equipments:	03	10

	Equipments for tank & pipe lining, roller covering, low pressure unreinforced hoses making.		
6.	Vulcanization Equipments: Equipments for Volume by methods other than molding, Autoclave, curing methods, equipments for continuous vol. hot air tunnel, molten salt bath, fluidized bed, microwave curing and recent developments etc.	06	10
7.	Finishing of Rubber Components: Equipments for flash & spew removal, hand trimming, roller trim, buffing, low temp tumbling, punching, grinding, shot blasting, painting & lacquering. New techniques.	03	10
8.	Safety In the Use of Rubber Machinery: Construction, use & maintenance of guards, fixed guards, interlocked guarding, trip devices, photo electric & pressure sensitive devices, maintenance of guards	03	10
9.	Elements Of Economics: Laws of scarcity, diminishing return & increasing costs, Capital & labor, Depreciation & taxes, Investment criteria, Business cycles & forecasting Banking system installation. Basic economic concepts, Demand, Supply loan & grants, Economic planning etc	03	10
10.	Industrial Organisation: Forms of Business enterprises, Organisational structure line, Staff line & staff organisation, function & responsibilities. Organisation development & types of organisations, Coordination & moral, Product development & research, simplification & standardization of product & materials, processed & material inspection, productivity, profit & human relations.	03	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. Rubber Technology & Manufacturing: by C. M. Blow
2. Calendering & Extrusion Technology by : Arun V. Apte
3. Rubber Engineering: IRI.
4. Rubber Processing & Production Organization By: Philip K. Freakley
5. Rubber Technology : by Maurice Morton

(b) Open source software and website:

- dir.indiamart.com/impcat/rubber-mixing-mill.html
- www.uttamrubtech.com/laboratory-rubber-mixing-mill.html
- dir.indiamart.com/impcat/calendering-machine.html
- www.motherson.com › Our Business › Rubber Moulding & Extrusion
- www.hindhydraulics.com/rubber.asp

Suggested Course Practical List: If any

Practical based on above topics.

List of Laboratory/Learning Resources Required:

Suggested Project List:

1. Optimization of Rubber Mixing Parameters in Open Mixing Mills
2. Effect of Calendering Process Parameters on Rubber Sheet Quality
3. Design and Analysis of a Rubber Extruder for Optimal Die Performance
4. Optimization of Injection Molding Parameters for Rubber Components
5. Manual Techniques vs. Machine-Assisted Forming: A Comparative Study
6. Improving Energy Efficiency in Vulcanization Processes
7. Techniques for Enhancing Surface Finish and Durability of Rubber Components
8. Developing a Safety Protocol for Rubber Machinery: A Case Study
9. Cost-Benefit Analysis of Automation in Rubber Manufacturing
10. Lean Manufacturing in Rubber Processing: A Case Study
11. Sustainable Rubber Manufacturing: Reducing Waste and Recycling in Rubber Processing
12. Preventive Maintenance Strategies for Rubber Processing Equipment

13. Optimizing Supply Chain Management for the Rubber Manufacturing Industry
14. Development of High-Performance Rubber Composites for Automotive Applications
15. Implementing Statistical Process Control (SPC) in Rubber Manufacturing

- **List of suggested activities for Problem Based Learning:**

Sl. 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.	Self-Learning Through Assignment Creation related to subject	Completion of five independent tasks, each designed for a 3-hour engagement. Total = 15h	Based on assignment submitted.
3.	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
4.	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
5.	Industry Interaction (Webinar/Interview/Quiz)	Total-10 h	Based on certificate produced for participation in webinar, interview, quiz and based on report submitted. Report should contain key takeaways.
6.	Peer Teaching Video	2 video preparation -10 h	Create a 5–10-minute video explaining a rubber technology concept for peers, incorporating visuals.
7.	Glossary Compilation	Duration -5h	Based on report submitted. Report should contain Accuracy, completeness, formatting, and use of illustrations/examples
8.	Videos focusing on Review on Economic Analysis Tools 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.

9.	Peer Interaction / Teaching	5 research paper/ Technical Topics = 20 h	Communication skill, clarity of explanation, concept understanding
10.	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.
11.	Software tool learning and Practice	Duration = 20 h	Based on report submitted. Report should contain the details of learning tools and its application.

Note:

- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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