



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3142601

Semester – IV

Subject Name: Rubber Textile & Metal Reinforcement of Elastomers

Type of course: Professional Core Course

Prerequisite:

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	4	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	General Introduction: Classification of Textiles, Textile terms & Definitions, Fiber Properties, Fiber Morphology, Property requirements of yarns for industrial uses, Production of textile yarns & cords, Textile & rubber composites, Production & properties of textile, Production methods for textile fibers: Cotton, Rayon, Nylon, Polyester, Aramid, General chemical & physical properties of textile fibers: Cotton, Rayon, Nylon, Polyester, Aramid.	06
2	Preparation & Design of Textile Structures: Production of single end reinforcements, Fabric production, Non-woven fabrics, The design of woven fabric.	04
3	Textile Processing: Introduction, Basic principles of adhesion, Method of achieving adhesion between textile and rubber, Adhesion test methods, Dipping, Coating of textiles with rubber compounds, Latex proofing, Coating of steel cords, etc.	04
4	Basic Properties of Fiber & Fiber Testing: Moisture content & moisture regain, Crimp, Modulus, Elongation, Bearing strength, Part load elongation, Impact strength, Hysteresis, Shrinkage, Stiffness, Electrical, Chemical & Physical Properties, Shrinkage, Twist, Stiffness, Fatigue, Adhesion.	05
5	Rubber-Fiber Composites: Fiber handling & compounding with Rubber, Properties & examples of application, Applications in rubber of santoweb short-fibers, Enhancement of rubber properties via short kevlar aramid fibers, Extrusion of short fiber reinforced rubber, Fibrous magnesium silicate as a high volume & high modulus reinforcing filler in rubber composites.	05
6	Short-Fiber Rubber Composites: Introduction, Advantages in comparison to cord reinforcement, Comparison with fiber reinforced plastics, Literature review, Fibrous materials, Rheology, Properties, Mechanics, Applications, Short-Fiber Composite concepts, Composite structure, Interfacial region, Theory of reinforcement with short(Discontinuous) fibers, Mechanics of complex	05



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3142601

	distributions, Short-fiber Reinforcing materials, Processing methods, Properties & performance, Design & applications.	
7	Heat Setting & Adhesive Treatment: Heat setting machinery, Heat setting, Adhesive treatments, The In-Situ bonding systems, Effects of rubber compounding ingredients, Mechanisms of adhesion, Environmental factors affecting adhesion.	04
8	Peel Performance & Other Assessment of Textiles: The static of peeling, Peeling as a visco-elastic process, Standard test procedure for peel strength, Non-standard methods of assessing results of peel tests, Peel tests involving heavy duty fabrics & multi-ply constructions, Peel tests involving light weight coating of fabrics, Peeling by dead-weight loading, Direct tension testing of rubber to fabric adhesion, Ballistic methods of testing rubber to fabric adhesion, Pull-out tests for cord adhesion, Adhesion in fatigue testing, Assessment of penetration of adhesive into textile.	05
9	Surface Treatment for Metal: Aluminum, Copper, Steel, Polymers, Corona discharge, Acid etching, Plasma treatment & other methods.	04
10	Adhesion, Corrosion and Staining: Adhesion to metals, Adhesion to fabrics, Adhesion to cord, Corrosion of, and adhesion to metals, Staining.	04
11	Rubber to Metal Bonding: Elements of rubber to metal system, Mechanical and chemical treatment, Application methods of rubber to metal bonding agent, Metal cleaning, Surface treatment, Rubber to metal assemblies, Materials, Manufacturing methods, Moulding, Insert moulding, Adhesives, Testing, Problem solving in rubber to metal bonding.	04
12	Wet blast preparation and the subsequent phosphating process and related equipment: Purpose, Operation, Comparison, Advantages and Other benefits.	04

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
12	12	16	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3142601

Reference Books:

- Textile Reinforcement of Elastomers, edited by William C. Wake & David B. Wootton; Applied Science Publishers
- Rubber Engineering by Indian Rubber Institute
- Polymer Latices Science and Technology, Second Edition: Volume-3: Applications of Latices, by D. C. Blackley
- Handbook of Elastomers: New Developments & Technology, Edited by Anil K. Bhowmick & Howard L. Stephens
- Proceedings the 8th Scandinavian Rubber Conference. (June 10-12, 1985, Copenhagen, Denmark)
- Proceedings for RAPRA Technology Ltd.

Course Outcomes:

After learning this course students will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Classify the different textile materials	20
CO-2	Identify the micro-structures and properties of materials	20
CO-3	Analyze the effects of different adhesive treatments	20
CO-4	Evaluate the peel strength, bearing strength, and physical properties for various fibres	20
CO-5	Solve the problems related to rubber to metal bonding	20

List of Experiments:

Tutorials/Presentation/Practicals based on above topics.

Major Equipment:

Pilling Tester, Specific gravity balance, Weighing balance, Adhesion Tester, Tensile Testing Machine etc.

List of Open Source Software/learning website:

- <http://www.iom3.org/events/rubber-reinforcement>
- <http://shodhganga.inflibnet.ac.in/>
- <http://deltarubberco.com/>
- <http://www.crayvalley.com/>