GUJARAT TECHNOLOGICAL UNIVERSITY

RUBBER TECHNOLOGY (26)
TEXTILE & METAL REINFORCEMENT OF ELASTOMERS
SUBJECT CODE: 2152603
B.E. 5th SEMESTER

Type of course: B. E. Rubber Technology

Prerequisite: NA

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	3	6	70	20	10	20	10	20	150

Content:

Sr. No	Topics	Teaching Hrs.	Module Weightage
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.	6	10
2.	Preparation & Design of Textile Structures: Production of single end reinforcements, Fabric production, Non-woven fabrics, The design of woven fabric.	4	10
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.	4	10
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.	5	10
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.	5	10

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 distributions, Short-fiber Reinforcing materials, Processing methods, Properties & performance, Design & applications.	5	10
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.	4	5
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.	5	10
9.	Surface Treatment for Metal: Aluminum, Copper, Steel, Polymers, Corona discharge, Acid etching, Plasma treatment & other methods.	4	5
10.	Adhesion, Corrosion and Staining: Adhesion to metals, Adhesion to fabrics, Adhesion to cord, Corrosion of, and adhesion to metals, Staining.	4	5
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.	4	10
12.	Wet blast preparation and the subsequent phosphating process and related equipment: Purpose, Operation, Comparison, Advantages and Other benefits.	4	5

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	15	15	-

Reference Books:

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

Course Outcome:

After learning the course the students should be able to

1. Able to learn about classification of Textiles.
2. Identify the type of fabric according to properties .
3. Compare the design of woven & non woven fabric.
4. Understand the Basic Properties of Fiber & Fiber Testing.
5. Able to develop Rubber-Fiber Composites.
6. Learn about Short-fiber Reinforcing materials, Processing methods, Properties & performance, Design & applications..
7. Understand the Mechanisms of adhesion & environmental factors affecting adhesion.
8. Learn the Surface Treatment for Metal.

.

List of Experiments:

Tutorials/Presentation/Practicals based on above topics

Design based Problems (DP)/Open Ended Problem:

1. Rubber Reinforcement by Fillers, Fibres and Textiles.
2. Factors affecting the properties of Short fiber- Rubber Composites.
3. Selection of bonding agents for rubber to metal bonding.
4. Metallic Co agents for Rubber-To-Metal Adhesion

Major Equipments:

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/

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.