GUJARAT TECHNOLOGICAL UNIVERSITY

RUBBER TECHNOLOGY (26)
THERMOPLASTICS ELASTOMERS & POLYMER BLENDS
SUBJECT CODE: 2162605
B.E. 6thSEMESTER

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	Course Content	Total Hrs	% Weightage
1.	Introduction : Introduction of Thermoplastic elastomers, Synthesis, Morphology of Thermoplastic Elastomers, Properties & Effect of Structure, Thermodynamics of Phase Separation, Rheology &Processing of Thermoplastic Elastomers, The Heat Fugitive Cross link.	5	15
2.	Styrene-Butadiene-Styrene Triblocks & Related Materials: Preparation, Structure, Properties, compounding & Processing, Applications	5	15
3.	Polyether-Ester Thermoplastic Rubbers : Synthesis & Structure, Properties, Processing, Applications	5	15
4.	Ethylene Vinyl Acetate Rubbers (EAM/EVA): Manufacturing, Properties, Processing, Compounding, Applications Vulcanizable & Thermoplastic EVA Rubbers:	5	20
5	Polyurethene Rubbers : Introduction, Isocynates, Preparation Chemistry of a polyurethane rubbers, Polyols Cast Polyurethene Rubbers, Unstable Prepolymer Systems, Stable Prepolymer Systems, Quasi-Prepolymer Systems, One-shot Systems, Markets for Cast Polyurethene Elastomers, Millable Gums, Polyurethene foams & Micro cellular Reaction, Moulded Polyurethenes, Other uses of Polyurethanes. Thermoplastic Polyurehene Rubbers : Preparation & Structure, Properties, Processing, Applications, Chemistry, Morphology & Thermal Responses, Molecular Weight Effects, Chemical c/s Effects, Environmental Stability & Stabilization, Compounding, Commercial Polymers & their properties.	6	20
6	Thermoplastic Polyolefin Rubbers: Formulation & Structure, General Properties, Applications, Halogenated Polyolefin Alloy Thermoplastic Rubbers	6	15
7	Thermoplastic Natural Rubber Blends: Elastomer-Thermoplastic Blends as Thermoplastic Elastomers: Rubber & Plastics used in Blends: Introduction, Preparation of Rubber-Plastic Blends, Phase Morphology, Properties of Unvulcanised Rubber-Plastic Blends,	6	

	Properties of Blends prepared by Dynamic Vulcanisation, Technological Applications, Poly (Vinyl Chloride) Blends, Nitrile Elastomers with PVC: Research & Development, Structure-Property Relationships, Polyesters with PVC, Ethylene Copolymers with PVC, Other Polymeric Plasticizers with PVC, Thermoplastic Polyolefin Rubbers (TPO) : Formulation & Structure, General Properties, Applications, Butyl Rubber with Polyethylene & Polypropylene, Ethylene/Propylene Copolymers & Terpolymers with Polyethylene & Polypropylene Other Blends: Ethylene-Acrylate Copolymers with Polyethylene, Poly (Dimethylsiloxane) with Polyethylene. Polyester amides & Polyether ester amides: Thermoplastic Polyamide Elastomers : Introduction, Segmented Block Copolymers, Structure & Morphology Polyester amides & Polyether ester amides Thermoplastic Elastomers : Synthesis & Morphology, Physical Properties of PEA & PEEA, Tensile Properties, High Temperature Tensile Properties, Dry Heat Aging, Humid Aging, Chemical & Solvent Resistance, Tear Strength, Abrasion Resistance, Compression Set, Flex Properties, Adhesion, Weatherability, Electrical Properties, Processing Characteristics, Potential Applications.		
8	Rubber-Rubber Blends: Introduction, Morphology, Analytical methods for Blend Characterisation, Preparation of Rubber Blends, Properties of Rubber Blends	6	10
9	Additional Types of Thermoplastic Elastomers : Thermoplastic 1,2-Polybutadiene, Trans-1-4-Polyisoprene.	4	10
10	Crosslinked Polyethylene: Introduction, Basic Structure, Compounding & Mixing of Polyethylene, Processing, Physical Properties of Crosslinked Polyethylene, Applications ofCrosslinked Polyethylene.	6	10

Suggested specification table with marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	15	15	15	10	0

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.

Reference Books:

1. Handbook of Elastomers: New Development & Technology, Edited by Anil K. Bhowmick, Howard L. Stephens
2. Thermoplastic Elastomers: A Comprehensive Review, Edited by N. R. Legge, G.Holden, H. E. Sehroeder
3. Rubber Materials & Their Compounds, by J. A. Brydson
4. Handbook of Thermoplastic Elastomer, Edited by Benjamin M. Walker
5. Science & Technology of Rubber, Edited by James E. Mark, Burak Erman, Frenrick R. Eirich
6. Handbook of Rubber Technology, Volume-3: Recycling & Pollution Control in Rubber Industries, Edited by J. M. Martin, W. K. Smith

Course outcome:
After learning the content of the subject the students will be able to:

1. Know about the importance of thermoplastic elastomers in rubber field.
2. Learn about Thermoplastic Elastomers of Surfaces, Rheology &Processing.
3. Able to understand the Rheology &Processing of Thermoplastic Elastomers.
4. Understand the Properties of Unvulcanised Rubber-Plastic Blends.
5. Learn about the Analytical methods for Blend Characterisation.
6. Compare the Polyester amides & polyether ester amides thermoplastic Elastomers.
7. Learn the importance of thermoplastic polyamide elastomers.
8. Learn about additional types of thermoplastic elastomers.
9. Know & study about thermoplastic polyolefin rubbers.

List of Experiments:
Tutorials/Presentation/Practicals based on above topics

Design based Problems (DP)/Open Ended Problem:

- High molecular weight thermoplastic polyether ester elastomers by reactive extrusion.
- Multifunctionality of Polymer Composites: Challenges and New Solutions.
- Micro and Nanostructured Epoxy / Rubber Blends

Major Equipments:
Melt Flow Index Tester, U-Tube Viscometer, Cup & Bob Viscometer etc.

List of Open Source Software/learning website:

- http://onlinelibrary.wiley.com/
- http://www.sciencedirect.com/
- https://www.crcpress.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.