

# GUJARAT TECHNOLOGICAL UNIVERSITY

## RUBBER TECHNOLOGY (40)

THERMAL & THERMAL ANALYSIS OF RUBBER & RUBBERY MATERIALS  
(TAR&RM)

**SUBJECT CODE:** 2724005

**SEMESTER:** II

**Type of course:** (Major Elective-II) (M.E.Rubber Technology)

**Prerequisite:** NA

**Rationale:** NA

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

**Content:**

Sr. No	Course Content	Total Hrs	% Weightage
1.	Instrumental Techniques used for Thermal Analysis of Rubbers and Rubbery Materials: Introduction, Differential Thermal Analysis (DTA) , Differential Scanning Calorimetry (DSC), Derivative Thermogravimetry (DTG), Evolved Gas Analysis (EGA) or Evolved Gas Detection (EGD), Thermo mechanical Analysis (TMA) and Thermodilatometry (TD) or Thermodilatometric Analysis (TDA), Parallel Plate Rheometry (PPR), Stress Relaxation Spectrometry, Dynamic Mechanical Analysis (DMA), Torsional Braid Analysis (TBA), Thermally Stimulated Current (TSC), Relaxation Map Analysis (RMA), Differential Photo Calorimetry (DPC), Dielectric Analysis (DEA) or Dielectric Thermal Analysis (DETA).	10	20
2.	Applications of DSC and TGA for the Characterization of Rubbers and Rubbery Materials: Introduction, Differential Scanning Calorimetry of Rubbery Materials, Thermo gravimetric Analysis of Rubbery Materials, Thermal Degradation and Stability of Rubbers by TGA, Miscellaneous Applications of TGA	12	20
3.	Micro-thermal Analysis of Rubbery Materials: Introduction, Basic Principles of $\mu$ TA, Modes of Micro-thermal Analysis, Micro-thermal Analysis of Rubbery Material, Morphological Investigation in Polymer Blends, Thin Films/Coating on the Substrate, Multilayer Material	10	20

	Characterization, Thermal Characterization of Micro-spheres, Powder Particle Characterization, Characterization of Microspores, Characterization of Nanostructure Material.		
4.	Thermal Analysis in Understanding Rubbery Matrix and Rubber-Filler Interactions: Introduction, Thermal Analysis and Investigation of Heterogeneous Materials, Structure-Properties Relationships in Particulate Filler/Rubbery Matrix Systems, Description of the Shape and Space Distribution of Filler Particles, Filler-to-Matrix and Filler-to-Filler Interactions as Investigated by Thermal Analysis, Thermogravimetry, DTA and DSC.	10	20
5.	Thermal Analysis of Rubber Products: Introduction, Thermal Analysis of Rubber Based Vibration Control Devices, Thermal Analysis of Rubber Seals, Thermal Analysis of Rubber-Based Cable Sheathing Compounds, Thermal Analysis of Rubber Based Adhesives, Thermal Analysis of Rubber Based Insulators, Thermal Analysis of Thermal Interface Materials (TIM), Thermal Analysis of Automobile Tyres.	12	20

#### Reference Books:

- Thermal Analysis of Rubbers and Rubbery Materials: Editors: Namita Roy Choudhury & Prajna P De and Naba K. Dutta.

#### Course Outcome:

After learning the course the students should be able to:

- Understand about Instrumental Techniques used for Thermal analysis of Rubbers & Rubbery Materials.
- Learn the applications of DSC & TGA for Characterization of Rubbers.
- Learn about Micro-thermal Analysis of Rubbery Material.
- Able to understand Characterization of Nanostructure Material .
- Develop the Structure-Properties Relationships in Particulate Filler/Rubbery Matrix Systems.
- Learn and Understand the Thermal Analysis of Rubber Products.

#### List of Experiments:

Tutorials/Presentation/Practicals based on above topics.

#### Open Ended Problems:

1. Differential scanning calorimetry analysis of natural rubber and related polyisoprenes. Measurement of the glass transition temperature.
2. Effect of Silane Coupling Agent on the Mechanical & Thermal Properties of Polymeric Materials.
3. Aging of Natural and Synthetic Rubber and Rubber Products:

#### Major Equipments:

Differential Scanning Calorimeter, Thermo mechanical Analyzer, Differential Thermal Analyzer etc.

**List of Open Source Software/learning website:**

<http://www.crcpress.com>

<http://pubs.acs.org/>

[www.cjps.org/EN/article](http://www.cjps.org/EN/article)

[www.sciencedirect.com/](http://www.sciencedirect.com/)

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website