



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3142601

Rubber Compounding Materials

B.E. 4<sup>th</sup> SEMESTER

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	Organic Materials: Hydrocarbons, Unsaturated Hydrocarbons, Aromatic Hydrocarbons, Phenols, Phenolic Antioxidants, Al, Alcohols, Fatty Acids, Amines, Rubber Chemicals, Organic Peroxides, Resins, Quantitative Analysis of Organic Compound.	06
2	Inorganic Materials: Calcium & Magnesium, Copper & Zinc, Compounds of Aluminum, Silicone and Ozone, Other Inorganic Compounds used in Rubber Industries, Sulfur etc.	06
3	Rubber Additives: Basic Principles, Introduction, Classification of Additives, Recurring Theories, Synergism, Toxicity.	06
4	Antidegradants: Introduction, Autoxidation of Hydrocarbon Polymers, Chain-Breaking Antioxidants, Amine & Phenolic Antioxidants, Antiozonants, Prevention of Ozone Attack, Use of Waxes & Saturated Polymer for Ozone Protection.	06
5	Compounding Materials: Plasticizers, Process aids & Fictices, Accelerators, Blowing Agents, Bonding Agents, Other Compounding Aids, Peptisers, Colors & Pigments, Special Purpose Additives, Non Black Fillers etc.	15
6	Environmental requirements in Compounding:	04
7	Principles of Compounding: Introduction, The ingredients & formulation of a mix, Compounding to meet processing requirements, Compounding of Vulcanizate properties, Compounding for Bonding to non-rubber substrates.	03
8	Art of compounding: Calculation of compound cost of a recipe, Calculation of compound volume of a recipe, Calculation of compound specific gravity of a recipe, formulation of mix, Processing	03



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	requirements.	
9	Carbon Black: Introduction, Properties, Rubber compounding aspects, Furnace process, Thermal process channel or impingement process, Lamp black process, Particles size, Structure, Particle porosity, Classification. Effect of properties of carbon black on properties of rubber Vulcanizates.	05

## 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.

## Reference Books:

- Rubber Engg. by IRI
- Rubber Technology Handbook, by Hofmann
- Science & Technology of Rubber, by J. Mark, B. Erman, F. Eirich
- Rubbery Materials & their Compounds, by J. A. Brydson
- Rubber Technology & manufacture, by C. M. Blow
- Rubber Product Mfg. Technology, by Anil K. Bhowmick

## Course Outcomes:

After learning this course students will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Identify the different organic and inorganic materials	20
CO-2	Analyze the effects of different fillers on rubber compound	20
CO-3	Calculate the compound specific gravity and cost of the compound for given materials.	20
CO-4	Solve the problems related to compounding, mixing and environment	20
CO-5	Design the different compounding formulation according to product	20



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## List of Experiments:

Tutorials/Presentation/Practicalsbased on above topics.

## Major Equipment:

Ph meter, Specific gravity balance, Weighing balance, Hot Plate, Melting Point Apparatus etc

## List of Open Source Software/learning website:

- [www.britannica.com/EBchecked/topic/511800/rubber/289657/Additives](http://www.britannica.com/EBchecked/topic/511800/rubber/289657/Additives)
- [www.ndsseals.com/rubber-ingredients.html](http://www.ndsseals.com/rubber-ingredients.html)
- [rubbertrainer.blog.com/2012/09/24/compounding-ingredients](http://rubbertrainer.blog.com/2012/09/24/compounding-ingredients)
- <https://rubbertech.wordpress.com/2013/07/.../basic-rubber-compounding>