

# GUJARAT TECHNOLOGICAL UNIVERSITY

## CHEMICAL TECHNOLOGY (36)

### REFRACTORIES-I

**SUBJECT CODE: 2163603**

**B.E. 6<sup>th</sup> SEMESTER**

**Type of course:** Chemical Technology

**Prerequisite:** The students should have a clear concept on basic chemistry, geology and Mineralogy that will help them to have an easy grasp of the subject and GC04.

**Rationale:** The main objective of this subject is to offer an overview over the fundamentals and basics of Refractory materials, the manufacturing processes of various refractory bricks, their application, their properties, beneficiation processes, process of recovery and their application and their testing process.

#### 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)		
				PA	ALA	ESE	OEP			
4	0	3	7	70	20	10	20	10	20	150

#### Content:

Sr. No.	Content	Total Hrs.	% Weightage
<b>1</b>	<b>Introduction</b> : Scope of refractory Industry - Global and Domestic Market Scenario	5	25
<b>2</b>	<b>Fundamentals of refractory science and engineering</b> – a) Brief review of raw materials – b) gap grading, continuous grading c) Fabrication and firing d) Importance of Phase diagram in refractory e) Phase rule, Eutectic, peritectic, Two component systems – Al <sub>2</sub> O <sub>3</sub> – SiO <sub>2</sub> ; Al <sub>2</sub> O <sub>3</sub> – MgO; MgO – Cr <sub>2</sub> O <sub>3</sub> ; MgO – CaO	10	25
<b>3</b>	<b>Manufacturing, Properties and applications of following refractories:</b> 1. Silica Refractories, Super duty, Semi silica refractories 2. High Alumina and Alumino Silicate Refractories: Significance of Phase diagram in the development of different phases – Sintered and fused alumina. 3. Basic Refractories: Magnesite, dolomite, lime, chromite: Production of Burnt refractories – Sintered and fused refractories: - Chemically bonded and Direct bonded. 4. Insulating Refractories	10	25
<b>4</b>	<b>Testing of important properties of refractories:</b> a) Chemical Analysis b) Phase analysis	15	25

c) Physical Testing:- A.P., B.D., Total Porosity, Spinel. Gravity, Pore size distribution, C.C. S, Cold MOR, Hot MOR, PCE, RUL, Compressive Strength, PLCAR, Spalling Resistance, reversible thermal Expansion, CO – disintegration, corrosion resistance.		
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**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
12	50	26	6	6	00

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

**Reference Books:**

1. Refractories – Production and properties – J. H. Chester
2. High Temperature Oxides (Part – I) – A. M. Alper
3. The Technology of ceramics and refractories – P. P. Budnikov
4. Refractories – F. H. Norton

**Course Outcome:**

1. To express their technical knowledge over fundamentals of the subject
2. To be able to utilize their knowledge and skills for the preparation of other related highly technical subjects in the Glass & Ceramic Technology course curriculum
3. To be able to apply this knowledge in their higher study, research work with related technical subjects.
4. To build a bridge between theoretical and practical concept used in industry.

**List of Experiments:**

1. Powder Preparation -- Crushing fireclay grog. Size separation of grog
2. Characterization of different clays -- Ball clay, Plastic clay etc
3. Determine grain B.D., Grain porosity, Grain Sp. Gr., Tap density of ceramic materials
4. Body preparation with Temporary binders (Dextrin, Starch etc.) and Ceramic binders
5. Study of effect of Composition, Forming pressure & Firing temperature on some properties of refractory bricks.
6. Fabrication of some high alumina & basic bricks
7. Testing of various important properties of refractories as per IS
8. Refractory corrosion test

**Design based Problems (DP)/Open Ended Problem:**

**Students are free to select any area of science and technology based on chemical technology applications to define Projects**

**List of Open Ended Projects:**

1. Industrial practices for sorting out various defects in fired silica bricks
2. Industrial practices for manufacturing Alumina bricks
3. Industrial practices for manufacturing Magnesia bricks
4. Industrial practices for manufacturing dolomite bricks
5. Industrial practices for manufacturing magnesia carbon bricks

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

1. Literature available on internet
2. Glass & Ceramic dictionaries
3. Delnet
4. Literature available under R&D in Ceramic & Glass industry.
5. Ceramic & Glass journals

**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.