GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3163616
Semester – VI
Subject Name: Refractories-I

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.
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	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction : Scope of refractory Industry - Global and Domestic Market Scenario	**10**
2	Fundamentals of refractory science and engineering – a) Brief review of raw materials – b) gap grading, continuous grading c) Fabrication and firing d) Importance of Phase diagram in refractory	**10**
3	Phase rule, Eutectic, peritectic, Two component systems – Al_2O_3 – SiO_2; Al_2O_3 – MgO; MgO – Cr_2O_3; MgO – CaO Manufacturing, Properties and applications of following Refractories: 1. Silica Refractories, Super duty, Semi silica refractories 2. High Alumina and Alumino Silicate Refractories: Signifiance of Phase diagram in the development of different phases – Sintered and fused alumina.	**10**
4	Basic Refractories : Magnesite, dolomite, lime, chromite refractories Production of Burnt refractories – Sintered and fused refractories: - Chemically bonded and Direct bonded refractories 4. Insulating Refractories	**10**

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5	Testing of important properties of refractories: a) Chemical Analysis b) Phase analysis c) Physical Testing:- A.P., B.D., Total Porosity, Spinel. Gravity, Pore size distribution,	**05**
6	C.C. S, Cold MOR, Hot MOR, PCE, RUL, Compressive Strength, PLCAR, Spalling Resistance, reversible thermal Expansion, CO – disintegration, corrosion resistance	**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
19	**36**	**13**	**11**	**11**	**10**

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

Reference Books:

1) Introduction to Glass Science & Technology – J.E. Shelby
2) Chemistry of Glasses - A. Paul
3) Handbook of Glasses – R. H. Doremus
4) Spectroscopy & Structure of Glasses – C. A. Angell
5) Handbook of Glass Manufacture - F.V. Tooley
6) Glass Engineering Handbook – E. B. Shand.
7) Handbook of Glass Properties – G. W. Morey.
8) Handbook of Glasses – R. H. Doremus

Course Outcomes:

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	To express their technical knowledge over fundamentals of the subject	30
CO-2	To be able to utilize the knowledge and skills for the preparation of other related highly technical subjects in the Glass & Ceramic Technology course curriculum	28
CO-3	To be able to apply this knowledge in the higher study, research work with related technical subjects.	27
CO-4	To build a bridge between theoretical and practical concept used in industry	5
CO-5	To ascertain and correlate the knowledge of this subject with the vast domain of materials sciences and ceramic materials.	5
CO-6	To investigate deep into the research scope over the refractory materials, their fabrication and various properties	5

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List of Experiments:

1. Powder Preparation -- Crushing fireclay grog. Size separation of grog
2. Characterisation 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

List of OEPs :

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