GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3153621
Semester – V

Subject Name: Glass Science & Technology

Type of course: Chemical Technology

Prerequisite: The students should have a clear concept on basic chemistry, mineralogy and the basics into the introduction of Glass & Ceramic materials.

Rationale: The main objective of this subject is to offer an overview over the fundamentals and basics of glass and ceramic materials, their manufacturing processes, the raw feed materials for batch preparation, their availability, their properties, their beneficiation processes, process of recovery and their application.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	The non-crystalline solids & the glasses. Formation from liquid phase. Formation from a gaseous phase. Formation from a solid phase. Definition of glass. Vitreous transition. Phenomenological study. Thermodynamic study. Theory of vitreous transition. Determination of transition temperature	10
2	Conditions of vitrification. Structural theory (Zachariasen model, Stanworth etc.). Kinetic theory of glass (Nucleation & Growth).Structure of Glass: XRD, SAXS and other methods of determining glass structure. Structural models of glass. Reaction mechanisms. Ion exchange & network breakdown processes. Glass durability controlling factors.	10
3	Thermodynamic basis of phase separation in glasses. Immiscibility in glasses. Kinetics of demixing. Application of immiscibility diagrams. Spinodal decomposition.	10
4	Density & Thermal expansion measurements & their implications and their dependence on compositions. Thermal history effects. Effect of crystallization. Additive rule.	10
5	Diffusion in Glasses. Electrical conductivity of glasses. Dielectric properties. Optical properties of glasses. Refractive index, Molar volume & Ionic refractivity, Birefringence. Photosensitive/Photo chromic glasses.	05

6	Glass production, Basic processes of glass making, Batch process, Continuous process, Raw materials selection, Batch house & mixing, Batch transportation, Tank furnace, Batch feeding, Melting & refining, Bottle glass, Sheet glass, Other glasses, Annealing, Thermal treatment, Chemical treatment, Production control & planning.	**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)

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) 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 identify the fundamentals of glass, raw materials, manufacturing technology, applications and properties.	30
CO-2	To determine batch composition for different glasses and ceramic products. To identify the fundamentals of glass materials, raw materials, manufacturing technology, applications and properties.	28
CO-3	To analyze the knowledge of thermodynamic phase separation and kinetic processes happening during glass making.	27
CO-4	To formulate the glass materials and investigate its scope, applications and classification.	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 glass materials, their fabrication and various properties	5

List of Open Source Software/learning website:

1. NPTEL
2. MIT Open course lecture available on Internet etc
3. Delnet

List of Experiments:

1. Preparation of Soda-Lime-Silica glass with different colouring oxides, e.g. CaO, FeO etc
2. Preparation of Borosilicate glass with alkali & alkaline earth oxides.
3. Preparation of Opal glass with different opacifying agents -- Fluoride & Phosphate opal.
4. Preparation of low melting Phosphate glass in various systems.
5. Determination of alkali resistance of glass
6. Determination of alkalinity of glass
7. Determination of density of glass
8. Thermal shock test on glass wares
9. Determination of strain in glass wares by polariscope
10. Demonstration of cord viewers

Major Equipment:

1) Muffle furnace
2) Mixing apparatus with stirrer

List of Open Source Software/learning website:

1) Chemical weekly
2) Scifinder online
3) Science direct
4) espacenet
5) Delnet