GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL TECHNOLOGY (36)
GLASS SCIENCE & TECHNOLOGY
SUBJECT CODE: 2153614
B.E. 5th 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 GC02

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
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	3	6	70	20	10	20	10	20	150

Content:

Sr. No.	Topic	Teaching Hours	Module Weightage (%)
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	16
2	Conditions of verification. Structural theory (Zachariasen model etc.). Kinetic theory of glass (Nucleation & Growth). d) Structure of Glass : XRD, SAXS and other methods of determining glass structure. e) Structural models of glass. Reaction mechanisms. Ion exchange & network breakdown processes. Glass durability controlling factors.	10	16
3	Thermodynamic basis of phase separation in glasses. Immiscibility in glasses. Kinetics of demixing. Application of immiscibility diagrams. Spindale decomposition.	10	16
4	Density & Thermal expansion measurements & their implications and their dependence on compositions. Thermal history effects. Effect of crystallization. Additive rule.	10	17
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	10	19
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,	7	14

	Bottle glass, Sheet glass, Other glasses, Annealing, Thermal treatment, Chemical treatment, Production control & planning		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20%	**39%**	**18%**	**11.5%**	**11.5%**	**-**

Reference Books:

1. Glasses and the Vitreous State – J. Zarzycki
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 Outcome: After learning this course the students can:

1. To express their technical knowledge over fundamentals of the subject
2. To choose batch composition for different glasses and ceramic products.
3. 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
4. To be able to apply this knowledge in their higher study, research work with related technical subjects.
5. To build a bridge between theoretical and practical concept used in industry.

List of Experiments:

1. Preparation of Soda-Lime-Silica glass with different colouring oxides, e.g. CoO.
2. Preparation of Boro-silicate 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

Design based Problems (DP)/Open Ended Problem:

Application and utility of NITRATION as unit process in Chemical Technology

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.