

**GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)**

**Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)**

Semester-IV

**Course Title: Glass-2**  
(Course Code: 4345202)

Diploma programme in which this course is offered	Semester in which offered
Ceramic Technology	4 <sup>th</sup> Semester

**1. RATIONALE**

Glass-2 subjects containing glass batch calculation, glass properties, glass tests, glass defects and decoration techniques which are important to maintain quality during glass production. As glass technologist subject knowledge of these topics is very important. It also contains preparation process of optical glass. Hence the course has been design to develop these competencies and its associated cognitive, practical and effective domain learning out comes.

**2. COMPETENCY**

The course should be taught and curriculum should implement with the aim to develop required skills so that students are able to acquire following competency leading to the achievement of the following competency:-

**Plan to apply glass principles to maintain desired quality of glass article.**

**3. COURSE OUTCOMES (COs)**

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

- Calculate glass composition and glass batch.
- Select suitable raw materials and manufacturing technique for optical glass.
- Explain various properties of glass.
- Perform various tests and annealing for glass article.
- Select suitable decoration technique for glass article.
- Identify various defects in glass article.

**4. TEACHING AND EXAMINATION SCHEME**

Teaching Scheme (In Hours)			Total Credits (CI+T/2+P/2)	Examination Scheme				
CI	T	P		Theory Marks		Practical Marks		Total Marks
			C	CA	ESE	CA	ESE	
3	-	2	4	30*	70	25	25	150

(\*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

**Legends:** L-Lecture; T- Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit, CA - Continuous Assessment; ESE -End Semester Examination.

## 5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the sub-components of the COs. *Some of the PrOs marked '\*' are compulsory, as they are crucial for that particular CO. These PrOs need to be attained at least at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Prepare glass batch from given composition.	I	2
2	Calculate glass composition from given Batch.	I	2
3	Identify various quality control steps required during preparation of optical glass.	II	4
4	Determination Refractive index of glass sample.	II & III	4
5	Determination density of glass sample by Archimedes' principle	III	4
6	Determination thermal shock resistance property of glass samples.	III	4
7	Determination chemical resistance property of glass samples.	III	4
8	Determination alkali resistance property of glass sample.	III	4
9	Identify stress in different glass sample by Polari scope.	IV	2
10	Decoration of glass article by etching method.	V	4
11	Decoration of glass article by sand blasting method.	V	4
12	Decoration of glass article by Engraving method.	V	4
13	Decoration of glass article by silvering method.	V	4
14	Decoration of glass article by coating Enamel.	V	4
15	Decoration of glass by transfer paper.	V	4
16	Identify defects in glass sample.	IV	2
<b>Minimum Practical Exercises required #</b>			<b>28 hrs</b>

### **Note**

- i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare of experimental setup	20
2	Perform the practical	20
3	Follow safe practices measures	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
<b>Total</b>		<b>100</b>

## 6. MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

These major equipment/instruments and Software required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management of the institutes. This will ensure conduction of practical in all institutions across the state in proper way so that the desired skills are developed in students.

S. No.	Equipment Name with Broad Specifications	PrO.No.
1	Digital weight balance	1,2,5
2	Laser pointer	4
3	Refractometer	4
4	Water bath, tong	6
5	Polaris cope	9
6	Sand blasting nozzle with portable compressor	10,13
7	Glass engraving pen for decoration	12

## 7. AFFECTIVE DOMAIN OUTCOMES

The following **sample** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned Cos and PrOs. More could be added to fulfill the development of this competency.

- a) Work as a leader/a team member.
- b) Follow ethical practices.
- c) Practice environmental friendly methods and processes.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- i. 'Valuing Level' in 1<sup>st</sup> year
- ii. 'Organization Level' in 2<sup>nd</sup> year.
- iii. 'Characterization Level' in 3<sup>rd</sup> year.

## 8. UNDERPINNING THEORY

The major Underpinning Theory is formulated as given below and only higher level UOs of *Revised Bloom's taxonomy* are mentioned for development of the COs and competency in the students by the teachers.(Higher level UOs automatically include lower level UOs in

them). If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application level)	Topics and Sub-topics
Unit – I Glass Batch Calculation	1a. List out molecular formula and molecular weight of raw materials. 1b. Prepare glass batch. 1c. Calculate batch composition.	1.1 Molecular formula and molecular weight of raw materials. 1.2 Prepare batch from Composition. 1.3 Prepare composition from glass Batch.
Unit – II Optical glass	2a. Explain optical characteristics of optical glass. 2b. Select suitable raw materials for optical glass. 2c. Select melting furnace and process for optical glass. 2d. Apply precautions required during preparation of optical glass.	2.1. Characteristics of optical glass. 2.2. Raw materials used for making optical glass. 2.3. Melting of optical glass. 2.4. Furnace for melting optical glass. 2.5. Precautions required during melting and manufacturing of optical glass.
Unit– III Glass Properties	3a. Explain different properties of glass. 3b. Perform various tests of glass	3.1 Physical properties:- Mechanical properties, Thermal properties, Electrical properties and optical properties 3.2 Determine density of glass. 3.3 Determine Refractive index of glass.
Unit– IV Viscosity and Glass annealing	4a. Explain importance of viscosity. 4b. Perform annealing method of glass. 4c. Relate viscosity and annealing of glass. 4d. Apply precautions required during annealing.	4.1 Importance of viscosity in glass industries. 4.2 Method of annealing of glass article. 4.3 Precautions required during annealing of glass. 4.4 Relation between annealing and viscosity
Unit– V Decoration of Glass Article	5a. Explain various glass decoration methods. 5b. Perform glass decoration process.	5.1 Various glass decoration methods. 5.2 Sand blasting method, Etching method, silvering and enamel decoration method etc.
Unit– VI Glass Defects	6a. Identify various glass defects. 6b Illustrate various reasons and remedies of glass defects.	6.1. Various types of glass defects. 6.2. Reasons and remedies of glass defects like stone, bubbles, blisters, seeds, devitrification etc.

**Note:** The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.

## 10. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Glass Batch Calculation	5	0	2	8	10
II	Optical Glass	8	2	4	6	12
III	Glass Properties	10	3	6	6	15
IV	Viscosity and Glass Annealing	7	2	5	3	10
V	Decoration of Glass Article	8	2	6	7	15
VI	Glass Defects	4	2	2	4	8
<b>Total</b>		<b>42</b>	<b>11</b>	<b>25</b>	<b>34</b>	<b>70</b>

**Legends:** R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

**Note:** This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

## 11. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare small reports (of 1 to 5 page for each activity). For micro project report should be as per suggested format, for other activities students and teachers together can decide the format of the report. Students should also collect/record physical evidences such as photographs/videos of the activities for their (student's) portfolio which will be useful for their placement interviews:

- a) Collect information regarding advance glass technology.
- b) Prepare various properties list of glass.
- c) Undertake micro-projects in teams
- d) Give seminar on any relevant topic.
- e) Undertake a market survey for optical glass.
- f) Prepare showcase portfolios.
- g) Prepare chart containing relationship of glass viscosity with temperature.

## 12. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a) Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- b) Guide student(s) in undertaking micro-projects.
- c) **'CI' in section No. 4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.

- d) About **20% of the topics/sub-topics** which are relatively simpler or descriptive in nature is to be given to the students for **self-learning**, but to be assessing during different assessment methods.
- e) With respect to **section No.11**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- f) Guide students on how to address issues on environment and sustainability using the knowledge of this course.
- g) Guide students for using data manuals.

### 13. SUGGESTED MICRO-PROJECTS

**Only one micro-project** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total work load on each students due to the micro-project should be about **14 to 16(Fourteen to sixteen) student engagement hours** (i.e. about one hour per week) during the course. The students ought to submit micro-project by the end of the semester (so that they develop the industry-oriented COs).

A suggestive list of micro-projects is given here. This should relate highly with competency of the course and the COs. Similar micro-projects could be added by the concerned course teacher:

- a) **Optical Glass industries in World:** Identify the different optical glass industries located in different parts of World and prepare the report. (**Duration: 8-10 hours**)
- b) **Glass Properties:** prepare a chart or report for different types of glass properties.
- c) **Glass Decoration techniques:** prepare charts for glass decoration techniques.
- d) **Glass Defects:** prepare charts for different glass defects or collect defected glass samples and identify it.
- e) **Advance application of glass:-** Collect information from internet and prepare a report on advance applications of glass.

### 14. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Glass Engineering Hand Book	E.B.Shand	McGraw-Hill book co
2	Glass manufactures Vol. I & Vol. II	F.V.Tooley	New York, N.Y., Ashlee Pub. Co.,
3	Modern Glass Practice	Samuel R. Schole	Boston : Cahners Books, [1975]

### 15. SUGGESTED LEARNING WEBSITES

- a) [http://www.digitalbookindex.com/\\_search/search010artglassa.asp](http://www.digitalbookindex.com/_search/search010artglassa.asp)

- b) <https://freevidelectures.com/course/4452/nptel-glass-processing-technology>
- c) <https://ocw.mit.edu/courses/3-071-amorphous-materials-fall-2015/pages/lecture-notes/>
- d) [https://onlinecourses.nptel.ac.in/noc21\\_ce51/preview](https://onlinecourses.nptel.ac.in/noc21_ce51/preview)
- e) <https://icglass.org/education/>
- f) <https://go.koppglass.com/properties-of-glass-ebook>

## 16. PO-COMPETENCY-CO MAPPING

Semester IV	Glass-2 (Course Code: 4335204)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & Environment.	PO 6 Project Management	PO 7 Life-long learning
<u>Competency</u>	Plan to apply glass principles to maintain desired quality of glass article.						
<u>Course Outcomes</u>							
CO a) Calculate glass composition and glass batch.	-	2	2	-	-	1	1
CO b) Select suitable raw materials and manufacturing technique for optical glass.	3	-	2	-	1	1	1
CO c) Explain various properties of glass.	3	-	1	-	1	1	-
CO d) Perform various tests and annealing for glass article	3	-	1	3	-	1	1
CO e) Select suitable decoration technique for glass article.	-	1	2	-	2	1	-
CO f) Identify various defects in glass article	2	1	1	-	-	1	1

Legend: '3' for high, '2' for medium, '1' for low or '-' for the relevant correlation of each competency, CO, with PO/ PSO

**17. COURSE CURRICULUM DEVELOPMENT COMMITTEE****GTU Resource Persons**

<b>S. No.</b>	<b>Name and Designation</b>	<b>Institute</b>	<b>Contact No.</b>	<b>Email</b>
1	Mr. B B Patel (Lecturer)	L E College (poly) Morbi.	8160590472	bharat.lecollege@gmail.com
2	Mr. Murali N (Lecturer)	L E College(poly) Morbi	9714464688	mceramic44@gmail.com