GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-II

Course Title: Introduction to Ceramics
(Course Code: C4325202)

Diploma programmer in which this course is offered	Semester in which offered
Ceramic Technology	Second

1. RATIONALE

This course is intended for those studying ceramics for the first time and is a comprehensive introduction to the Ceramics. Students will explore how aesthetics, function, society and culture have influenced historical and contemporary ceramics. Introduction to ceramics is the backbone of the ceramic engineering course. The students are advised to undergo each skill experience with remembrance, understanding and application with special emphasis on attitude of enquiry to know why and how for the various instructions and practices imparted to them in this course.

2. COMPETENCY

Apply Concepts of ceramic in ceramic engineering application.

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:

a) Distinguish various branches of ceramics.
b) Define history and scope of ceramics.
c) Explain uses of different types of ceramic products.
d) Define advance ceramics and uses.
e) Dispose ceramic waste safely.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (CI+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
CI	T	P	C	CA	ESE	CA	ESE	
3	0	0	3	30	70	0	0	100

(*): 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: CI**-Class Room Instructions; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. 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 includes 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 INTRODUCTION TO CERAMICS	1a. Introduction. 1b. Define ceramics and explain the classification of ceramic materials. 1c. Explain Scope in ceramic engineering. 1d. Development of ceramics.	1.1 History and development of ceramics. 1.2 Definition and classification of ceramics such as Structural ceramics, Refractory, White wares, Pottery, Insulators, Glass, Cement. 1.3 Different Opportunities in ceramics. 1.4 Development of ceramics in India and advancement in other country.
Unit – II White ware & Refractory	2a. Give Introduction of white ware materials. 2b. Explain the types and uses of white ware products. 2c. Give introduction of refractory materials. 2d. List the different types of refractory materials with their applications.	2.1 Definition of white ware. 2.2 Explain different types and applications of white ware products such as Terracotta, Bone china ware, porcelain ware, Earthen ware, Stone ware, sanitary ware, Table ware, Ceramic wall and floor tiles, Electrical insulators etc. 2.3 Definition of Refractory. 2.4 Explain different types and applications of refractory products.
Unit– III Glass, Enamel & cement	3a. Give Introduction of glass materials. 3b. Give introduction of cement.	3.1 Definition of glass. 3.2 Explain different types of glass and its applications. 3.3 Definition of Enamel. 3.4 Explain different types of enamel and its applications. 3.5 Define cement and its various applications.
Unit– IV Advanced Ceramics	4a. Give Introduction of advanced ceramics 4b. Explain the types and uses of advanced ceramics.	4.1 Definition of advanced ceramics. 4.2 Explain different types of advanced ceramics products. 4.3 Uses of Advanced ceramic products in different fields.
Unit– V Handling	5a. Justify the need of understanding ceramic waste	5.1 Explain different types of ceramic wastes.

ceramic waste	5b. Establish the relationship of sustainability and ceramic waste. 5c. Suggest methods of handling ceramic waste with examples. 5d. Suggest methods to dispose ceramic waste	5.2 Suggest different way to utilize or dispose ceramic wastes.

***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.*

6. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to ceramics	12	7	7	3	17
II	White ware & Refractory	12	4	7	7	18
III	Glass & cement	12	4	8	8	20
IV	Advanced Ceramics	08	2	4	4	10
V	Handling Ceramic Waste	04	1	2	2	5
Total		**48**	**12**	**28**	**30**	**70**

***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.*

7. 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 some YouTube videos related to topics.
b) Give seminar on any relevant topic.
c) Prepare chart on different topics of ceramics.
d) Collect samples of various ceramic products.
e) Search internet to collect different applications of ceramic products.

8. 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 assessed using 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.

9. 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 are 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 ***16 (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) **Glass**: Collect different types of glass samples and state differences among all the types of glasses. (**Duration: 8-10 hours**).
b) **White ware and Refractory:** Collect different types of white ware and Refractory sample and state it's uses.
c) **Ceramic waste**: Compile a report of handling ceramic waste with figures, tables and comparative charts and strategies used and suggested

10. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Ceramic Material	C. Barry Carter M. Grant Norton	Springer-Verlag New York ISBN : 978-1-4614-3522-8
2	Industrial Ceramics	Singer, F.	Springer Netherlands ISBN : 978-94-017-5257-2
3	Refractories	F.H. Norton	McGraw-Hill Inc.,US

			ISBN: 978-0070475380
4	Elements of Fuels, Furnaces & Refractories	O.P.Gupta	Khanna Publisher ISBN : 978-81-7409-088-1
5	Elements of Ceramics	F.H. Norton	McGraw-Hill Inc.,US ISBN: 978-0070475380
6	Fundamentals of Ceramics	Barsoum	

11. SUGGESTED LEARNING WEBSITES

a) https://en.wikipedia.org/wiki/Pottery
b) https://ceramicartsnetwork.org
c) http://en.wikipedia.org/wiki/ceramic
d) https://www.machinedesign.com/materials/article/21812897/advanced-ceramics.

.

12. PO-COMPETENCY-CO MAPPING

Semester II	**INTRODUCTION TO CERAMICS (Course Code:** C4325202**)**									
	POs and PSOs									
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**	**PSO 1**	**PSO 2**	**PSO 3** (If needed)
Competency Apply concepts of ceramic to solve ceramic engineering problems.	2	1	1	1	1	0	3	2	2	0
Course Outcomes CO a) Distinguish various branches of ceramics.	3	0	1	0	0	0	2	2	1	0
CO b) Define history and scope of ceramics.	3	0	1	0	0	0	2	1	1	0
CO c) Explain uses of different types of ceramic products.	3	0	1	0	0	1	2	2	2	0

CO d)Define advance ceramics and uses.	2	0	1	1	0	1	2	2	2	0
CO e)Dispose ceramic waste safely.	2	2	2	2	3	1	2	3	2	0

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

13. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Ashita S. Pareek (Lecturer)	**L.E.College,Morbi**	**9887087525**	**ashita3112@gmail.com**
2	Murali N(Lecturer)	**L.E.College,Morbi**	**9714464688**	**mceramic44@gmail.com**