GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Advance White Ware
(Course Code: 4355202)

Diploma programme in which this course is offered	Semester in which offered
Ceramic Technology	5th Semester

1. RATIONALE

Diploma Ceramic engineers should be able to appreciate the texture effect in white ware products, special ceramic white wares, effect of heat on white wares etc. They have to deal with grain growth during sintering, vitrification process, ceramic colour and decoration for white ware bodies and kiln operations. Hence the course has been design to develop these skills and its associated cognitive, practical and effective domain learning out comes in students.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Plan and supervise process of production of special white ware to achieve desired quality (With minimum defects and required surface texture and finish).**

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) Explain the importance of advance white ware products.
b) Describe the texture effect and factors affecting it.
c) Describe the processing of white ware products.
d) Describe Grain Growth, Sintering And Vitrification.
e) Describe the manufacturing of ceramic colours.

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	
4	-	4	6	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 samples of plaster of Paris mould.	I	6
2	Prepare different sanitary ware body.	III	8
3	Determine the effect of electrolyte and their behavior on clays.	II	4
4	Determine Cold Crushing Strength of given sample.	II	4
5	Determine Crazing test for wall tile sample.	II	4
6	Determine Modulus of Rupture of given sample.	II	4
7	Determine Whiteness test of given sample.	III	4
8	Determine chemical durability of a given sample.	III	4
9	Prepare ceramic stain.	III	6
10	Demonstrate the method of decorating ceramic wares.	III	6
11	Demonstrate the method of glaze application on ware.	IV	6
			56 hrs

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

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	Total	**100**

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	Pr.No.
1	Pot mill, Sieve shaker with sieve set	2,9
2	Digital weight balance	1-11
3	Universal testing machine	4,6
4	Autoclave testing machine	5
5	Whiteness testing machine	7

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 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd 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 Introduction	1a. Describe the scope of advance white ware. 1b. Discuss the applications of	1.1 Introduction and scope about the Advance white wares. 1.2 Different applications of

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application level)	Topics and Sub-topics
	advanced ceramic wares in given situation. 1c. List out newly emerging advanced white ware products.	advanced ceramic products. 1.3 List the different advanced white ware products.
Unit – II Texture Effect	2a. Explain texture effect on white ware products. 2b. Describe function of quartz on white ware 2c. Describe effect of texture on removing water, controlling the particle size and properties of slip. 2d. Describe effect of processing methods on the physical properties of ceramic white wares.	2.1 Introduction 2.2Texture effect in white wares 2.3 Function of quartz in white wares 2.4 Dewatering of porcelain slip 2.5 Practical control of slip properties Effect of processing methods on the physical properties of ceramic white wares.
Unit– III Special Ceramic White wares	3a.Explain special features of different types of ceramic wares. 3b.Describe the manufacturing process of special ceramic white wares. 3c.Give reason for increase in strength and breakdown of electric insulator. 3d. Describe low alkali porcelain as a resistor carrier.	3.1 Introduction 3.2 Specialization in the technology of special ceramic white wares- bone china wares, porcelain wares, chemical wares, sanitary wares, electrical wares and ceramic fibers 3.3 Manufacture process of special ceramic white wares 3.4 Increase in strength of porcelain insulators 3.5 Factors affecting breakdown of electric insulators, 3.6 Low alkali porcelain as a resistor carrier
Unit– IV Grain Growth, Sintering And Vitrification	4a. Describe method of grain growth and sintering. 4b. Explain vitrification and factors affecting the vitrification. 4c. Explain biscuit firing and glost firing of ceramic wares.	4.1 Introduction 4.2 Method of grain growth 4.3 Method of sintering 4.4 Details about vitrification in ceramic white wares 4.5 Factors affecting the vitrification 4.6 Method of biscuit firing and glost firing of ceramic wares.
Unit– V Ceramic Colours	5a. List various raw material used for manufacturing of ceramic colours.	5.1 Introduction 5.2 Raw materials used for manufacturing of ceramic

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application level)	Topics and Sub-topics
	5b. Explain properties ofraw material used for manufacturing of ceramic colour. 5c. Describe the properties of ceramic colours. 5d. State the steps to prepare ceramic colours	colours. 5.3 Properties and function of raw materials used in manufacture of ceramic colours 5.4 Method of manufacture of ceramic colours and Factors affecting the properties of ceramic colours 5.5 Preparation of ceramic colours for decoration on ceramic articles 5.6 Factors affecting decoration

***Note**:TheUOs 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	Introduction	10	7	4	3	14
II	Texture Effect	12	4	3	7	14
III	Special Ceramic White wares	12	3	4	7	14
IV	Grain Growth, Sintering And Vitrification	12	3	4	7	14
V	Ceramic Colours	10	4	7	3	14
Total		**56**	**21**	**22**	**27**	**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.*

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) Prepare list of some advance white ware articles.
b) Undertake micro-projects in teams
c) Give seminar on any relevant topic.
d) Undertake a market survey for advance white ware article.
e) Prepare showcase portfolios.
f) Prepare charts, PowerPoint presentation containing details of various raw materials.

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) Collect different raw material samples used in advance white ware industries.
b) Collect different types of advance white ware products and lable them.
c) Prepare any one type of advance white ware product in laboratory and make a report.
d) Prepare/study of advance white ware product in industry and make a report.

14. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	A Hand Book of Modern Pottery Manufacture	H.N.Bose	Ceramic Publishing House,Bhagalpur
2	Ceramic glazes	Kenneth shaw	Amsterdam, London, New York, Elsevier
3	Element of Ceramic	F.H.Norton	Addison-Wesley Pub. Co.
4	Ceramic White Wares	Sudhir Sen	Oxford & IBH Pulishing Co., New Delhi
5	Industrial Ceramics	Felix Singer , Sonja S. Singer	Springer Dordrecht 978-94-017-5257-2

15. SUGGESTED LEARNING WEBSITES

a. http://www.gobookee.org/elements-of-ceramics-f-h-norton/
b. http://www.cheminfonet.org/art/ceramics101.pdf
c. http://en.wikipedia.org/wiki/Ceramic_engineering

16. PO-COMPETENCY-CO MAPPING

Semester V	Advance white ware(Course Code: 4355202)						
	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
Competency • **Plan and supervise process of production of special white ware to achieve desired quality (With minimum defects and required surface texture and finish).**							
Course Outcomes a) Explain the importance of advance white ware products.	3	1	1	1	1	1	1
b) Describe the texture effect and factors affecting it.	3	2	2	3	1	2	2
c) Describe the processing of white ware products.	3	2	3	3	2	2	2
d) Describe Grain Growth, Sintering And Vitrification.	3	2	3	3	2	2	2
e) Describe the manufacturing of ceramic colours.	2	2	3	2	1	2	1

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

15. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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