GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Tile Technology
(Course Code: 4365203)

Diploma programme in which this course is offered	Semester in which offered
Ceramic Technology	Sixth

1. RATIONALE

A diploma ceramic engineer have to deal with the manufacturing of different types of tiles, they have to work with raw material selection, body formulation, batch calculation of different types of tiles, glaze applications, Drying and firing process. Hence the course has been designed to develop these competencies and it's associated with cognitive, practical and effective domain learning out comes. Tile technology is a subject that imparts Knowledge of the above mentioned topics. Hence the course has been design to develop these skills 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 and supervise process of manufacturing of Tiles to achieve desired quality products.

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). Illustrate the types, properties and manufacturing of tiles.
b). Discuss the body making operations in dry and wet method.
c). Select the different glazing and decoration techniques.
d). Describe zones and firing schedule in roller kiln along with firing defects and polishing of vitrified tile.
e). Evaluate and control the qualities of tile.

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	-	-	3	30*	70	-	-	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: L**-Lecture; **T**– Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. 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.

6. 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 Introduction & history of different types of tiles. 1b. List out different Types of tiles. 1c. Explain the Properties of tiles.	1.1 Introduction & history of flooring tiles, Definition of Glazed tiles, raw Materials with their sources, typical composition (for body & glaze) & properties. Types of glazed tiles, (wall and floor) 1.2 manufacturing process of glazed tiles with flow Chart (Both wet and Dry method). Definition of Vitrified tile, raw materials used,Typical body composition, properties. Types of vitrified ceramic tiles, manufacturing Process with flow chart.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application level)	Topics and Sub-topics
		1.3 Comparison between glazed floor tiles vs glazed wall tiles vs vitrified tiles. Recent advancement in tile technology.
Unit – II **Body Making**	2a. Describe Wet Method. 2b. Describe Dry Method.	2.1 Wet Method: Describe Batch compositions for glazed and vitrified tile, ball mill feeding, typical operating parameters of ball mill, grinding in ball mill, agitator, screening, magnetic separation, granulation in spray dryer, operating parameters of spray drier. 2.2 Dry Method: Crushing, Pendular Mill (Pan mill), tube mill, Storing in silo, moisture addition for pressing. Powder characteristics. Use sketches wherever applicable.
Unit– III **Pressing & drying**	3a. Describe types of pressing machine and its operation. 3b. Explain the Drying process of tiles.	3.1 Describe dry pressing machine, single and multi-stroke, uni-axial And biaxial pressing, stages in dry pressing, pressing variables, capacity of pressing machine, die size. Discuss possible defects and their remedies occurring during pressing. 3.2 Describe drying, its need, drying time, drying temperature, driers used with respect to tile industry. Explain pressing & drying defects (laminations, warping & cracks) with causes and remedies.
Unit– IV **Glaze line operations**	4a. Explain the Tile preparation steps before glazing. 4b. Describe Engobing and glazing methods. 4c. Illustrate Printing decoration techniques.	4.1 Illustrate water spraying, application of top and bottom engobe, glazing-spraying (mechanical / disc, pneumatic), curtain coating (bell method/water fall) 4.2 typical operating parameters (density, viscosity, glaze thickness). 4.3 Describe decoration methods (direct & indirect) screen printing, roller printing, digital printing and other decoration methods.
Unit– V **Firing**	5a. Explain Various Types of fuels used for tiles firing. 5b. List out Firing defects. 5c. Describe the Finishing operation of fired tiles.	5.1 Describe fuels (natural gas, LPG) & furnace (roller hearth kiln) used in tile industry, different zones with temperature and pressure, maintaining draught, illustrate typical firing schedule, control parameters in firing.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application level)	Topics and Sub-topics
		5.2 Describe firing defects such as pin holes, blisters, over glazing, under glazing, discoloration, over firing, peeling,crazing, crawling, fish scaling, stuck ware with their causes&remedies. 5.3 Operations for Vitrified Tiles: Polishing, edge trimming, different polishing materials with grades. Describe defects in vitrified tiles.
Unit– VI **Testing and Quality Control**	6a. Describe Different testing methods of raw materials. 6b. Describe Different testing methods of tiles.	6.1 Describe the methods for measurement of Moisture content with conventional and IR Moisture balance, particle size analysis of body powder, green body density distribution (penetrometer), viscosity & density of glaze and body slip. 6.2 Dimensional accuracy, water absorption test, porosity test, density test, shrinkage, thickness, glossiness, Strength (green and fired), MOR test, White ness test, color measurement test warp age test & abrasion resistance.

***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.*

8. 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**	6	3	3	3	09
II	**Body Making**	6	3	3	4	10
III	**Pressing & drying**	6	3	3	3	09
IV	**Glaze line operations**	8	3	4	7	14
V	**Firing**	8	3	7	4	14
VI	**Testing and Quality Control**	8	3	4	7	14
Total		**42**	**18**	**24**	**28**	**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.*

9. 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) List the tile manufacturing industries in India.
b) Undertake micro-projects in teams
c) Give seminar on any relevant topic.
d) List different uses of tiles.
e) List the raw materials used in tiles manufacturing.

10. 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) Prepare a report on glazed Wall tiles/floor tile/Vitrified tile/Glazed vitrified tile.
b) Prepare a report on Plant layout of tile manufacturing industry.
c) Prepare a report on raw materials used for manufacturing of tiles.
d) Prepare a note on applications of tiles.
e) Prepare a report on types of tiles and their properties.
f) Collect different types of tiles available in local market and make a report on it.
g) Collect different Raw materials of tiles available in market and make a report on it.

14. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Industrial Ceramics	Felix Singer , Sonja S. Singer	Springer Dordrecht 978-94-017-5257-2
2	White wares	Sudhir sen.	Oxford and IBH Publishing c1992 8120406753

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

PO-COMPETENCY-CO MAPPING

Semester VI	**Tile Technology (Course Code:** 4365203**)**						
	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**
Competency	**Plan and supervise process of manufacturing of tiles to achieve desired quality products.**						
Course Outcomes CO a) Illustrate the types, properties and manufacturing of tiles.	1	2	0	1	1	0	1
CO b) Discuss the body making operations in dry and wet method.	2	2	2	1	2	1	1
CO c) Select the different glazing and decoration techniques.	2	1	2	2	1	1	1
CO d) Describe zones and firing schedule in roller kiln along with firing defects and polishing of vitrified tile.	2	1	2	3	1	1	1
CO e) Evaluate and control the qualities of tile.	1	2	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

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