

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: CERAMIC PROCESSING
(COURSE CODE: 3355208)**

Diploma Programme in which this course is offered	Semester in which offered
Ceramic Engineering	5 th Semester

1. RATIONALE

Diploma ceramic engineer has to deal with the different types of forming methods, preparation of body, and different machineries and equipments used for preparation of ceramic ware. They should also know the role of particle size, compaction behaviour and their importance in ceramic processing. Hence the course has been designed to develop these skills and its associated cognitive, practical and effective domain learning outcomes.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop required skills in students so that they are able to acquire the following competency:

- **Plan and supervise ceramic processing.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Apply ceramic fabrication process.
- Apply stabilizing Techniques.
- Relate particle size and compaction behaviour of ceramic body.
- Identify the role of binders in forming processes.
- Perform calcinations and sintering process of ceramic body.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
3	0	2	5	70	30	20	30	

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Introduction	1a. Explain different types of fabrication process and give their classification.	1.1 Ceramic fabrication processes. Classification of ceramic fabrication methods.
Unit – II Colloidal Processing of Ceramics.	2a. List out properties of colloidal materials. 2b. Describe types of stabilization techniques. 2c. Apply the sol-gel process.	2.1 Types of colloids 2.2 Attractive surface forces. Electrostatic, Steric and electrostatic stabilizations. Structure of consolidated colloids. Rheology of ceramic systems. 2.3 Particle sol-gel processing.
Unit – III Effect of Particle Size on Ceramic Ware.	3a. Characterise the solid particle. 3b. State the effects of particle size on ceramic ware	3.1 Characteristics of solid particles. Particle shapes, Size, Equivalent particle diameter. Surface area, Average particle size & size distribution.
Unit – IV Bonding and Forming Methods.	4a. Explain packing of particles. 4b. Select additive. 4c. Distinguish various plastic forming process	4.1 Packing of particles, 4.2 Additives in forming processes, Selection of additives, Dry pressing, 4.3 Plastic forming, Slip casting, tape casting methods and extrusion.
Unit –V Calcinations and Sintering	5a. Explain sintering and sintering process. 5b. Identify the factors affecting calcinations.	5.1 Introduction to sintering of ceramics. Hot and iso-static processing. Binder removal, 5.2 Calcinations & affecting factors.

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (Theory)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	2	2	2	0	04
II	Colloidal Processing of Ceramics	10	3	7	6	16
III	Effect of Particle Size On Ceramic Ware.	10	3	7	6	16
IV	Bonding and Forming Methods	10	3	7	8	18
V	Calcinations and Sintering	10	3	7	6	16
Total		42	14	30	26	70

Legends: R = Remember U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Exercise (outcomes in psychomotor domain)	Apprx. Hrs. Required
1	I	Apply thin film coating by CVD Method.	6
2	II	Prepare fine particles by ball milling method.	6
3	II	Prepare ceramic article by Sol-Gel method.	4
4	III	Analyze the given Powder for its particle size distribution using Sieve shaker.	4
5	IV	Prepare earthen ware brick by dry pressing method.	6
6	IV	Prepare a hallow type wares by slip casting method.	6
7	IV	Prepare a flat type of wares by jiggering Method.	6
8	IV	Prepare hallow wares by jollying method.	6
9	IV	Demonstrate Mechanism of Sintering process.	2
10	V	Demonstrate Hot and Iso-static process for advance ceramic.	2
Total (Perform the any practical from above for total 28 hours so that most units are covered)			48

8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Visit to a nearest industries and have a group discussion on Industrial Visit.
- ii. Explore internet and describe different types of pressing methods.
- iii. Explore internet and discuss about jiggering and jollying methods.
- iv. Refer Journals and Magazines of advance ceramic.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any):

- i. Display animation/videos/Photographs of ceramic processing
- ii. Arrange visit to nearby ceramic processing industry and ask students to prepare a report..
- iii. Facilitate the students to set up practical apparatus on their own.

10. SUGGESTED LEARNING RESOURCES

A. List of Books

S. No.	Title of Books	Author	Publication
1	Ceramic processing.	R.H.Rahaman	McGraw-Hill book co.,
2	Principle of ceramic processing	James s Reed	New York, N.Y., Ashlee Pub. Co.,

B. List of Major Equipment/Materials

- i. Different Plastic and non-plastic Raw Materials and additives.
- ii. Digital Weight Balance, Electric Oven.
- iii. Electric sieve shaker machines with sieves.
- iv. Electric muffle kiln.
- v. Jigging and jollying machine.
- vi. Mould for slip casting.
- vii. Autoclave for Sol-Gel Processing
- viii. CVD Apparatus.
- ix. Iso-static pressing Machine.

C. List of Software/Learning Websites

- i. <http://www.morgantechnicalceramics.com/products-materials/process-animations/>
- ii. <http://www.sigmaaldrich.com/technical-documents/articles/material-matters/sol-gel-science-for.html>
- iii. www.sciencedirect.com
- iv. <http://www.ceramic-science.com/>
- v. <http://ceramics.org/journals>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. B. B. Patel**, Lecturer L. E. College, Morbi
- **Prof. S. B. Upadhyay**, Lecturer L. E. College, Morbi
- **Prof. P. M. Swami**, Lecturer L. E. College, Morbi
- **Prof. Y.R. Gupta**, Lecturer L.E.College, Morbi

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. Abhilash Thakur**, Associate Professor, Department of Applied Sciences
- **Prof. Bashirullah Shaikh**, Assistant Professor, Department of Applied Sciences