

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: BIO-CERAMIC
(COURSE CODE: 3355207)**

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

1. RATIONALE

Diploma Ceramic engineer have to deal with hard tissues, hydroxyapatite, alumina and zirconia in surgical implants, glass-ceramics, carbon implants along with traditional ceramics products. Dealing of above requires the knowledge of bio-ceramics. 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 content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the following competencies

- Use bio-ceramic materials.

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 out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- i. Identify Bio-ceramic materials.
- ii. Identify structure property relationship in proteins.
- iii. Select appropriate applications of Hydroxyapatite.
- iv. Distinguish composition & structure of alumina and zirconia.
- v. Plan production of carbon implants.

4. TEACHING AND EXAMINATION SCHEME

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

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 Bio-Ceramics	1a. Classify bio ceramic materials.	1.1 Introduction and Classification of Bio Ceramics materials: Oxide Ceramics, <u>Aluminum Oxide (Al₂O₃)</u> , <u>Aluminum Titanate (Al₂TiO₅)</u> , <u>Mixed/Dispersion Ceramics</u> , <u>Piezo-ceramics</u> , <u>Silicate Ceramics</u> , <u>Zirconium Oxide (ZrO₂)</u> Non-oxide Ceramics, <u>Aluminum Nitride (AlN)</u> , <u>Silicon Carbide (SiC / SiC)</u> , <u>Silicon Nitride (Si₃N₄)</u> , <u>SiAlONs</u> , Ceramic Composite <u>Metal-Ceramic Composite (MMC)</u>
UNIT – II Hard Tissues	2a. Describe Structure of Proteins 2b. Describe the healing of Hard tissues 2c. Explain features of bio ceramic for Biocompatibility	2.1 Structure of Proteins, Structure Property relationship. 2.2 Hard tissue – Healing & Remodelling 2.3 Biocompatibility
UNIT – III Hydroxyapatite	3a. Explain the composition of Hydroxyapatite. 3b. Describe the properties of Hydroxyapatite.	3.1 Source, Composition & Structure 3.2 Properties and Applications of Hydroxyapatite
UNIT – IV Alumina and Zirconia in Surgical Implants	4a. Describe the composition & structure of alumina and zirconia. 4b. Explain the Mechanical and Fatigue properties of alumina and zirconia 4c. Describe the application of alumina and zirconia in surgical implants	4.1 Source, Composition & Structure 4.2 Mechanical Properties, Fatigue properties and Service life 4.3 Applications alumina and zirconia In surgical implants
UNIT – V Glass-Ceramics, Carbon Implants	5a. Explain the formation of Glass-Ceramics. 5b. Describe Properties of Glass-Ceramics, Coating & Composites 5c. Identify the source of carbons. 5d. Explain manufacturing process of carbon implants.	5.1 Formation of Glass-Ceramics 5.2 Properties of Glass-Ceramics, Coating & Composites 5.4 Source & Structure of Carbons 5.5 Manufacturing of carbon implants

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
1	Bio-Ceramics	6	4	2	2	8
2	Hard Tissues	10	8	6	3	17
3	Hydroxyapatite	7	6	6	2	14
4	Alumina and Zirconia in Surgical Implants	8	4	6	4	14
5	Glass-Ceramics, Carbon Implants	11	6	6	05	17
Total		42	28	26	16	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)	Approx. Hrs. Required
1	5	Draw manufacturing process of carbon implants.	4
2	5	Draw the process of formation of Glass- Ceramics.	4
3	2	Draw Structure of Proteins	2
4	4	Test Mechanical and Fatigue properties of alumina	4
5	3	Test the properties of Hydroxyapatite	6
6	4	Test Mechanical and Fatigue properties of zirconia	4
7	5	Test the Properties of Glass- Ceramics, Coating & Composites	4
Total			28

8. SUGGESTED LIST OF STUDENT ACTIVITIES :

- i. Teacher guided self-learning activities.
- ii. Course/topic based internet based assignments.
- iii. Library/internet survey regarding bio-ceramic materials.

9. SPECIAL INSTRUCTIONAL STRATEGIES(if any):

- i. Display videos/photos and samples of the Bio Ceramic material and their applications.
- ii. Arrange visit to nearby bio ceramic industry.
- 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	Bio-ceramics Properties, Characterizations, and Applications	Park, Joon	Springer
2	Hydroxyapatite and Related Materials [Hardcover]	Paul w. Brown, Brent constantz	CRC Press

B. List of Major Equipment/Materials

- i. Surgical implants of alumina and zirconia surgical implants.
- ii. Ceramic Soft Materials and Hard Materials and additives.
- iii. Weighing balance with weight box, Pans, Vanier scale, Measuring cylinder.
- iv. Lab type manufacturing process of carbon implants
- v. Lab type Hot air Oven, Electric Muffle Kiln.
- vi. Lab type Universal testing machine, Refractro meter.

C. List of Software/Learning Websites

- i. <http://www.worldscientific.com/worldscibooks/10.1142/2028>
- ii. <http://www.reade.com/products/84-biomaterials-dry-particles/53-biomaterials-biocide-bioceramics-biocompatible-biomedical-bioceramic-powders-biomaterial-biomedical-mill-product-powder-rod-bar-biocompatible-bioglasses>
- iii. http://delfinspa.com/content/What_is_Bio-Ceramic-.htm
- iv. <http://www.ceramtec.com/ceramic-materials/>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. B.B. Patel**, Lecturer L.E. College, Morbi
- **Prof. H.B. Dedania**, Lecturer (Retired) L.E. College, Morbi
- **Prof. S. Prasad**, Lecturer (Retired) L. E. College, Morbi

Coordinator and Faculty Members from NITTTR Bhopal

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