# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Engineering**
**Level: Diploma**
**Branch: Ceramic Engineering**
**Course / Subject Code : DI02C52011(Only for C to D Students)**
**Course / Subject Name : Ceramic Science**

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|---|---|
| w. e. f. Academic Year: | 2024-25 |
| Semester: | 2nd |
| Category of the Course: | Engineering Science Courses |

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|---|---|
| **Prerequisite:** | |
| **Rationale:** | Ceramic Science is an essential subject in a diploma curriculum, particularly for students pursuing careers in ceramic engineering, design, or related industries. It is a foundational subject for diploma-level students, providing them with a well-rounded education in the atomic structure, chemical bonding, structure of solid, crystallography, crystal imperfection, phase rule and thermodynamics. This knowledge becomes vital for understanding and solving ceramic industrial problems. |

**Course Outcome:**

After Completion of the Course, Student will able to:

| No | Course Outcomes | RBT Level |
|---|---|---|
| 01 | Apply the principles of atomic structure and chemical bonding to understand various engineering problem. | R,U, |
| 02 | Apply the principle of solid structure and crystallography to identify crystal structure of materials. | R,U,A |
| 03 | Identify effect of imperfection in crystal properties. | R,U,A |
| 04 | Apply the concepts of phase rule and phase diagrams to determine different phases of component. | R,U, A |
| 05 | Apply the principles of thermodynamics for different practical application | R,U,A |

**Revised Bloom's Taxonomy (RBT)*

**Teaching and Examination Scheme:**

| Teaching Scheme (in Hours) | | | Total Credits L+T+ (PR/2) | Assessment Pattern and Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | Tutorial / Practical | | |
| L | T | PR | C | ESE (E) | PA / CA (M) | PA/CA (I) | ESE (V) | |
| 3 | 0 | 0 | 3 | 70 | 30 | 0 | 0 | 100 |

*(*):Outof30marksunderthetheoryCA,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.*

**Course Content:**

| Unit No. | Content (Topics and Sub-topics) | No. of Hours | % of Weightage |
|---|---|---|---|
| **1.** | **Atomic Structure and Chemical Bonding**<br>1.1 Structure of Atom<br>1.2 The Periodic Table<br>1.3 Hund's Rule<br>1.4 Pauli's exclusion principle<br>1.5 Ionization Potential, Electron affinity and Electro negativity<br>1.6 Bond energy, Bond Type and Bond Length<br>1.7 primary bonds like Ionic bond, Covalent Bond, Metallic bond<br>1.8 secondary bonds like Hydrogen bond and Vander Walls bond | **7** | **17** |
| **2.** | **Structure of solid**<br>2.1 The crystalline and Non Crystalline state<br>2.2 Ionic Solid<br>2.3 Covalent Solid<br>2.4 Metal and Alloy<br>2.5 The structure of silica and silicates | **6** | **14** |
| **3.** | **Crystallography**<br>3.1 Unite cell and space lattices<br>3.2 Bravais lattices and its Crystal system<br>3.3 Miller indices of crystal direction<br>3.4 The bregg law of X-ray diffraction<br>3.5 Powder method to determine crystal structure | **9** | **21** |

| | | | |
|---|---|---|---|
| **4.** | **Crystal Imperfections**<br>4.1 Point imperfection<br>4.2 Line imperfection<br>4.3 Surface imperfection<br>4.3 Volume imperfection | **5** | **12** |
| **5.** | **Phase rule and Phase Diagrams**<br>5.1 Phase rule<br>5.2 Single Component system<br>5.3 Binary component system<br>5.4 Al2O3-SiO2 Phase diagram<br>5.5 Mgo-Al2O3 Phase diagram<br>5.6 Tie-line rule and Lever rule | **9** | **21** |
| **6** | **Basic concept of Thermodynamics**<br>6.1. Define Thermodynamics<br>6.2. Thermodynamics systems<br>6.3. Thermodynamics process<br>6.4. Thermodynamics equilibrium<br>6.5. Thermodynamics properties<br>6.6. Define heat, work, internal energy, Enthalpy, Entropy.<br>6.7. Laws of thermodynamics | **6** | **15** |
| | **Total** | | **100** |

**Suggested Specification Table with Marks (Theory):**

| Distribution of Theory Marks (in %) | | | | | |
|---|---|---|---|---|---|
| **R Level** | **U Level** | **A Level** | **N Level** | **E Level** | **C Level** |
| **25** | **40** | **35** | **0** | **0** | **0** |

*Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)*

**References/Suggested Learning Resources:**

**(a) Books:**

| S. No. | Title of Book | Author | Publication with place, year and ISBN |
|---|---|---|---|
| 1 | Material Science and Engineering | V. Raghavan | PHI Learning Private Limited,Delhi |
| 2 | Material Science and Engineering an introduction | William D. Callister and Jr. David G. Rethwisch | John Wiley & Sons,Inc. |

| | | | |
|---|---|---|---|
| 3 | Basic and Applied Thermodynamics | P K NAG | Tata Mcgraw Hill Publishing Company Limited |
| 4 | Material Science & Metallurgy | Dr.RB Choudary | Khanna Publications |

**(b) Open source software and website:**

1. http://nptel.iitm.ac.in/courses.php
2. www.khanacademy
3. https://books.google.co.in/books?id=hjS_CAAAQBAJ&printsec=frontcover&redir_esc=y#v=onepage&q&f=false
4. https://www.britannica.com/science/chemical-bonding/Periodic-arrangement-and-trends
5. https://www.cif.iastate.edu/services/acide/xrd-tutorial/crystallography
6. https://byjus.com/physics/thermodynamics/

**Suggested Course Practical List: If any: Not Applicable**

**List of Laboratory/Learning Resources Required: Not Applicable**

**Suggested Project**

***Only one 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 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 different physics law.

b) Surf different websites related materials.

c) Collect relevant information about crystal structure of ceramic materials.

d) Prepare chart on Crystal structure and phase diagram of two or three component system.

e) Prepare power point presentation on different topics of ceramic science.

**Suggested Activities for Students: If any**

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 specification of some materials.

b) Give seminar on any relevant topic.

c) Undertake a market survey of different materials.

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