

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

**Course Title: Advanced Chemistry
(Code: 3335201)**

| Diploma Programme in which this course is offered | Semester in which offered |
|--|----------------------------------|
| Diploma Ceramic Technology | Third Semester |

1. RATIONALE

Ceramic Technology is the science of creating objects from the material that are inorganic and non-metallic. Though ceramic is related to fine art yet it requires a thorough working knowledge.

Advanced chemistry is an intensive study of matter and the changes that matter undergoes. The study of chemistry at this level requires a sound appreciation of basic principles without which it is difficult to understand the many facts of the science. Students in this course will attain a depth of understanding of fundamentals and a reasonable competence in dealing with chemical problems. This course will contribute to the development of each student's ability to think clearly and to express their ideas.

2. COMPETENCY

Understand behaviour and Basic chemistry of ceramic materials, electrolytes and different types of a analytical solutions. Perform chemical analysis of ceramic materials and products.

3. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme | | | | |
|---------------------------------------|----------|----------|----------------------------------|---------------------------|-----------|----------------------------|-----------|------------------------|
| | | | | Theory Marks | | Practical Marks | | Total Marks |
| L | T | P | C | ESE | PA | ESE | PA | |
| 4 | 0 | 2 | 6 | 70 | 30 | 20 | 30 | |

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

4. COURSE DETAILS

| Unit | Major Learning Outcomes | Topics and Sub-topics |
|---|--|---|
| Unit – I Matter | 1.a. Explain characteristics of different states of matter 1.b. Describe the inter-conversion of Matter 1.c. Explain kinetic theory of matter | Introduction 1.1 States of Matter - Solid, Liquid and Gas 1.1.1 Characteristics of different states of matter 1.2 Changes of State of Matter 1.3 Inter-conversion of Matter 1.4 Kinetic theory of Matter |
| Unit – II Colloids | 2.a. Compare types of solutions 2.b. Explain types of colloids 2.c. Classify colloids 2.d. Describe methods of preparation of colloids 2.e. Explain purification of colloids 2.f. Explain properties of colloids 2.g. State the applications of colloids | Introduction 2.1 Comparison of properties of true solutions, colloids and suspensions. 2.2 Colloids – Dispersion medium and Dispersed phase 2.3 Types of Colloidal Dispersion 2.4 Classification of Colloids 2.5 Methods of Preparation of Colloids/Sols 2.5.1 Dispersion methods 2.5.2 Condensation methods 2.6 Purification of Colloidal Dispersion 2.6.1 Dialysis and Electrodialysis 2.6.2 Ultra-filtration 2.6.3 Ultra-centrifuging 2.7 Properties of Colloids 2.7.1 Colligative Properties 2.7.2 Optical Property – Tyndall Effect 2.7.3 Kinetic Property – Brownian Movement 2.7.4 Electrophoresis 2.7.5 Coagulation 2.8 Emulsion 2.9 Applications of Colloid Chemistry |
| Unit – III Absorption and Adsorption | 3.a. Explain the differences absorption and adsorption 3.b. Describe the types of adsorption 3.c. Comprehend the different factors affecting adsorption 3.d. Explain adsorption isotherms 3.e. State the application of adsorption | Introduction 3.1 Differences between absorption and adsorption 3.2 Types of Adsorption 3.2.1 Physical adsorption 3.2.2 Chemical adsorption 3.3 Factors influencing adsorption 3.4 Adsorption Isotherms 3.4.1 Freundlich adsorption isotherm 3.4.2 Langmuir adsorption isotherm 3.5 Applications of Adsorption 3.6 Role of Adsorption in Catalytic reactions |

| Unit | Major Learning Outcomes | Topics and Sub-topics |
|---|---|---|
| | 3.f. Explain the role of adsorption in catalytic reactions | |
| Unit – IV Phase Rule | 4.a. Explain the terms of Phase rule 4.b. Describe one component (water) system 4.c. Explain two components and three components systems 4.d. State the applications and limitations of Phase rule | Introduction 4.1 Phase Rule 4.1.1 Phase 4.1.2 Components 4.1.3 Degrees of Freedom 4.2 Phase Diagrams 4.3 One Component System 4.3.1 Water Systems 4.4 Two component systems 4.4.1 Al ₂ O ₃ -SiO ₂ Phase diagram 4.4.2 SiO ₂ -Na ₂ O Phase diagram 4.4.3 MgO-Al ₂ O ₃ Phase diagram 4.5 Three component Systems 4.5.1 Al ₂ O ₃ -SiO ₂ -Na ₂ O Phase diagram 4.5.2 Al ₂ O ₃ -SiO ₂ -MgO Phase diagram 4.5.3 SiO ₂ - Na ₂ O –CaO Phase diagram 4.5 Applications of Phase Rule 4.6 Limitations of Phase Rule |
| Unit – V Catalysts and Catalysis | 5.a. Explain the various types of catalysis and industrial catalysts 5.b. List the industrial applications of catalysts | Introduction 5.1 Catalyst and Catalysis 5.1.1 Types of catalysis 5.1.2 Theory of catalysis 5.2 Types of Catalyst 5.2.1 Positive catalyst 5.2.2 Negative catalyst 5.2.3 Auto catalyst 5.3 Catalytic promoter and Catalytic inhibitor 5.4 Industrial applications of catalysts |
| Unit – VI Chemical Bonding | 6.a. Describe the different types of chemical bonds 6.b. Explain various properties of material depending upon bond formation | Introduction 6.1 Theory Of Valence 6.2 Arrangement of electrons in s, p, d, f orbitals 6.3 Electron configuration of elements 6.4 Types of chemical bonds 6.4.1 Ionic (Electrovalent) bond & its characteristics 6.4.2 Covalent bond & its characteristics 6.4.3 Co-ordinate bond & its characteristics 6.4.4 Metallic bond, Explanation of Metallic properties. 6.4.5 Hydrogen bond, its types and Significance 6.4.6 Intermolecular force of attraction (van der Waals bond) |
| Unit – VII Chemical | 7.a. List out of various apparatus required for chemical analysis of | 7.1 Details of apparatus required for chemical analysis of ceramic materials And Finished products. |

| Unit | Major Learning Outcomes | Topics and Sub-topics |
|--------------------------------------|---|--|
| Analysis of ceramic materials | ceramic materials 7. b Prepare solution for chemical analysis and their classification and calculation. 7.c. Describe the concentration terms of solutions 7.d. Solve the numerical based on different concentration terms related to solutions 7.e. Explain standard solutions and stock solutions | 7.2 Methods of preparing solutions for examination such as water solution, acid solution and insoluble solutions. 7.3 Details about the different types of soluble such as water soluble, acid Soluble and insoluble. Method of calculating the amount of water soluble, water soluble radicals, For knowing the method of filtration. 7.4 determination of total dissolve solid by different methods such as gravimetric method and Conductivity method. 7.5.1. Types of Solutions 7.5.2. Concentration terms of solutions 7. 5.2.1 Normality 7. 5.2.2 Molarity 7. 5.2.3 Molality 7. 5.2.4 Formality 7. 5.2.5 Mole-fraction 7. 5.2.6 % w/w 7. 5.2.7 % w/v 7. 5.2.8 % v/v 7. 5.2.9 ppm 7. 5.3. Standard solutions 7. 5.4. Stock solutions |

5. 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 | Matter | 3 | 2 | 4 | 0 | 6 |
| 2 | Colloids | 8 | 4 | 6 | 2 | 12 |
| 3 | Absorption and Adsorption | 4 | 2 | 4 | 2 | 8 |
| 4 | Phase Rule | 5 | 3 | 5 | 2 | 10 |
| 5 | Catalysts and Catalysis | 4 | 2 | 4 | 2 | 8 |
| 6 | Chemical Bonding | 7 | 4 | 6 | 2 | 12 |
| 7 | Chemical analysis of ceramic materials | 11 | 4 | 6 | 4 | 14 |
| Total | | 42 | 21 | 35 | 14 | 70 |

Legends:

R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)

6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills so that students are able to acquire the competency. Following is the list of experiments for guidance.

| S. No. | Unit No. | Practical/Exercise | Apprx. Hrs. Required |
|--------------|----------|--|----------------------|
| 1 | - | Study of Ceramic Chemistry's Laboratory. | 2 |
| 2 | - | Study adjustment of Analytical balance. | 2 |
| 3 | 7 | Prepare stock solutions of NaOH, Ca(OH) ₂ . | 2 |
| 4 | 7 | Prepare standard solutions of H ₂ SO ₄ , HCl.. | 2 |
| 5 | 7 | Prepare standard solution of NaCl, | 2 |
| 6 | 7 | Standardize KMnO ₄ solution by preparing standard oxalic acid. | 2 |
| 7 | 7 | Standardize Na ₂ S ₂ O ₃ solution by preparing standard potassium dichromate. | 2 |
| 8 | 7 | Find out strength of given acidic solution using standard solution of base. | 2 |
| 9 | | Determine pH-Values of given samples of solutions by using Universal indicator and pH meter. | 2 |
| 10 | 7 | Make chemical analysis of clay, quartz, potash feldspar. | 4 |
| 11 | 7 | Make chemical analysis of soil, cement, lime, refractory. | 4 |
| 13 | 7 | Determination of silica (SiO ₂), ferric oxide, titania (TiO ₂). | 4 |
| 14 | 7 | Determination of alumina (Al ₂ O ₃), lime (CaO), magnesia (MgO). | 4 |
| 15 | 7 | Estimation of calcium in limestone or dolomite. | 4 |
| Total | | | 38 |

7. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- Teacher guided self-learning activities.
- Course/topic based internet based assignments.
- Library survey regarding Engineering Material used in different industries.
- Industrial Visits of one or two Industries.
- Quiz & Brain storming session related to ceramic materials & utilization of ceramic materials for different purposes. These could be individual or group-based

8. SUGGESTED LEARNING RESOURCES

A. List of Books:

| Sr. No. | Title of Books | Author | Publication |
|---------|---------------------------------|------------------|--|
| 1. | Text book of Physical Chemistry | Samuel Glasstone | D.VanNostrand Company, Inc. Newyork and London |

| | | | |
|----|------------------------------------|---|---|
| 2. | Text book of Engineering Chemistry | C. P. Murthy, C. V. Agarwal, A. Naidu | B S Publications, Hyderabad www.bspublications.net |
| 3. | Engineering Chemistry | N. Krishnamurthy P.Vallinayagam D. Madhavan | Prentice-Hall of India Pvt. Ltd. New Delhi |
| 4. | Engineering Chemistry | O.P. Aggarwal | Khanna Publishers, Delhi |
| 5. | Technical Methods of Analysis | Roger Castle Griffin | McGraw-Hill Book Company, Inc. New York and London |
| 6. | Quantitative Analysis | V. Alexeyev | MIR Publishers, Moscow |

B. List of Major Equipment/Materials

| Sr. NO. | LIST OF THE EQUIPMENTS | QUANTITY REQUIRED |
|---|-------------------------------------|-------------------|
| 1 | Indane gas Connection (DBC) | 1 |
| 2 | Exhaust Fan | 3 |
| 3 | Chemical Balance/Analytical Balance | 3 |
| 4 | Weight box | 2 |
| 5 | Fractional weight box | 5 |
| 6 | pH meter | 1 |
| 7 | pH paper | 10 |
| GLASSWARES (To conduct laboratory for a batch of 22) | | |
| 1 | Burette 50cc | 25 nos |
| 2 | Pipette 10 cc | 30 nos |
| 3 | Pipette 20 cc | 30 nos |
| 4 | Conical Flask 250cc | 50 nos |
| 5 | Funnel 3" (Polythene) | 30 nos |
| 6 | Porcelain Tile 6x6" | 30 nos |
| 7 | Measuring Cylinder 100cc | 5 nos |
| 8 | Measuring Cylinder 30cc | 5 nos |
| 9 | Measuring Cylinder 10cc | 5 nos |
| 10 | Reagent Bottle (White) 250cc | 250 nos |
| 11 | Reagent Bottle (White) 125cc | 100 nos |
| 12 | Reagent Bottle (Amber) 250cc | 100 nos |
| 13 | Test tube Stand | 30 nos |
| 14 | Test tube Holder | 30 nos |
| 15 | Test tube Cleaning brush | 30 nos |
| 16 | Glass Trough | 1 no |

| | | |
|----|----------------------------------|---------|
| 17 | Beaker 1000 cc | 5 nos |
| 18 | Beaker 500 cc | 5 nos |
| 19 | Beaker 250 cc | 5 nos |
| 20 | Test-tubes | 300 nos |
| 21 | Glass Rods | 2 kg |
| 22 | Watch Glass 3" | 30 nos |
| 23 | Wash Bottle (Polythene) 250cc | 30 nos |
| 24 | Tongs | 30 nos |
| 25 | Nickel Spatula | 10 nos |
| 26 | Kipps Apparatus | 1 nos |
| 27 | Burner Nipple | 30 nos |
| 28 | Bunsen Burner for gas connection | 6 nos |
| 29 | Wire Gauge with asbestos center | 6 nos |
| 30 | Plastic Buckets | 6 nos |
| 31 | Tripod Stand (Iron) | 6 nos |
| 32 | Filter Paper Round sheets | 400 nos |
| 33 | Measuring flask 250cc | 35 nos |
| 34 | Measuring flask 100cc | 35 nos |
| 35 | Dropper | 20 nos |
| 36 | Burette Stand –Wooden 6x4x18" | 35 nos |
| 37 | Burette clamp with boss head | 35 nos |
| 38 | Plastic Beaker 100ml | 40 nos |

C List of Software/Learning Websites

- (a) www.chemistryteaching.com
- (b) en.wikipedia.org/wiki/chemistry
- (c) www.chm1.com
- (d) www.em-ea.org
- (e) www.ce.sc.edu
- (f) www.chemistry.msu.edu

9. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

1. **Shri D. B. Chhag**, Lecturer in Chemistry, Science Department, L.E. College (Polytechnic), MORBI.
2. **Shri B.B.Patel**, Lecturer in Ceramic, Ceramic Department, L.E. College (Polytechnic), MORBI.