

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**COURSE CURRICULUM**

Course Title: Applied Chemistry (Group-1)

(Code: 3300009)

Diploma Programmes in which this course is offered	Semester in which offered
Civil Engineering, Ceramic Engineering, Environment Engineering, Mining Engineering, Transportation Engineering	Second Semester

1. RATIONALE

Science is the foundation for all technician courses. The Basic aim of teaching science is to develop in the students the habit of scientific inquiry, ability to establish the cause and effect, relationship.

Applied Chemistry forms the part of applied science and the study of basic concepts of chemistry like chemical bonding, corrosion, water treatment, and different engineering materials like polymers, paints ,glasses, cement, Refractories etc. and awareness of pollution in chemical industries etc. will help the students in understanding engineering subjects where the emphasis is laid on the application of these concepts

Chemistry is concerned with the changes in structure and properties of matter. Many of these processes, forms the basis of engineering activities. Teaching of chemistry should be aimed at developing the right type of aptitude in the students and the ability to predict the result under given condition, thus good foundation in basic science will help the students in their self development, to cope up with continuous flow of innovations.

2. COMPETENCIES

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competencies:

- **Apply the basic concepts and principles of Chemistry in Engineering applications.**
- **Select the proper materials for given engineering applications.**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			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

Note: It is the responsibility of the institute heads that marks for **PA of theory & ESE and PA of practical** for each student are entered online into the GTU Portal at the end of each semester within the dates specified by GTU.

4. DETAILED COURSE CONTENTS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I Chemical Bondings and Catalysis	1a. Explain various properties of material depending upon bond formation 1b. Describe the molecular structure of solid, liquid and gases 1c. Explain the crystal structure of metal and properties reflected by packing of atoms 1d. Explain the various types of catalysis and catalyst	Introduction 1.1 Theory Of Valence 1.2 Types of chemical bonds 1.2.1 Electrovalent bond,& its characteristics 1.2.2 Covalent bond & its characteristics 1.2.3 Co- ordinate bond & its characteristics 1.2.4 Hydrogen bond, its types and Significance 1.2.5 Metallic bond, Explanation of Metallic properties 1.3 Intermolecular force of attraction 1.4 Molecular arrangement in solid, liquid and Gases. 1.5 Structure of solids. 1.5.1 Metallic solids- Unit cell- bcc, fcc and hcp packing of metals –examples and properties reflected by the packing of atoms 1.6 Catalysis, 1.6.1 Types of catalysis 1.6.2 Theory of Catalysis 1.7 Types of Catalyst 1.7.1 Positive Catalyst 1.7.2 Negative Catalyst 1.7.3 Auto-catalyst 1.8 Catalytic Promoter and Catalytic inhibitor 1.9 Industrial Application of Catalyst

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit- II Ionization And pH	2a. Describe the theory of ionization and factors affecting it. 2b. Describe the importance of pH & and Perform its industrial application	2.1 Introduction 2.2 Arrhenius theory of ionization. 2.3 Ionic Equilibrium of water 2.3 Degree of ionization 2.3.1 Factors affecting the degree of ionization 2.4 Definition of pH 2.4.1 pH of acid, base and neutral solution 2.4.2 pH calculations of acid, base and salt solution at different concentration 2.4.3 Importance of pH in various fields.
Unit- III Metal corrosion and its control	3a. Describe the different types of corrosion 3b. List the different factors affecting rate of corrosion 3c. Describe the different protective measures to prevent the corrosion	3.1. Explanation of corrosion 3.2 Types of corrosion 3.2.1 Dry corrosion: Oxidation corrosion mechanism corrosion-mechanism , Nature of oxide film 3.2.2 Wet corrosion-mechanism 3.2.3 Concentration cell corrosion 3.3 Pitting corrosion 3.4 Waterline corrosion 3.5 Crevice corrosion 3.6 Factors affecting the rate of corrosion, 3.7 Corrosion Control Modification of environment , Modification of the properties of metal , Use of protective coatings. Anodic and Cathodic protection, Modification in design and choice of material
Unit- IV Water Treatment	4a. Differentiate the hard and soft water 4b. Explain the types and degree of Hardness 4c. Describe the ill effect of hard water in boiler operation 4d. Explain the different methods for removal hardness in water 4e. Apply the water treatment for drinking water	4.1. Hard water and soft water. 4.2 Types of hardness of water 4.2.1 Salts producing hardness of water. 4.2.2 Method to express the hardness of water 4.3 Estimation of total hardness by EDTA Method 4.3.1 Examples to calculate the hardness 4.4 Effect of hard water in Boiler operation 4.4.1 Scale and sludge formation and it's Prevention 4.4.2 Priming and foaming and it's prevention. 4.4.3. Caustic embrittlement and it's prevention. 4.4.4 Corrosion and it's prevention. 4.5 Softening of Water 4.5.1 Soda-Lime process 4.5.2 Permutit process 4.5.3 Ion Exchange process 4.5.4 Reverse Osmosis process

Unit	Major Learning Outcomes	Topics and Sub-topics
		4.6 Treatment of Drinking water 4.6.1 Sedimentation 4.6.2 Coagulation 4.6.3 Filtration 4.6.4 Sterilization of water by chlorination 4.6.5 Break-point chlorination 4.7 Treatment of waste water
Unit- V Cements, Glasses & Refractories	5a. Describe the constituents of cements 5b. Explain setting and hardening chemistry of cement 5c. Describe variety of glass and their application	5.1 Cement, Constituting compound in cement 5.2 Composition of Portland cement 5.3 Manufacture of Portland cement 5.4 Setting and Hardening of cement 5.5 Glass and its general properties 5.6 Manufacture of glass 5.7 Variety of Glasses and their application 5.8 Definition & application of refractories. 5.9 Characteristics of refractories 5.10 Classification of refractories like 5.10.1 Acid refractories 5.10.2 Basic refractories 5.10.3 Neutral refractories
Unit- VI Paints, Varnishes & Insulators.	6a. Differentiate paints and varnishes 6b. Describe different Ingredients of paints and their function 6c. Differentiate between paints and varnishes 6d. Describe the properties and uses of insulating materials	6.1 Definition of paints and Varnishes 6.2 Purpose of oil paint 6.3 Characteristics of oil paints 6.4 Ingredients of paints 6.5 Function and Examples of each ingredients 6.6 Varnish and its types 6.7 Difference between paints and varnishes 6.8 Definition Of Insulators 6.9 Characteristics of Insulators 6.10 Classification of insulators 6.11 Properties and Application of 6.11.1 Glass wool 6.11.2 Thermocole
Unit- VII Polymer, Adhesives & Elastomers	7a. Explain the process of polymerisation 7b. Describe the properties and uses of Polymers, elastomers & adhesives. 7c. Explain the process of vulcanization of rubber 7d. Classify the types of	7.1 Introduction and Definition of Polymer and Monomer 7.2 Classification of Polymer on basis of Molecular structure as Linear, Branch and Cross-linked polymers 7.3 Classification on basis of monomers (homopolymer and copolymer) 7.4 Classification of Polymers on basis of Thermal behavior (Thermoplastics & Thermosetting) 7.5 Types polymerization Reaction

Unit	Major Learning Outcomes	Topics and Sub-topics
	adhesives and their application	7.5.1 Addition Polymerization 7.5.2 Condensation Polymerization 7.6 Synthesis, properties and application of 7.6.1 Polyethylene 7.6.2 Polypropylene 7.6.3 Polyvinyl chloride 7.6.4 Teflon 7.6.4 Polystyrene 7.6.5 Phenol formaldehyde 7.6.6 Acrylonitrile 7.6.7 Epoxy Resin 7.7 Define the term elastomers 7.8 Natural rubber and its properties 7.9 vulcanization of rubber 7.10 Synthetic rubber, Synthesis, properties and uses 7.10.1 Buna-S Rubber 7.10.2 Buna-N Rubber 7.10.3 Neoprene Rubber 7.11 Definition of adhesives and Examples 7.11.1 Characteristics of adhesives 7.11.2 Classification of adhesives and their uses.

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks (Duration –Hours)			
			R Level	U Level	A Level	Total
I	Chemical Bondings and catalysis	06	3	2	3	08
II	Ionization and pH	06	2	4	4	10
III	Metal corrosion & its control	05	3	2	3	08
IV	Water Treatment	06	4	2	4	10
V	Cements, Glasses & Refractories	07	4	2	4	10
VI	Paints, Varnishes & Insulators.	05	4	2	4	10
VII	Polymer, Adhesives & Elastomers	07	4	4	6	14
	Total	42	24	18	28	70

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

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

6. SUGGESTED LIST OF EXERCISES/PRACTICALS

The experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency –

S. No.	Unit No.	Practical Exercise	Approx Hours Required
1	I	Determine the strength of acidic solution by using standard solution of Base.	02
2	II	Standardize KMnO_4 solution by preparing standard oxalic acid and to estimate ferrous ions.	02
3	II	Standardize $\text{Na}_2\text{S}_2\text{O}_3$ solution by preparing standard potassium dichromate and to estimate percentage of copper from brass.	02
4	II	Determine PH-Values of given samples of Solution by using Universal Indicator and PH-meter	02
5	IV	Determine the total hardness of water by EDTA method	02
6	VII	Determine molecular weight of a polymer using Ostwald viscometer	02
7	VII	Preparation of (any one) polystyrene, urea formaldehyde, phenol formaldehyde and its Characterization	02
8	V	Determine Calcium from given sample of cement by volumetric method	02
9	IV	Determination of total dissolved and suspended solids in given water sample	02
10	III	Study of corrosion of metals in medium of different pH	02
11	III	Determine total alkalinity of water sample	02
12	IV	Determine the COD of given water sample	02
13	III	Study of Corrosion of Metals in the different Mediums.	02
	Note	Minimum Ten Experiments should be performed by the students from the above given list or experiment related to above topics	
		Total	26

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 Fuel properties & Utilization of fuel for different purposes.
- Sampling & Testing of water collected from different places.
- These could be individual or group-based.

8. SUGGESTED LEARNING RESOURCES

A. List of Books

Sr.No.	Title of Books	Author	Publication
1	Engineering Chemistry	JAIN & JAIN	Dhanpat Rai and Sons
2	A Text Book of Polytechnic Chemistry	V.P. Mehta	Jain Brothers
3	A Text Book of Applied Chemistry	J. Rajaram	Tata McGraw Hill Co. New Delhi
4	Engineering Chemistry	S.S.Dara	S.Chand Publication

B. List of Major Equipment/ Instrument

- PH- Meter
- Red wood Viscometer
- Electronic Balance/ Chemical Balance
- Glass wares

C. List of Software/Learning Websites:

9. COURSE CURRICULUM DEVELOPMENT COMMITTEE:

- **Faculty Members from Polytechnics**
 1. **Prof.J.C.Patel**, I/C.Head, Science & Humanities Department, Dr.S.& S.S. Ghandhy College of Engineering Technology, Surat
 2. **Dr. P.R.Patel**, Head, Science & Humanities Department, N.G.Patel Polytechnic, Isroli, Bardoli
 3. **Prof.S.A.Nimakwala**, I/C.Head, Science & Humanities Department, Shri.K.J. Polytechnic, Bharuch.
 4. **Prof.R.R.Patel**, I/C.Head, Science & Humanities Department,G.P. Himmatnagar.
- **Coordinator and Faculty Members From NITTTR Bhopal**
 1. **Dr. Abhilash Thakur**, Associate Professor, Dept. of Applied Sciences
 - 2.**Dr. Bashirulla Shaik**, Assistant Professor, Dept. of Applied Sciences