

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

Course Title: Engineering Chemistry(Group-2)  
(Code: 3300006)

Diploma Programmes in which this course is offered	Semester in which offered
Biomedical Engineering, Electrical Engineering, Power Electronics Engineering	<b>First Semester</b>
Metallurgy Engineering	<b>Second Semester</b>

### 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.

Chemistry forms the part of applied science. The study of basic concepts of chemistry like chemical bonding, corrosion, water treatment, and different engineering materials like polymers, paints, lubricants, cement, Refractories etc. will help the students 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 the process which are involved to bring out this changes 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. LIST OF COMPETENCIES

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the following competency.

- i. **Apply the basic concepts and principals of Chemistry in various engineering applications.**

### 3. 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	<b>150</b>
3	0	2	5	70	30	20	30	

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit;  
ESE - End Semester Examination; PA - Progressive Assessment.

## 4. DETAILED COURSE CONTENTS

Unit	Major Learning Outcomes	Topics and Sub-topics
<b>Unit – I</b>  <b>Chemical Bondings and Catalysis</b>	1.1. Describe the different types of chemical bonds  1.2. Explain various properties of material depending upon bond formation  1.3. Describe the molecular structure of solid, liquid and gases  1.4. Comprehend the crystal structure of metal and properties reflected by packing of atoms  1.5. Explain the various types of catalysis and catalyst industrial  1.6. List the industrial applications of 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
<b>Unit– II</b>  <b>Concepts of Electro Chemistry</b>	2.1 Explain theory of ionization and factors affecting it.  2.2 Explain the importance of pH &and its industrial application  2.3 List the	2.1 Introduction 2.2 Arrhenius theory of ionization. 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. 2.5 Definition of buffer solution. 2.5.1 Buffer Action & Types of buffer solution. 2.5.2 Application of buffer solutions. 2.6 Electrolytes and Non-electrolytes

Unit	Major Learning Outcomes	Topics and Sub-topics
	<p>difference between electrolytes and non-electrolytes</p> <p>2.4 Describe construction and working of electrochemical cell</p> <p>2.5 State the term: electrode potential and standard condition for its measurement</p> <p>2.6 State the application of electrolysis process for surface coating</p>	<p>2.6.1 Types of electrolytes</p> <p>2.7 Construction and working of electrochemical cell</p> <p>2.8 Standard conditions</p> <p>2.9 Standard hydrogen electrodes</p> <p>2.10 Nernst theory of single electrode potential &amp; Nernst equation</p> <p>2.11 Electrochemical series, galvanic series</p> <p>2.12 Electrolysis, Faradays laws of electrolysis</p> <p>2.13 Industrial application of Electrolysis</p> <p>2.14 Conductance of solution (a) Conductivity (b) Specific Conductivity (c) Equivalent conductivity (d) Molar conductivity</p>
<p><b>Unit– III</b></p> <p><b>Corrosion of metals &amp; its prevention</b></p>	<p>3.1 Describe the different types of corrosion</p> <p>3.2 Comprehend the different factors affecting rate of corrosion</p> <p>3.3 Explain the different protective measures to prevent the corrosion</p>	<p>3.1. Definition of corrosion</p> <p>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</p> <p>3.3 Pitting corrosion</p> <p>3.4 Waterline corrosion</p> <p>3.5 Crevice corrosion</p> <p>3.6 Factors affecting the rate of corrosion,- Nature of film, Nature of Environment,PH of Solution, Area of cathode anode and, Temperature, Moisture, Purity of metal</p> <p>3.7 . Methods of prevention of corrosion- Modification of environment , Modification of the properties of metal , Use of protective coatings. Anodic and cathodic protection, Modification in design and choice of material</p>
<p><b>Unit– IV</b></p> <p><b>Fuels and Combustion</b></p>	<p>4.1 Classify different fuels</p> <p>4.2 Determinate calorific value</p> <p>4.3 State the significance of</p>	<p>4.1 Definition of fuels classification of fuels</p> <p>4.2 Calorific value and its unit 4.2.1 Determination of calorific value by Bomb calorimeter</p> <p>4.3 Solid Fuels: Coal 4.3.1 Classification of coal 4.3.2 proximate and ultimate analysis of fuels</p> <p>4.4 Numerical based analysis of coal-Dulong formula</p> <p>4.5 Liquid Fuels: Petroleum,</p>

Unit	Major Learning Outcomes	Topics and Sub-topics
	octane and cetane number 4.4 Justify the need of alternative fuels such as power alcohol and Bio-diesel and hydrogen gas	4.5.1 Origin of petroleum& Composition of petroleum, 4.5.2 Refining of petroleum 4.5.3 Octane Number of petroleum,Cetane number of petroleum 4.5.4 Power alcohol, Bio-diesel. 4.6 Gaseous fuels: Composition, Properties and application of natural gas 4.6.1 .CNG,LPG and LNG-Properties and application 4.6.2 Hydrogen gas as fuel 4.7 Combustion-chemical reaction.
<b>Unit- V</b>  <b>Lubricants</b>	5.1 Explain terms Lubrication and Lubricants 5.2 Describe the different types of lubricants 5.3 Describe the physical and chemical property of lubricants 5.4 Selection of proper lubricants for engineering use	5.1 Introduction and definition of lubricants and lubrication 5.2 function of lubricants 5.3 Types of lubrication 5.3.1 Fluid film lubrication. 5.3.2 Boundary lubrication 5.4 Classification of lubricants 5.4.1 Solid lubricants 5.4.2 Semi-solid lubricants 5.4.3 Liquid lubricants 5.4.4 Synthetic oils 5.5 Physical Properties of lubricants and their significance like 5.5.1 Viscosity and viscosity index 5.5.2 Flash point and fire point 5.5.3 Pour point and cloud point 5.5.4 oiliness 5.6 Chemical Properties of lubricants like 5.6.1 Saponification value 5.6.2 Neutralization number 5.6.3 Emulsification number 5.7 Selection of lubricants for 5.7.1 Gears 5.7.2 Cutting tools 5.7.3 Steam turbine.
<b>Unit- VI</b>  <b>Polymers, Elastomers &amp; Insulating Material</b>	6.1 Explain the process of polymerisation 6.2 Classify polymers based on different properties 6.3 Explain the	6.1 Introduction and Definition of Polymer and Monomer 6.2 Classification of Polymer on basis of Molecular structure as Linear, Branch and Cross-linked polymers 6.3 Classification on basis of monomers (homopolymer and copolymer) 6.4 Classification of Polymers on basis of Thermal behavior(Thermoplastics& Thermosetting) 6.5 Types polymerization Reaction 6.5.1 Addition Polymerization 6.5.2 Condensation Polymerization 6.6 Synthesis, properties and application of 6.6.1 Polyethylene 6.6.2 Polypropylene 6.6.3 Polyvinyl chloride

Unit	Major Learning Outcomes	Topics and Sub-topics
	<p>properties and uses of Polymers, elastomers &amp; adhesives.</p> <p>6.4 Describe the process of vulcanization of rubber</p> <p>6.5 Explain the properties and uses of different insulating materials</p>	<p>6.6.4 Teflon</p> <p>6.6.4 Polystyrene</p> <p>6.6.5 Phenol formaldehyde</p> <p>6.6.6 Acrylonitrile</p> <p>6.6.7 Epoxy Resin</p> <p>6.7 Elastomers</p> <p>6.8 Natural rubber and its properties</p> <p>6.9 Vulcanization of rubber</p> <p>6.10 Synthetic rubber, Synthesis, properties and uses</p> <p>6.10.1 Buna-S Rubber</p> <p>6.10.2 Buna-N Rubber</p> <p>6.10.3 Neoprene Rubber</p> <p>6.11 Insulators: Definition</p> <p>6.12 Classification and properties of insulating materials :</p> <p>6.12.1 Natural insulating materials(wood,cotton,mica,paper etc.)</p> <p>6.12.2 Insulating oils.</p> <p>6.12.3 Insulating wool,resines</p> <p>6.13 Synthetic insulating</p>
<b>Unit– VII</b> <b>Electrochemical Energy Sources</b>	<p>7.1 List of various types of Batteries</p> <p>7.2 Describe the construction and working of various batteries</p> <p>7.3 Explain the working of fuel cell</p>	<p>7.1 Batteries: An electrochemical source of energy</p> <p>7.2 Types of Batteries :-Primary, Secondary and fuel batteries.</p> <p>7.3 Dry cell- construction and working.</p> <p>7.4 Lead acid storage cell- -construction and working.</p> <p>7.5 Nickel/Cadmium battery –construction and Working.</p> <p>7.6 Fuel cell- definition example H<sub>2</sub>/O<sub>2</sub> fuel cell [green fuel cell] - solar cells</p>

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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total
1.	Chemical Bondings and catalysis	06	3	2	3	08
2.	Concepts of Electro Chemistry	07	4	4	4	12
3.	Corrosion of metals & its prevention	05	3	2	3	08
4.	Fuels and Combustion	07	4	4	4	12
5.	Lubricants	05	2	3	3	08
6.	Polymers, Elastomers & Insulating Material	07	4	4	6	14
7.	Electrochemical Energy Sources	05	3	2	3	08
	<b>Total</b>	<b>42</b>	<b>23</b>	<b>21</b>	<b>26</b>	<b>70</b>

### Legends:

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

## 6. SUGGESTED LIST OF EXERCISES/PRACTICAL/EXPERIMENTS

The exercises/practical/experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency. Following is the list of exercises/practical/experiments for guidance.

S. No.	Unit No.	Practical Exercises/Experiment
1	1	Find out strength of given acidic solution using standard solution of Base.
2	3	Standardize $\text{KMnO}_4$ solution by preparing standard oxalic acid and to estimate ferrous ions.
3	3	Standardize $\text{Na}_2\text{S}_2\text{O}_3$ solution by preparing standard potassium dichromate and to estimate percentage of copper from brass.
4	6	Determine the viscosity of given lubricating oil by using Red-wood Viscometer
5	6	To Determine Flash of given lubricating oil.
6	2	To Determine PH-Values of given samples of Solution by using Universal Indicator and PH-meter
7	6	Determine molecular weight of a polymer using Ostwald viscometer
8	6	Prepare (any one ) polystyrene, urea formaldehyde, phenol formaldehyde and its Characterization
9	6	Determine Acid Value of given lubricating Oil.
10	4	Determine percentage of moisture in given sample of coal by proximate analysis
11	6	Determine of saponification value of an lubricating oil
12	3	Study of corrosion of metals in medium of different pH
13	4	Determine ash content of a given sample of coal
14	6	Determine Fire point of given lubricating oil.
15	3	Study of Corrosion of Metals in the different Mediums.
	<b>Note</b>	<b>Minimum Ten Experiments/Practical Exercises should be performed by the students from the above given list. Or any other experiments related to above topics</b>

## 7. SUGGESTED LIST OF PROPOSED 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.
- Pensky Martin Apparatus / Abel's Apparatus.
- Cleveland open cup apparatus.
- Glass wares

### C. List of Software/Learning Websites: ---

- (a) [www.chemistryteaching.com](http://www.chemistryteaching.com)
- (b) [en.wikipedia.org/wiki/chemistry](http://en.wikipedia.org/wiki/chemistry)
- (c) [www.chm1.com](http://www.chm1.com)
- (d) [www.em-ea.org](http://www.em-ea.org)
- (e) [www.ce.sc.edu](http://www.ce.sc.edu)
- (f) [www2.chemistry.msu.edu](http://www2.chemistry.msu.edu)

## 9. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### Faculty Members from Polytechnics

- **Prof.J.C.Patel**, I/C.Head, Science & Humanities Department, Dr.S.& S.S. Ghandhy College of Engineering Technology, Surat
- **Prof. Dr. P.R.Patel**, Head, Science & Humanities Department N.G.Patel Polytechnic, Isroli, Bardoli
- **Prof.S.A.Nimakwala**, I/C.Head, Science & Humanities Department, Shri.K.J. Polytechnic, Bharuch.
- **Prof.R.R.Patel**, I/C.Head, Science & Humanities Department, G.P. Himmatnagar

### Co-ordinator and Faculty Members from NITTTR Bhopal

- **Dr. Anju Rawley** , Professor Applied Science Dept. NITTTR, Bhopal
- **Dr. C.K.Chug** , Professor & Head Dept. of Electronic media , NITTTR, Bhopal