ENGINEERING CHEMISTRY

Effective from the Academic Year 2018-19

Course code: 18CH1ICCHY/18CH2ICCHY **Credits: 04**

L: P: T: S: 3: 0: 2: 0 **CIE Marks: 50**

Exam Hours: 03 **SEE Marks: 50**

Course Objectives: **Total Hours: 50**

To provide students with knowledge of engineering chemistry for building technical competence in industries, research and development in the following fields.

1. Study the various chemical energy sources and significance of renewable sources of energy.
2. Fundamentals for the conversion of chemical energy to electrical energy and applications in daily life as batteries.
3. Understand the fundamentals of corrosion and methods to protect the metal structures.
4. Appreciate the properties and applications of few important polymers.
5. Evaluate the purity and usage of water for industrial and domestic purposes.
6. Learn the different methods of synthesis of nanomaterials and their applications.

Course outcomes: On completion of this course, students will be able to	
CO1	Identify the terms and processes involved in various scientific and engineering applications
CO2	Explain the phenomenon of chemistry to appreciate the methods of engineering processes
CO3	Solve for the problems in chemistry that are pertinent in engineering applications
CO4	Apply the basic concepts of science in understanding the chemical properties
CO5	Analyze various issues associated with chemical substances in multidisciplinary situations
CO6	Apply the principles of chemical reactivity in industrially relevant processes

Mapping of course outcomes to program outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	---	---	---	---	---	---	2	2	---	---
CO2	3	2	---	---	---	---	---	---	2	2	---	---
CO3	3	1	---	---	---	---	---	---	2	2	---	---
CO4	3	2	---	---	---	---	---	---	2	2	---	---
CO5	3	2	---	---	---	---	---	---	2	2	---	---
CO6	3	2	--	---	---	---	--	---	2	2	---	---

Unit	Course content	Hours	COs
1	**ENERGY SOURCES** **Non renewable Energy Sources:** Introduction, classification of chemical fuels, calorific value-gross and net calorific values, determination of calorific value of a fuel using bomb calorimeter, numerical problems. Cracking: Introduction, fluidized catalytic cracking, Gasoline knocking and its mechanism, Octane number and cetane number, anti- knocking agents, unleaded petrol and power alcohol. Disadvantages of non-renewable energy sources. **Renewable Energy Sources**: Introduction, Biodiesel- Synthesis, Advantages and disadvantages. Photovoltaic cells- construction and working, advantages and disadvantages of PV cells. Production of solar grade Silicon. Purification of Silicon by zone refining.	**10**	**CO1-CO6**
2	**ELECTROCHEMICAL ENERGY SYSTEMS** **Thermodynamic functions:** Energy, free energy. Free energy and Emf. **Electrodes:** Introduction, single electrode potential, origin of single electrode potential, derivation of Nernst equation for electrode potential and applications. **Types of electrodes:** Metal-Metal ion, Metal-Metal insoluble salt, gas, Amalgam, red-ox & Ion selective. **Reference electrodes:** Introduction, Demerits of SHE, construction, working, applications of Calomel and Ag-AgCl electrodes. **Ion selective electrodes:** Construction and working of glass electrode, determination of pH using glass electrode. Electrolyte concentration cells, numerical problems on electrode potential, emf of cells and concentration cells. **Battery Technology**: Introduction, classification-primary, secondary and reserve batteries. Construction, working and applications of Ni-MH battery. **Lithium batteries:** Introduction, construction, working and applications of Li-ion battery. **Fuel Cells**: Introduction, Differences between conventional cell and fuel cell, Limitations and advantages of fuel cells, construction & working of Hydrogen-Oxygen fuel cell.	**10**	**CO1-CO6**
3	**CORROSION SCIENCE AND METAL FINISHING** **Corrosion**: Introduction, electrochemical theory of corrosion, Free energy in corrosion, galvanic series. Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, nature of metal, nature of corrosion product, nature of medium-pH and temperature. Types of corrosion-differential metal and differential aeration corrosion (pitting and	**10**	**CO1-CO6**

	waterline). **Corrosion control**: Metal coating-Galvanization and Tinning. Cathodic protection- Sacrificial anodic and impressed current methods. **Metal Finishing:** Introduction, Technological importance. **Electroplating:** Introduction, principles governing-polarization, decomposition potential and overvoltage. Surface pre-treatment and electroplating of chromium (hard and decorative). **Electroless plating:** Introduction, distinction between electroplating and electroless plating, electroless plating of copper.		
4	**POLYMER CHEMISTRY** **Introduction to organic reactions:** Substitution, addition, elimination, oxidation, reduction, cyclisation and ring openings. **Polymers:** Introduction, types of polymerization: addition and condensation, mechanism of polymerization-free radical mechanism taking ethylene as an example. Molecular weight of polymers: Number average and weight average, numerical problems. Glass transition temperature (Tg): Significance of Tg, factors influencing Tg –flexibility, inter molecular forces, molecular mass, branching & cross linking and stereo regularity. **Biodegradable Polymers:** Introduction and their requirements. Properties and synthesis of poly lactic acid and their applications. **Elastomers:** Introduction, synthesis, properties and applications of silicone rubber. **Adhesives:** Introduction, synthesis, properties and applications of epoxy resin. **Polymer Composites:** Introduction, synthesis, properties and applications of Kevlar. **Conducting polymers:** Introduction, mention of Polyaniline, Poly pyrrole and their applications.	**10**	**CO1-CO6**
5	**WATER TREATMENT AND NANO-MATERIALS** **Water Treatment**: Introduction, boiler feed water, boiler troubles, formation of scale and sludge, disadvantages, boiler corrosion (due to dissolved O_2, CO_2 and $MgCl_2$). Determination of DO and COD. Numerical problems on COD. Sewage treatment (water recycling): Primary, secondary (activated sludge method) and tertiary methods. Softening of water by ion exchange process. Desalination of sea water by reverse osmosis. **Nano Materials**: Introduction, size dependent properties (surface area, electrical and optical), Synthesis: top-down and bottom up approaches. Methods of synthesis - solution combustion and sol-gel. Nano scale materials, properties of fullerenes and carbon nano-tubes. Nanomaterials for water purification, light emitting diodes (LED), sensors and Fluorescence in Nano medicine. **Characterization of nanomaterials (no description of instrumentation):** Diffraction and scattering: X-ray diffraction (XRD). Electron microscopy: Transmission electron microscopy (TEM) and scanning electron microscopy (SEM).	**10**	**CO1-CO6**

Self-study component:

Note: 1. Questions for CIE and SEE not to be set from additional learning component.

2. Assignment Questions should be from additional learning component only.

Unit 1: *The current ways of minimizing environmental pollution during thermal power generation. Hydrogen as fuel: production, advantages and disadvantages.*

Unit 2: *Measurement of standard electrode potential using calomel electrode. Biological applications of electrochemistry.*

Unit 3: *Electroless plating of copper on Printed Circuit Board. Types of polluting effluents from plating industries and remedial measures.*

Unit 4: *Synthesis, properties and applications of PMMA (plexi glass), Teflon, polyurethane. Mechanism of conduction in Polyaniline. Photoconducting polymers and applications.*

Unit 5: *Determination of BOD, methods of purification for potable water (bacteria removal using Silver nanoparticles). Desalination of water by electrodialysis. Medical applications of nanomaterials in medicine.*

List of projects:

1. Analysis of water.
2. Synthesis of nanomaterials by sol-gel, solution combustion and co-precipitation methods and their characterization.
3. Measurement of rate of corrosion.
4. Synthesis of Biodiesel.
5. Metal finishing.
6. Construction of battery/Homemade cells.
7. Polymer synthesis.
8. Determination of Fe in a sample of rust.
9. Determination of molecular weight of a polymer using Ostwald's viscometer.

Text books:

1. O.G.Palanna, "Engineering Chemistry", Tata McGraw-Hill Education Pvt.Ltd, 2011.
2. R.V. Gadag & A. Nityananda Shetty., "Engineering Chemistry", I K International Publishing House Private Ltd. New Delhi, Third edition, 2014.
3. P.C. Jain & Monica Jain., "Engineering Chemistry", Dhanpat Rai Publications, New Delhi. "Wiley Engineering Chemistry", Wiley India Pvt. Ltd. New Delhi. Fifteenth Edition, 2006.

Reference books:

1. D. Pletcher & Frank C Walsh, "Industrial Electrochemistry", Blackie academic and professional, 1993.
2. S. Glasstone & D. Lewis, "Elements of Physical Chemistry", The Macmillan Press Limited, Reprint: 1976.
3. R. Narayan & B. Vishwanathan, "Chemical and Electrochemical Energy Systems", University Press (India) Ltd., 1998.
4. M.G.Fontana., "Corrosion Engineering", Tata McGraw Hill publications, New York, 1987.
5. V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, "Polymer Science", Wiley-Eastern Ltd.

Assessment Pattern: CIE–Continuous internal evaluation (50marks)			
Bloom's Category	**Tests**	**Assignment**	**AAT**
Marks (Out of 50)	**30**	**10**	**10**
Remember	10	--	02
Understand	10	05	05
Apply	05	05	03
Analyze	05	--	--
Evaluate	--	--	--
Create	--	--	--

Alternate Assessment Tool: Project based learning/ E-course certification/building models/Group discussion/case study/ seminar/paper presentation/projects

Assessment Pattern: SEE –Semester end examination theory (50 Marks)	
Bloom's Category	**Marks Theory (50)**
Remember	10
Understand	15
Apply	15
Analyze	10
Evaluate	--
Create	--

ENGINEERING CHEMISTRY LABORATORY

Effective from the Academic Year 2018-19

Course code: 18CH1ILCHY/18CH2ILCHY **Credit: 01**

L: P: I: S: 0: 2: 0: 0 **CIE Marks: 50**

Exam Hours: 03 **SEE Marks: 50**

Course Objectives:

To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.

Course Outcomes: On completion of this course, students will be able to	
CO1	Identify and use different types of instruments for quick and accurate analysis.
CO2	Apply the various titrimetric analyses for the estimation of metal ions present in raw materials like ores, alloys *etc.*
CO3	Analyze water sample for hardness, sodium /potassium content, COD and DO.

Mapping of course outcomes to program outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	---	---	---	---	---	---	---	---	---	---
CO2	3	2	---	---	---	---	---	---	---	---	---	---
CO3	3	2	---	---	---	---	---	---	---	---	---	---

LIST OF EXPERIMENTS		
Experiment No.	**Course Content**	**COs**
1.	Estimation of copper in industrial waste water effluent by using colorimeter	CO1
2.	Estimation of strength of an acid mixture by conductometry	CO1
3.	Determination of pKa value of a weak acid using pH meter	CO1
4.	Determination of viscosity coefficient of a given lubricant /polymer using Ostwald's viscometer	CO1
5.	Estimation of Iron in mild steel solution using standard $K_2Cr_2O_7$ solution by potentiometry	CO1
6.	Determination of percentage of copper in brass solution by Iodometric method	CO2
7.	Determination of Iron in the given sample of rust solution by external indicator method	CO2
8.	Determination of Calcium Oxide in the given sample of cement by rapid EDTA method	CO2
9.	Assessment of total hardness in a sample of water by complexometric method	CO3
10.	Determination of Chemical Oxygen Demand of the given industrial waste Water sample	CO3
11.	Determination of Dissolved Oxygen in the given water sample by Winkler's method (Demo)	CO3
12.	Estimation of Sodium & Potassium by Flame photometric method in a water sample (Demo)	CO3

Reference books:

1. J. Bassett, R.C. Denny, G.H. Jeffery, A. I. Vogel, Text book of quantitative inorganic analysis, 4th Edition, 1978.
2. O. P. Vermani & Narula, "Theory and Practice in Applied Chemistry" New Age International Publisher, second edition, 2012.
3. Gary D. Christian, "Analytical chemistry", Wiley India, 6th edition, 2007.
4. DSCE laboratory manual 2018-19.

Assessment Pattern		
CIE –Continuous internal evaluation lab (50 Marks)		
Bloom's Category	**Performance (Day To Day)**	**Internal Test**
Marks (Out of 50)	**25**	**25**
Remember	10	10
Understand	05	05
Apply	05	05
Analyze	05	05
Evaluate	--	--
Create	--	--

Assessment Pattern	
SEE –Semester end Examination lab (50 Marks)	
Bloom's Category	**Lab Marks(50)**
Remember	10
Understand	15
Apply	15
Analyze	10
Evaluate	--
Create	--