

Sl. No. The Course objectives are:

To impart the knowledge of;

- 1 Methods of chemical and electrochemical analysis for matter, electrochemical energy system for social and industrial applications.
- 2 Identifying and analyzing engineering problems related to metal corrosion, achieving practical solutions for corrosion control and surface modifications of materials for engineering applications.
- 3 Applying principles of green chemistry in chemical synthesis and meet out the fuel crises in the present scenario for sustainable development.
- 4 Various polymer materials and dyes with their applications for future prospects.

UNIT – I**Water Technology****5 Hours**

Introduction, sources, impurities and specifications of water, Hardness of water, Classification, Determination of total hardness of water by EDTA method, Numerical problems. Boiler feed water - boiler problems, Scale and sludge formation, priming and foaming, boiler corrosion (due to dissolved O₂, CO₂ and MgCl₂).

Chemical analysis of water: Standard for potable water, Determination of; Dissolved oxygen, Chlorides. Water softening - Desalination of sea water by reverse osmosis.

Self Study: Softening of water by ion exchange process.

Electro Chemical Technology**5 Hours**

Introduction, Origin of electrode potential, Nernst equation, concentration cell, numerical problems on concentration cell, Reference electrode – Calomel electrode. Determination of single electrode potential using calomel electrode, Ion Selective Electrode – Glass electrode, Determination of pH of solution using glass electrode.

Energy storage devices: Introduction, Basic concept, Classification, Characteristics of batteries. Construction and working of; 1) Nickel Metal hydride battery 2) Li-Cobalt oxide battery

Self Study: Different types of electrodes and their working principle.

UNIT – II**Corrosion Science****5 Hours**

Introduction, Corrosion – Definition, Types of corrosion, Chemical (Dry) and Electrochemical (Wet) corrosion. Theory of electrochemical corrosion by taking Iron as an example. Types of Electrochemical corrosion - Differential metal corrosion, Differential aeration corrosion. e.g. water line corrosion, Pitting corrosion. Stress corrosion e.g. Caustic embrittlement. Factors affecting the rate of corrosion; Related to metal & Related to environment. Numerical problems on Corrosion Penetration Rate (CPR) by Weight loss method.

Corrosion Control: Protective coatings: Inorganic coatings, Anodizing – meaning, Anodizing of Al and applications. Cathodic protection - i) Sacrificial anodic method ii) Impressed current method.

Self study: *Metallic coating methods.*

Metal Finishing

5 Hours

Introduction, Technological importance of metal finishing. Factors governing electroplating - Polarization, Decomposition potential and Over voltage.

Electroplating process: Theory of electroplating - Definition, Principle components of an electroplating bath. Effects of plating variables on the nature of electro deposit. Determination of throwing power of plating bath by Haring - Blum cell and Numerical problems. Surface preparation for electroplating. Electroplating of Chromium (Decorative & Hard) and its applications.

Electroless plating process: Introduction, Difference between electroplating and electroless plating. Surface preparation, Electroless plating of Copper on printed circuit board(PCB) and its applications.

Self study: *Electroplating of Gold and Electroless plating of Ni on Al*

UNIT – III

Green Chemistry

5 Hours

Introduction, Definition, Major environmental pollutants, Basic principles of green chemistry (Brief discussion of 12 principles). Various green chemical approaches – Microwave synthesis, Bio - Catalytic reactions, Phase transfer catalysis. Synthesis of typical organic compounds by conventional and green route; i) Adipic acid ii) Paracetamol

Atom economy – Atom economy calculations on synthesis of Ethylene oxide & Methyl Methacrylate. Numerical problems on Atom economy calculations. Industrial applications of green chemistry.

Self study: *Information on recent green technology in industry.*

Renewable Energy Sources

5 Hours

Bioenergy - Introduction, Classification of biofuel. Biodiesel- production of biodiesel by alkali catalyzed trans - esterification method. Advantages and disadvantages of biodiesel.

Solar Energy – Photo Voltaic Cell; Introduction , Construction and Working of Typical P.V.Cell, Preparation of solar grade silicon by union carbide process, Advantages & Disadvantages of P.V.Cell.

Green fuel: Hydrogen – production(Photo electrocatalytic and photo catalytic water splitting) and applications in hydrogen fuel cells. Construction, working and applications of Methanol-Oxygen fuel cell (H_2SO_4 as electrolyte)

Self study: Biomass, Sources of biomass.

UNIT – IV

Polymer materials

5 Hours

Introduction, definitions, classification, types of polymerization. Ionic polymerization; Mechanism of polymerization – Cationic and Anionic polymerizations of styrene. Molecular weight of polymers - Number average and weight average methods, numerical problems. Glass transition temperature and factors affecting T_g & its significance. Synthesis, properties and applications of; i) Epoxy resin ii) Silicon rubber

Conducting polymers: Introduction – Definition, Mechanism of conduction in poly pyrrol (both n and p) and its applications.

Self study: Bio- degradable polymer.

Dyes

5 Hours

Introduction, definition, sensation of colour, classification based on chromophores. Theories of dyes- Witt theory and Electronic theory. Synthesis and applications of; i) Indigo ii) Malachite green. Applications of Phenolphthalein & Methyl orange in chemical analysis.

Self study: *Food dyes and its impact on human health.*

Text Books:

1. Engineering Chemistry, 2nd Edn., by Dr. Suba Ramesh et al., Wiley India Pvt. Ltd., Delhi. 2011.
2. A Text Book of Engineering Chemistry, 3rd Edn, by Shashi Chawla, Dhantpat Rai & Co. Pvt., Pub. Delhi. 2003.

Reference Books:

1. Engineering Chemistry, 12th Edn., by Dr. S. S. Dhara, Dr. S. S. Omare, S.Chand & Company Ltd., 2010
2. Engineering Chemistry, 16th Edn., by Jain & Jain, Dhanapath Rai Pub. Co.2013.
3. A Text Book of Engineering Chemistry, 1st Edn., by Dr. P. L. Timmanagoudar & Dr. S. K. Patil, , EBPB, Gadag, 2014.
4. Green organic Chemistry, 1st Edn., by Kenneth Doxsee & James Huchison, Thomson-Brooks/Cole, 2004.
5. Introduction to Bio fuels, 3rd Edn., by David M. Mousdale, CRC Press, 2017.

Course Out comes:

Sl. No. At the end of the course the student should be able to:

- 1 Apply and demonstrate quantitative chemical analysis and electrochemical analysis techniques and incorporate new methods to produce soft water for industrial and domestic use at cheaper cost.
- 2 Analyze engineering problems related to corrosion and develop/practice suitable preventive measures. Utilize surface modification methods to improve various cost effective properties of materials
- 3 Apply the principles of green chemistry in design and development of alternative ecofriendly chemical synthesis methods to minimize hazardous substances and impart the knowledge of conventional and non-conventional energy sources and their effective management.
- 4 Acquire the knowledge of different polymer materials and dyes for wide variety of engineering applications.

Laboratory Experiments for the year 2022 – 23

21UCH114L/21UCH214L: ENGINEERING CHEMISTRY LABORATORY

1.0 Credits (0 – 0 – 2)

Sl. No. The Course objectives are:

- 1 To impart the knowledge of independent experimental skills and to develop analytical ability.
- 2 Handling different types of instruments for chemical analysis of materials for quick and accurate results.

PART – A

1. Potentiometric estimation of iron in the given solution using standard $K_2Cr_2O_7$ solution.
2. Determination of pKa of a weak acid by standard NaOH using pH meter.
3. Conductometric estimation of HCl & CH_3COOH in acid mixture by standard NaOH.
4. Colorimetric estimation of copper in the given solution.

PART – B

5. Preparation of standard solution and standardization of a given solution.
6. Determination of total hardness of a given water sample by EDTA method.
7. Determination of alkalinity of water sample by dual indicator method.
8. Determination of amount of iron in a given solution using standard $K_2Cr_2O_7$ solution.

VIRTUAL LAB

9. Determination coefficient of viscosity of a given liquid by Ostwald's viscometer..
10. Electro gravimetric estimation of metals.

Reference Books:

1. Laboratory manual in Engineering Chemistry by Department of Chemistry, BEC Bagalkot.
2. Vogel's Text Book of Quantitative Chemical Analysis revised by G. H. Jeffery, J. Bassett, J. Mendham and R.C. Denny, 4th Edition.
3. Practical Engineering Chemistry by Sunita & Ratan Pub: S.K.Kataria & Sons.

Course Outcomes:

Sl. No. At the end of the course the student should be able to:

1. Write systematic procedure for setting up and conduct of experiment.
2. Perform experiment on volumetric analysis of materials of social relevance individually along with interpretation of results of analysis and calculation.
3. Perform experiments using instruments for chemical analysis with high accuracy.
4. Incorporate the practical skills of chemistry for engineering applications.