

UCH168C/UCH268C: ENGINEERING CHEMISTRY

04 Credits (3 – 2 – 0)

UNIT – I

Principles of volumetric analysis

L – 10 Hours, T – 6 Hours

Introduction, Fundamentals of volumetric analysis. Terminology - titration, equivalence point, indicators. Types of titrations – Acid-Base, Complexation, Precipitation & Redox titrations. Standard solution – concentration terms; Normality, Molarity, Mole fraction, percentage by weight and numerical problems on Normality & Molarity. Requirements primary of standard substance.

Acid-base titration: acids-base indicator, Ostwald's theory of acid – base indicator. Action of indicator – Phenolphthalein & Methyl orange. Choice of indicator for acid-base titrations, Titration curves – HCl v/s NaOH , CH₃COOH v/s NaOH.

Bio Fuels:

Introduction, Limits of conventional fuel & Need for Biofuel. Classification of bio fuels. Biomass, Sources of biomass. Biodiesel- production of biodiesel by transesterification, mechanism of acid catalyzed reaction and alkali catalyzed reactions. Advantages and disadvantages of biodiesel. Fuel cell technology eg: CH₃OH – O₂ fuel cell. Microbial production of bio gas (Bio-methanation).

Bio refineries: concept, types of bio refineries, Co production of ethanol and other chemicals.

UNIT – II

Corrosion Science

L – 10 Hours, T – 8 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) & Weight loss method.

Corrosion Control: Protective coatings – Inorganic coatings – (i) Anodizing – meaning, Anodizing of Al and applications (ii) Phosphating – process and applications. Metal coatings– (i) Galvanization (anodic coating) (ii) Tinning (cathodic coating).

Metal Finishing

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 Numericals. Electroplating of Chromium and applications.

Electroless plating:- Meaning, Distinction between electroplating and electroless plating. Surface preparation, Electroless plating of Copper on PCB and applications.

UNIT – III

Green Chemistry

L – 10 Hours, T – 6 Hours

Introduction, Aims and Objectives, Major environmental pollutants, Basic principles (12 principles). Various green chemical approaches – Microwave synthesis, Bio catalysed reactions, Phase transfer catalysis. Synthesis of typical organic compounds by conventional and green routes, i) Adipic acid ii) Indigo. Atom economy – Synthesis of ethylene oxide & Synthesis of ethyl bromide. Industrial applications of green routes.

Pollution abatement in chemical industries

Introduction, Need for abatement of pollutants, Effect of industrial pollutants on environment. Abatement processes in Sugar industry, Distilleries, Cement Industry; Standards for effluents discharge, nature of effluents, ill effects and treatment procedure in each industry.

Effluent Analysis: Biological Oxygen Demand (BOD) and Chemical Oxygen Demand(COD). Numerical problems on COD & BOD.

UNIT – IV

Engineering materials

L – 10 Hours, T – 6 Hours

Polymer composites: Introduction, structure of polymer composites, Properties and applications of Kevlar and Carbon fibres.

Organic Light Emitting Diodes (OLEDs): Introduction, Definition, Anatomy of OLED, Types of OLEDs, Comparisons between LED and OLED, Advantages and Disadvantages. Applications of OLEDs.

Shape Memories Alloys: Introduction, Phases of Shape Memories Alloys, Shape Memories effect – One way and Two way effects. Example – Nitinol(Ni-Ti Alloy): Meaning, Composition, Production by Vacuum Arc Remelting (VAR) method. Properties – Physical and Mechanical. Applications of Nitinol.

Polymer materials

Plastics & Resins: Introduction, Commercial thermoplastics & thermosets. Preparation, Properties & Applications of plasticized PVC & PET.

Elastomers: Introduction, Classification, Olefin Elastomers, Synthetic rubber, Preparation, Properties & Applications of Poly sulphide rubber & Silicon rubber.

Adhesives: Introduction, Classification, Preparation, Properties & Applications of Epoxy resin.

Conducting Polymers: Introduction, Mechanism of conduction in polyacetylene, enhancing conductivity in poly acetylene by doping methods. Applications of conducting polymers.

Biodegradable Polymer : Introduction, Composition, Preparation, Properties & Applications of poly lactic acid (PLA) and poly caprolactone (PCL).

Total L (Lectures) – 40Hours

T (Tutorials) – 26Hours

Text Books:

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

Reference Books:

1. Principles of Physical Chemistry B. R. Puri, L.R. Sharma & M.S. Pathania, & Co., 33rd Ed., 1992.
2. Engineering Chemistry by Jain & Jain, 15th Edn., Dhanapath Rai pub. Co.
3. A Text Book of Engineering Chemistry by Dr. P. L. Timmanagoudar & Dr. S. K. Patil, First Edn., 2014, EBPB, Gadag
4. Environmental Chemistry with Green Chemistry, by Dr. A. K. Das, Books & Allied (P) Ltd, Kolkata, 2012.
5. Green organic Chemistry by Kenneth Doxsee & James Huchison, 1st edn., 2004.
6. Polymer Science by V. R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar, New Age Int. Publication.
7. Introduction to Bio fuels by David M. Mousdale
8. Bio fuels by Wim Soetaert Erick J. Vandamme
9. Shape memory materials by K Otsuka & C M Wayman, 1998, Cambridge Uni. Press.
10. Organic Light Emitting Diodes, Materials, devices & Applications by Alastaer Buckley, Woodhead Publishing Ltd. 2013, Delhi.

Course Outcomes:

The student will be;

1. Able to conduct experiment along with analysis and interpretation of data.
2. Able to identify renewable sources to solve conventional crises.
3. Able to develop practical solutions for control of corrosion in metallic structures.
4. Able to impart modification of surface properties in various engineering materials.
5. Able to utilize eco friendly reactions scheme and chemical process for the need of the society.
6. Able to resolve the effect of chemicals for industry and environmental related problems.
7. Able to discuss the evolution of new materials for future applications.
8. Able to apply knowledge to replace conventional materials by polymers for various engineering applications.

UCH172L/UCH272L: ENGINEERING CHEMISTRY LABORATORY

1.5 Credits (0 – 0 – 3)

PART – A

1. Determination of molecular weight of polystyrene by Ostwald's Viscometer.
2. Potentiometric estimation of Iron in stainless steel using standard $K_2Cr_2O_7$ solution.
3. Determination of pKa of a soft drinks using standard NaOH by pH meter.
4. Conductometric estimation of HCl & CH_3COOH in acid mixture by Standard NaOH.
5. Colorimetric estimation of copper in PCB.
6. Study of titration curve of Na_2CO_3 versus HCl using pH meter.

PART – B

1. Preparation and Standardization of a solution.
2. Determination of total hardness of water before and after R.O. treatment by EDTA method.
3. Determination of amount of CaO in the cement solution by EDTA method.
4. Determination of alkalinity of water sample by dual indicator method.
5. Determination of percentage of Fe in mild steel using standard $K_2Cr_2O_7$ solution.
6. Determination of chloride in water by Mohr's method.

Reference Books:

1. Laboratory manual in Engineering Chemistry - Sudharani , Dhanapatrai, Publishing Company.
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:

The student will be;

1. Able to write systematic procedure for setting up & conduct of experiment.
2. Able to perform experiment on volumetric analysis individually along with interpretation of results of analysis and calculation.
3. Able to perform experiments using instruments for trace of chemical analysis with high accuracy.
4. Able to incorporate the practical knowledge of chemistry for engineering applications.