Syllabus for the year 2020 – 21

UCH168C/UCH268C: ENGINEERING CHEMISTRY

04 Credits (3 – 2 – 0)

UNIT – I

Water Technology L – 10 Hours, T – 6 Hours

Introduction, sources, impurities and specifications of water, Boiler feed water - boiler problems, Scale and sludge formation, priming and foaming, boiler corrosion (due to dissolved O_2, CO_2 and $MgCl_2$).

Chemical analysis of water: Standard for portable water, Determination of; Dissolved oxygen, Chlorides, Sulphates, TDS and numerical problems.

Water softening: Softening of water by ion exchange process. Desalination of sea water by reverse osmosis.

***Self Study*:** BOD and its determination.

Electro Chemical Technology

Introduction, Origin of electrode potential, Nernst equation, concentration cell, numerical on Concentration cell, Reference electrode – Calomel electrode. Determination of single electrode potential using calomel electrode, Ion selective 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) Lithium ion batteries; i) Li-Air battery ii) Li-Cobalt oxide battery iii) Li-Sulphur battery

Self Study: Electrochemical Sensors & applications.

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. Cathodic protection - i) Sacrificial anodic method ii) Impressed current method.

Self study: Corrosion control by Metallic coating methods.

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 Harring-Blum cell and Numerical problems. Surface preparation for electroplating. Electroplating of Chromium and applications.

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

Self study: Information on Multifunctional Coating

UNIT – III

Green Chemistry L – 10 Hours, T – 6 Hours

Introduction, definition, Major environmental pollutants, Basic principles of green chemistry (12 principles). Various green chemical approaches – Microwave synthesis, Bio catalysed reactions, Phase transfer catalysis. Super critical conditions for solvent free reactions. Synthesis of typical organic compounds by conventional and green route; i) Adipic acid ii) Paracetamol

Atom economy – Synthesis of Ethylene oxide & Mehtyl Methacrylate. Industrial applications of green chemistry, Numerical problems on Atom economy.
Self study: Information on recent green technology, green chemical products and application

Fuel Technology

Non Renewable Energy Sources

Introduction, Definition, classification, characteristics of fuel, Combustion, Calorific value-Definition, HCV, LCV, Determination of CV solid/liquid fuel by Bomb calorimeter, numerical problems.

Renewable Energy Sources

Biofuel **-** Introduction, Classification of biofuels. Biomass, Sources of biomass. Biodiesel-production of biodiesel by trans-esterification, mechanism of acid catalyzed reaction and alkali catalyzed reactions. Advantages and disadvantages of biodiesel. Fuel cell technology eg: CH_3OH – O_2 fuel cell.

Solar Energy – P.V.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.

Self study: Information on Wind Energy

UNIT – IV

Polymer materials L – 10 Hours, T – 6 Hours

Introduction, definitions, classification, polymerization types. Mechanism of polymerization- Cationic/Anionic polymerizations of styrene. Molecular weight of polymers- Number average and weight average methods, numerical problems. Glass transition temperature and factors affecting. Synthesis, properties and applications of; i) Epoxy resin ii) Silicon rubber iii) PLA iv) PET.

Conducting polymers – Definition, Mechanism of conduction in polyacetylene and applications, Graphene – introduction, Mechanism of conduction in graphene and applications.

Self study: Polymer membranes and their applications

Dyes

Introduction, definition, sensation of colour, classification based on applications of dyes. Theories of dyes- Wit theory, Electronic theory, Relationship of absorbed and visible colours. Synthesis, Properties and applications of; i) Azo dyes

Fluorescent dyes – Introduction, Classification, flurophores and their bio-Applications.

Self study: Information on food dyes with example and applications

Text Books:

1. Engineering Chemistry, 2nd Edn., by Dr. Suba Ramesh etal., 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. Environmental Chemistry with Green Chemistry, 1st Edn., by Dr. A. K. Das, Books & Allied (P) Ltd, Kolkata, 2012.
5. Green organic Chemistry, 1st Edn., by Kenneth Doxsee & James Huchison, Thomson-Brooks/Cole, 2004.
6. Polymer Science,1st Edn., by V. R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar, New Age International Publication, 1986.
7. Introduction to Bio fuels,3rd Edn., by David M. Mousdale, CRC Press,2017.
8. Bio fuels 1st Edn., by Wim Soetaert, Erick J. Vandamme, Wiley Series,2009.
9. Industrial chemistry, 14th Edn., by Dr. B. K. Sharma, vol.1, Goel Publishing House, Meerut, 2004.
10. Organic Chemistry, 14th Edn., by I. L. Finar, Vol.-1, Pearson Publications, 2013.
11. Electrical conduction in Graphene & Nanotubes,1st Edn., by Dr. Shigeji Fujita, Dr. Akira Suzuki Wiley Publisher 2013.

Laboratory Experiments for the year 2020 – 21

UCH172L/UCH272L: ENGINEERING CHEMISTRY LABORATORY

1.5 Credits (0 – 0 – 3)

PART – A

1. Determination of viscosity of liquid by Ostwald's Viscometer.
2. Potentiometric estimation of Iron in the given solution using standard $K_2Cr_2O_7$ solution.
3. Determination of pKa of a weak acid by standard NaOH using pH meter.
4. Conductometric estimation of HCl & CH_3COOH in acid mixture by Standard NaOH.
5. Colorimetric estimation of copper in the given solution.

PART – B

6. Preparation standard solution and Standardization of a given solution.
7. Determination of total hardness of a given water sample by EDTA method.
8. Determination of amount of CaO in the cement solution by EDTA method.
9. Determination of alkalinity of water sample by duel indicator method.
10. Determination of amount of Fe in a given solution using standard $K_2Cr_2O_7$ solution.

Reference Books:

1. Laboratory manual in Engineering Chemistry by 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, 4^{th} Edition.
3. Practical Engineering Chemistry by Sunita & Ratan Pub: S.K.Kataria & Sons.