

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

I/II SEMESTER B.E. ENGINEERING CHEMISTRY SYLLABUS BLOW UP

(With effect from the Academic year – 2006-07)

Sub Code : 06CHE-12/06CHE-22

IA Marks : 25

Hrs/Week : 04

Exam Hours : 03

Total Hrs. : 52

Exam Marks : 100

PART – A

Unit I

Chemical Energy Sources

Introduction to energy; Fuels - Definition, Classification based on the physical state and occurrence with examples; Importance of hydrocarbons as fuels. Calorific value - definition, classification - Gross and Net calorific values, units (S.I). Experimental determination of calorific value of a solid and liquid fuels by using Bomb Calorimeter, numerical problems. Petroleum cracking - Definition, Fluidized catalytic cracking. Reformation of petrol – explanation with reactions. Octane Number, Cetane Number. Knocking – mechanism, prevention of knocking - anti-knocking agents – Unleaded petrol. Synthetic petrol – Bergius process and Fishcher Tropsch process. Power alcohol.

5 Hours

Solar Energy

Introduction, Photovoltaic cells – Introduction, Definition, importance. Properties of silicon relevant to photovoltaics, production of solar grade silicon by chemical vapour deposition method, purification by zone refining. Doping of silicon. Working of a PV cell.

2 Hours

Unit II

Electro Chemical Energy Systems – Electrode potential and cells

Single electrode potential – Definition, Origin – Helmholtz Electrical double layer. Standard electrode potential – Definition. Sign conventions. Derivation of Nernst Equation Electro Chemical Conventions. Construction of Galvanic cell – classification – primary, secondary and concentration cells. E.M.F of a cell – definition, notation and conventions. Measurement of single electrode potential; Numerical problems on electrode potential and E.M.F.

Types of electrodes - Reference electrodes – definition, limitations of primary reference electrode and the need for developing secondary reference electrodes. Calomel electrode - construction, cell representation, electrode reactions and applications; Ag/AgCl electrode - construction, electrode reactions and applications;

Ion selective electrodes – definition; Glass electrode – construction, cell representation, electrode reactions, advantages and limitations; Determination of pH of a solution using glass electrode.

6 Hours

Unit III

Conversion and Storage of Electro Chemical Energy

Battery Technology

Batteries – Introduction, Basic concepts – principal components of a battery, operation of a battery during discharge and charge. Battery characteristics – voltage, current, capacity, electricity storage density, energy density, power density, energy efficiency, cycle life and shelf life. Classification of batteries – Primary, Secondary and Reserve batteries with examples. Classical batteries – construction, working and applications of Lead acid and Ni – Cd batteries; Modern batteries – construction, working and applications of Zn – Air, Ni – Metal hydride and Lithium – MnO₂ batteries.

5 Hours

Fuel Cells

Fuel cells - Introduction, Definition, differences between a battery and a fuel cell and advantages. Types of fuel cells - Alkaline, Phosphoric acid, Molten carbonate, Solid polymer electrolyte and Solid oxide fuel cells – Mention of electrode materials, electrolyte used and one or two applications (construction and reactions are not insisted). Construction, working and applications of H₂ – O₂ and Methanol - O₂ fuel cells.

Unit IV

Corrosion Science

Corrosion – Definition; Chemical corrosion (Dry) and Electrochemical corrosion (Wet), Theory of electrochemical corrosion taking Iron as an example.

Types of corrosion – Differential metal corrosion – Concept of electrode potential difference; Differential aeration corrosion – concept of medium having different oxygen concentration – e.g. pitting corrosion and water line corrosion; Stress corrosion – concept of higher potential at stressed areas e.g. Caustic embrittlement.

Factors affecting the rate of corrosion – Related to nature of metal: Potential of electrode, relative areas of anodic and cathodic parts, hydrogen over voltage, tendency to form protective films and nature of corrosion product. Related to nature of environment: pH of the medium, temperature, humidity of air, conductance of medium, presence of chemicals in atmosphere (CO₂, H₂S, SO₂, Fumes of HCl, H₂SO₄ etc.)

4 Hours

Corrosion Control

Protective coatings - Inorganic coatings – (i) Anodizing – meaning, anodizing of Al and applications and (ii) Phosphating – process and applications;

Metal coatings – (i) Galvanization (anodic metal coating) and (ii) Tinning (cathodic metal coating).

Corrosion inhibitors – Definition, Anodic inhibitors and cathodic inhibitors. Cathodic protection – Sacrificial anodic method and Impressed voltage method & Anodic protection.

2 Hours

PART – B

Unit V

Metal Finishing

Introduction, Technological importance of metal finishing – To impart - corrosion resistance, particular physical and mechanical properties to the surface (e.g. electrical conductivity, heat, abrasion, wear and thermal resistance); In manufacturing of electronic components – PCBs, capacitors and conductors; Electroforming, electrochemical machining, electropolishing and electrochemical etching.

Polarization, Decomposition potential and Over voltage – explanation and their applications with reference to the electro deposition of the metals.

Electroplating process – Principle components of an electroplating process – Electroplating bath, cathode, anode (soluble or insoluble), an inert vessel, D.C. electrical power source.

Effects of plating variables on the nature of electro deposit – Metal ion concentration, electrolytes, complexing agents, organic additives (brighteners, levelers, structure modifiers and wetting agents), current density, pH, temperature and throwing power.

Surface preparation – Importance: steps - (i) Removal of organic substances – Degreasing – use of organic solvents and alkaline solution, (ii) Removal of inorganic substances – Descaling processes – Grinding, polishing, sand blasting and pickling & (iii) Rinsing with water.

Electroplating of Cr and Au – Bath composition, additives, pH, current density, current efficiency, temperature, anode, cathode (including reactions) and applications.

4 Hours

Electroless plating

Meaning, Distinction between electroplating and electroless plating (Driving force, anodic and cathodic reactions, site of anode and cathode reactions and nature of deposit). Advantages of electroless plating.

Electroless plating of Copper on PCB and Nickel on Al and other metals – bath composition, additives, pH, temperature, anodic and cathodic reactions and applications.

2 Hours

Unit VI

Liquid Crystals and their Applications

Introduction, meaning, positional and orientational order in solid, liquid crystals and liquids. Classification – Thermo tropic and Lyo tropic with examples. Types of mesophases - Nematic, Chiral nematic (Cholesteric), Smectic and Columnar – molecular ordering with examples. Liquid crystalline behaviour in homologues series - PAA and MBBA series. Applications of liquid crystals in display systems – explanation of display working, mention of LCD devices.

4 Hours

Instrumental Methods of Analysis

Theory, Instrumentation and applications of Colorimetry. Potentiometry and Conductometry.

2 Hours

Unit VII

High Polymers

Polymers – Definition, classification – Natural and Synthetic with examples; Polymerization – Definition, types of polymerization – addition and condensation with examples. Mechanism of polymerization – Free radical mechanism by taking the formation of polyethylene as an example – Initiation, Propagation and Termination - coupling & disproportionation. Methods of polymerization – Bulk, Solution, Suspension and Emulsion polymerization. Glass transition temperature(Tg) – meaning, parameters affecting Tg - Flexibility, intermolecular forces, molecular mass, branching and cross linking and presence of plasticizers; Significance of Tg; Structure and property relationship – strength, crystallinity, elasticity, deformation and chemical resistivity. Resins and plastics – Meaning, distinction between resins and plastics; Compounding of resins – Incorporation of additives such as plasticizers, fillers, accelerators, colourants, stabilizers and their significance. Synthesis, properties and applications of Teflon, PMMA, Polyurethane and Phenol – formaldehyde resins. Elastomers – deficiencies of natural rubber and advantages of synthetic rubber; Synthesis and applications of Neoprene and Butyl rubber. Adhesives – Manufacture and applications of Epoxy resins. Conducting polymers – Introduction, definition, mechanism of conduction in Polyacetylene; Structure and applications of conducting Polyaniline.

7 Hours

Unit VIII

Water Technology

Natural sources of water - impurities in water – Dissolved, suspended, colloidal and biological. Water analysis – Determination of different constituents in water – Hardness – Definition, types of hardness, units of hardness and its determination by EDTA method – numerical problems; Alkalinity – Definition and its determination by phenolphthalein and methyl orange indicator method – numerical problems; Determination of Chloride by Mohrs (Argentometric) method, Fluoride by SPADNS method, Nitrate by Phenol disulphonic method and Sulphate by Gravimetric method; Determination of Dissolved Oxygen by Winklers method. Biological Oxygen Demand – Definition, determination and numerical problems; Chemical Oxygen Demand – Definition, determination and numerical problems. Sewage treatment – Primary treatment, Secondary treatment by activated sludge method and Tertiary treatment.

Potable water – Meaning, purification of water by Flash evaporation, Electro dialysis and Reverse Osmosis. Hazardous chemicals – Compounds of Cd, As, Pb, & Hg with ill effects.

7 Hours