CY6151

ENGINEERING CHEMISTRY - I

OBJECTIVES

- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photo physical and photochemical Processes and spectroscopy.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I POLYMER CHEMISTRY

Introduction : Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting.Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (FreeRadical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.

UNIT II CHEMICAL THERMODYNAMICS

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore(problems).

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry : Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Quantum efficiency – determination- Photo processes - Internal Conversion, Intersystemcrossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitization.Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational androtational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagramonly).

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UNIT IV PHASE RULE AND ALLOYS

Phase rule : Introduction, definition of terms with examples, One Component System- water system- Reduced phase rule - Two Component Systems- classification – lead-silver system, zincmagnesium system. Alloys: Introduction- Definition- Properties of alloys- Significance of alloying, Functions and effect of alloying elements- Ferrous alloys- Nichrome and Stainless steel – heattreatment of steel; Non-ferrous alloys – brass and bronze.

UNIT V NANOCHEMISTRY

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrode position, chemical vapour deposition, laser ablation; Properties and applications.

TOTAL : 45 PERIODS

OUTCOMES

The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

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CHEMISTRY LABORATORY-I

GE6163

OBJECTIVES

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by vacometry.

LIST OF EXPERIMENTS

(Any FIVE Experiments)

- 1 Determination of DO content of water sample by Winkler's method.
- 2 Determination of chloride content of water sample by argentometric method.
- 3 Determination of strength of given hydrochloric acid using pH meter.
- 4 Determination of strength of acids in a mixture using conductivity meter.
- 5 Estimation of iron content of the water sample using spectrophotometer.
 (1,10- phenanthroline / thiocyanate method).
- 6 Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
- 7 Conductometric titration of strong acid vs strong base.

TOTAL: 30 PERIODS

OUTCOMES

The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

ENGINEERING CHEMISTRY – II

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CY6251

OBJECTIVES

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- Principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.

UNIT I WATER TECHNOLOGY

Introduction to boiler feed water-requirements-formation of deposits in steam boilers and heat exchangers- disadvantages (wastage of fuels, decrease in efficiency, boiler explosion) prevention of scale formation -softening of hard water -external treatment zeolite and demineralization -internal treatment- boiler compounds (phosphate, calgon, carbonate, colloidal) - causticembrittlement -boiler corrosion-priming and foaming- desalination of brackish water –reverseosmosis.23

UNIT II ELECTROCHEMISTRY AND CORROSION 9

Electrochemical cell - redox reaction, electrode potential- origin of electrode potential oxidationpotential- reduction potential, measurement and applications – electrochemical series and itssignificance - Nernst equation (derivation and problems). Corrosion- causes factors- typeschemical, electrochemical corrosion (galvanic, differential aeration), corrosion control - materialselection and design aspects - electrochemical protection – sacrificial anode method andimpressed current cathodic method. Paints- constituents and function. Electroplating of Copper and electroless plating of nickel.

UNIT III ENERGY SOURCES

Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generatorclassification of nuclear reactor- light water reactor- breeder reactor- solar energy conversionsolar cells- wind energy. Batteries and fuel cells: Types of batteries

alkaline battery- lead storage battery- nickel-cadmium battery- lithium battery- fuel cell H₂ -O₂ fuel cell- applications.

UNIT IV ENGINEERING MATERIALS

Abrasives: definition, classification or types, grinding wheel, abrasive paper and cloth. Refractories: definition, characteristics, classification, properties – refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, porosity; Manufacture of alumina, magnesite and silicon carbide, Portland cement- manufacture and properties - setting and hardening of cement, special cement- waterproof and white cement–properties and uses. Glass -manufacture, types, properties and uses.

UNIT V FUELS AND COMBUSTION

Fuel: Introduction- classification of fuels- calorific value- higher and lower calorific values coalanalysis of coal (proximate and ultimate)- carbonization- manufacture of metallurgical coke (OttoHoffmann method) - petroleum- manufacture of synthetic petrol (Bergius process) knockingoctane number - diesel oil- cetane number - natural gas- compressed natural gas(CNG)- liquefied petroleum gases(LPG)- producer gas- water gas. Power alcohol and bio diesel. Combustion of fuels: introduction- theoretical calculation of calorific value- calculation of stoichiometry of fuel and air ratio- ignition temperature- explosive range - flue gas analysis (RSAT Method).

TOTAL: 45 PERIODS

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OUTCOMES

The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

CHEMISTRY LABORATORY – II

GE6262

OBJECTIVES

• To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

LIST OF EXPERIMENTS (Any FIVE Experiments)

- 1 Determination of alkalinity in water sample
- 2 Determination of total, temporary & permanent hardness of water by EDTA method
- 3 Estimation of copper content of the given solution by EDTA method
- 4 Estimation of iron content of the given solution using potentiometer
- 5 Estimation of sodium present in water using flame photometer
- 6 Corrosion experiment weight loss method
- 7 Conductometric precipitation titration using BaCl₂ and Na₂SO₄
- 8 Determination of CaO in Cement.

TOTAL: 30 PERIODS

OUTCOMES

• The students will be conversant with hands-on knowledge in the quantitative chemical analysis of water quality related parameters, corrosion measurement and cement analysis.