

S.Y.B.Sc.

INDUSTRIAL CHEMISTRY

COURSE NO. : I.C. – 201 (3 Hours , 80 Marks)

SUBJECT : INTRODUCTION TO CHEMICAL INDUSTRIES AND POLLUTION

Unit 1 : Fossil fuels, their classification, analysis of coal, pulverisation of coal, bomb calorimeter, carbonization of coal, distillation of tar.

Gaseous fuels- coal gas, producer gas, water gas, blast furnace gas, natural gas, LPG.

Unit 2 : Ceramic industries : raw materials, white wares, structural clay products.

Refractory : classification, properties and manufacture of important refractories, their selection and failure. Cement : Portland cement, other cements, manufacture and uses.

Glass : raw materials, types of glasses, manufacture, properties and uses.

Unit 3 : Corrosion – theories of corrosion, corrosion reactions, special corrosions, factors affecting corrosion rate, protection against the corrosion, protective coatings and surface preparation, metallic inorganic and organic coatings, paint manufacture, characteristics of oil and pigment.

Unit 4 : Mechanical Properties of materials, Heat Treatment processes,

Metals and Alloys : important metals and alloys- iron, copper, aluminium, lead, nickel, titanium and their alloys- mechanical and chemical properties, applications.

Unit 5 : Air pollution – sources, effect of CO, NO_x, SO_x, O₃, particulates and Pb on environment, material damage due to air pollution.

Solid waste management – collection and disposal – sanitary landfill, open dumping, incineration, composting.

Emission controls of particulates by Cyclone, Electrostatic precipitator, Fabric filter bag house.

Unit 6 : Pollution – introduction, types of pollution, sources of pollution, water pollution, source of water pollution, waste water treatments- primary treatments (screening, flocculation/coagulation, sedimentation, filtration and disinfection, secondary treatments (biological treatments – trickling filters, activated sludge), chemical treatments (neutralization, chemical precipitation), BOD , COD and DO analysis of polluted water.

REFERENCE BOOKS :

1. Chemistry of Engineering Materials by C. V. Agrawal (Tara Publication)
2. Shreve's Chemical Process Industries by Austin (McGraw-Hill Publication, New Delhi)
3. Environmental Chemistry by B. K. Sharma (Krishna Prakashan Media (P) Ltd., Meerut)
4. Environmental Pollution Control Engineering by C. S. Rao (Wiley Eastern Ltd., New Delhi)
5. Engineering Chemistry by Jain and Jain (Dhanpat Rai and Sons)
6. Outlines of Chemical Technology by Charles Dryden (Affiliated East West Private Ltd.)
7. Introduction to Environmental Engineering and Science by G. M. Masters

COURSE NO. : I.C. – 202 (3 Hours , 80 Marks)**SUBJECT : CHEMICAL PROCESS PRINCIPLES & APPLIED THERMODYNAMICS**

Unit 1 : Molal units in computation, Basis of calculations, Units for composition of systems, Sp. Gravity, Behaviour of gaseous mixtures, volume changes with change in composition, adsorption, adsorbent and adsorbates, chemisorptions and physical adsorption, adsorption isotherms, application of adsorption.

Unit 2 : Vaporization and vapour pressure, boiling points, vapour pressure of solids, effect of temperature on vapour pressure. Critical properties and their estimation, vapour pressure of immiscible liquids. Vaporization with superheated steam, vapour pressure of solution, saturated and unsaturated vapour-gas mixture, vaporization and condensation, humidity chart.

Unit 3 : Elementary concepts of unit operations and unit processes, flow sheet preparation, concept of mass balance and types of mass balance problems. Strategy and guide for mass balance calculations. Mass balance calculations for processes without and with chemical reactions. Recycle operation and purge operation, by pass operation. Calculations based on above topics.

Unit 4 : Energy balance for batch and continuous processes, heat capacity and specific heat, energy balance calculations, heat engines, temperature scales, entropy, combustion and calorific value of fuels, combustion calculations, fuel gas analysis.

Unit 5 : Compression equipments, reciprocating compressor, work of single stage compressor, effect of clearance, volumetric efficiency, multistage compression.

Refrigeration, COP & refrigerating effect, industrial refrigerants, Carnot and other refrigeration cycles.

Unit 6 : Water- Impurities and hardness of water, water for steam making and industrial processes, boiler water treatments, calculations on water treatments. Steam boilers – their classification, mountings and accessories, steam generation, conditions of steam, steam table. Internal combustion engines and external combustion engine, calculation of ideal work and lost work.

REFERENCE BOOKS :

1. Chemical Process Principles: Part I – By Haugen, Waston and Regatz (Asia Pub. House)
2. Stoichiometry : By B. L. Bhatt & Vora S. M. (Tata McGraw- Hill Publication)
3. Introduction to Chemical Engineering Thermodynamics (IV edition) by J. M. Smith & Vanness, (McGraw-Hill Co.)
4. Basic Principles & Calculation in Chemical Engineering by David M Himmelblan (Prentice Hall Inc.)
5. Chemical Process Calculation (Stoichiometry) by K. A. Gavhane (Nirali Prakashan-Pune)
6. Chemistry of Engineering Materials by C. V. Agrawal (Tara Publication)

COURSE NO. : I. C. – 203 (3 Hours, 80 Marks)

PRACTICALS

1. Water Analysis : suspended solids, total dissolved solids, carbonates and bicarbonate, sulphate as BaSO_4 , chloride content, calcium and magnesium determination, acidity and total hardness.

2. Cement Analysis : loss on ignition, total insoluble residue, silica, oxide, calcium, magnesium estimation in the given cement sample.

3. Four to Five experiments based on;

- a. Qualitative organic mixture of binary compounds.
- b. Semi-micro inorganic qualitative analysis of compound containing four radicals.

4. Instrumentation experiments :

Experiments based on the use of conductometer, pH meter, Colorimeters and Chromatography.

COURSE NO. : C-211 (3 Hours, 80 Marks)

SUBJECT : ORGANIC CHEMISTRY - I

UNIT I FUNDAMENTAL ASPECTS IN ORGANIC CHEMISTRY*

Hybridization, sigma and pi bonds, hydrogen bond, inductive effect, electronic effect, resonance effect, hyperconjugation, steric effect, acid and bases, definition, structure and stability of free radical, carbocation, carbanion and benzyne, energy profiles.

UNIT II ALCOHOLS, ETHERS AND EPOXIDES**

Alcohols- Structure, classification, nomenclature, preparation, physical properties, reactions, alcohols as acids and bases, synthesis using alcohols, formation of 1,2-diols, analysis of 1,2-diols, pinacol rearrangement, oxidation cleavage of polyhydroxy alcohols.

Ethers- Structure, nomenclature, preparation, physical properties, reactions, cyclic ethers.

Epoxydes- Preparation and reactions.

UNIT III PHENOLS**

Structure, nomenclature, preparation, physical properties, salts of phenol, acidity of phenols, reactions, Fries rearrangement, Claisen rearrangement.

UNIT IV ALDEHYDES AND KETONES & *****

Structure, nomenclature, preparation, physical properties, nucleophilic addition reactions, Aldol and cross Aldol condensation, Perkin condensation, Koevenagel condensation, Wittig reaction, Mannich reaction, oxidation, reduction, Cannizzaro and cross cannizzaro reaction, Meerwein-Ponndorf Verlie reduction, Clemmenson reduction, Wolff Kishner reduction, base promoted halogenation of ketones, acid catalyzed halogenation of ketones.

UNIT V CARBOXYLIC ACIDS AND THEIR DERIVATIVES & #**

Structure, nomenclature, preparation, physical properties, salts of carboxylic acids, acidity of carboxylic acids, effect of substituents on acidity, reactions, reactions of acid chloride, acid anhydrides, amides and esters. Preparation of malic acid and tartaric acid from maleic acid, preparation of citric acid from glycerol, preparation of unsaturated acids - acrylic acid and crotonic acid.

UNIT VI AMINES AND DIAZONIUM SALTS**

Amines- Structure, nomenclature, preparation, Hoffman rearrangement, physical properties, salts of amines, basicity of amines, effect of substituents on basicity, reactions, Hoffman elimination, analysis of amines, phase transfer catalyst.

Diazonium salts- Synthesis, reaction and characteristics, benzidine rearrangement, synthesis of Congo Red dye, sulfa drugs.

REFERENCE BOOKS

- * Organic Chemistry by M. K. Jain and S. C. Jain (Shoban LAI Nagin Chand & Co. Educational Publishers, Jalandhar).

- ** Organic Chemistry by Robert T. Morrison and Robert T. Boyd (VIth Edition, Prentice Hall of India Pvt. Ltd. New Delhi)
- *** Organic Chemistry by R. K. Bansal (Tata McGraw – Hill Publishing Co. Ltd. New Delhi)
- # Text Book of Organic Chemistry by B.S. Bahal and Arun Bahal (S. Chand & Co. Ltd., New Delhi)

COURSE NO. : C – 212 (3 Hours, 80 Marks)

SUBJECT : INSTRUMENTAL ANALYSIS

Unit 1 : The measurement of pH – introduction and determination of pH, applications, Potentiometric titrations – introduction, types of titrations, advantages of potentiometric titrations.

Conductometric measurements – introduction, some important laws, definition and relations, effect of dilution, applications of conductance measurements, types of titrations, advantages and disadvantages.

Unit 2 : Chromatography : introduction, classification, paper chromatography, experimental details for qualitative analysis, experimental details for quantitative analysis, applications.

Thin layer chromatography – superiority of TLC over the other techniques, experimental techniques, applications, limitations, scope.

Column chromatography – introduction, experimental details, theory of development, factors affecting column efficiency, applications.

Unit 3 : HPLC, GC, Ion exchange techniques – instruments involved, sampling methods and applications.

Unit 4 : Visible spectrophotometry and Colorimetry – introduction, theory of spectrophotometry and colorimetry, deviation from Beer's Law, instrumentation, applications, molar composition of complexes and quantitative analysis.

Ultra Violet Spectroscopy – introduction, origin and theory of ultraviolet spectra, choice of solvent, instrumentation, applications.

Introduction to Mass Spectroscopy.

Unit 5 : IR – introduction, range of infrared radiation absorption, theory of IR, instrumentation, applications to quantitative analysis, limitations.

NMR – introduction, quantum description of NMR, instrumentation, chemical shift, spin-spin coupling, applications and limitations.

Unit 6 : Thermal methods – introduction, TG, DTA, thermometric titrations, DSC-introduction, instrumentation and applications.

REFERENCE BOOKS :

1. Instrumental Methods of Chemical Analysis by Chatwal – Anand. (Himalaya Publishing House)
2. Instrumental Methods of Chemical Analysis by B. K. Sharma(Krishna Prakashan Media(P) Ltd, Meerut)
3. Organic Spectroscopy by William Kemp (Macmillan Press Ltd., - London)
4. Analytical Chemistry by Gary D. Christian (Vth edition – Wiley & Sons, Inc.)

COURSE NO. : C – 214 (3 Hours, 80 Marks)

SUBJECT: CHEMICAL PROCESS INDUSTRIES

Unit 1: Nitrogenous products – Manufacture and study of properties of synthetic nitrogen products and miscellaneous inorganic chemicals such as ammonia, hydroamine, iodine, fluorine, fluorocarbon and various types of nitrogenous fertilizers such as urea, ammonium sulphate, ammonium nitrate, calcium ammonium nitrate.

Unit 2: Chlor-alkali industries – manufacture of caustic soda by membrane cell method and by lime soda process, soda ash, sodium hypochlorite and chlorine.

Industrial Gases – Hydrogen, Oxygen, Nitrogen, Carbon dioxide, Sulphur dioxide.

Unit 3: Electro thermal industries- introduction, uses and economics of furnaces and their classification, manufacture of silicon carbide, calcium carbide, boron carbide, boron nitride, synthetic graphite, carbon electrode.

Electrochemical industries – magnesium anhydrous, $MgCl_2$, MgO , hydrogen peroxide, potassium permanganate, hydroxyl amine.

Unit 4: Fermentation – introduction, definition, culture development, inoculums preparation, nutrients for micro organism, toxic effects on culture, manufacture of industrial alcohol, absolute alcohol, vinegar.

Unit 5: Phosphorus industries – raw materials, manufacture of phosphorus, phosphoric acid, ammonium phosphate, super phosphate.

Introduction to Agrochemical industries

Unit 6: Catalysis – types-Homogeneous & Heterogeneous, basic principles, mechanism, factors affecting the performance, phase transfer catalysis, enzyme catalysis reactions, industrially important reactions, Industrially important catalysts – their classification and preparation.

Quality control – Quality control of products, concept of quality, important of quality, quality decision, quality management, quality cost, quality assurance, reliability, ISO 9001: 2000

REFERENCE BOOKS:

1. Industrial Chemistry by B. K. Sharma. (Krishna Prakashan Media (P) Ltd., Meerut)
2. Shreve's Chemical Process Industries by G. T. Austin (McGraw-Hill Book Company, New Delhi)
3. Riegel's Hand Book of Industrial Chemistry by James A Kent (CBS Publishers & Distributors – New Delhi)
4. Industrial Microbiology by A. H. Patel (Macmillan India Ltd. – New Delhi).
5. Products of Operation management by S. A. Chnnawalla and Dr. Patel, (Himalaya Publishing House)