JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2021 BATCH AND THEREAFTER

Programme: B.Sc.
CHEMISTRY-I

Semester: I **Course Code: 21ICH1**

No. of Hours: 60

Course Objectives (COs):

At the end of the course the student should be able to:

1. Apply concepts of accuracy, precision and errors in laboratory work and be able to handle toxic chemicals, concentrated acids and organic solvents following appropriate safety procedures in the laboratory
2. Perform volumetric analysis and prepare organic compounds by single and double steps.
3. Summarise preparation of alkanes, alkenes and alkynes and their reactions.
4. Explain fundamental principles of quantum chemistry and apply them to solve problems on uncertainty principle and matter waves.
5. Set up the Schrodinger wave equation for a particle in a one-dimensional box and interpret the results
6. Illustrate the principles behind writing electronic configuration of atoms with elements upto atomic number 30
7. Illustrate the concept of periodicity of properties w.r.t. atomic, ionic and covalent radii, ionization energy, electron gain enthalpy and electronegativity in the s and p blocks.
8. Compare the chemistry of hydrides, carbides, oxides and halides of p-block compounds.
9. Explain the reactivity of organic species and the mechanisms of elimination reactions establishing a firm foundation for the study of organic chemistry

Learning Outcomes (LOs):

At the end of the course the student will be able to:

1. Apply concepts of accuracy, precision and errors in laboratory work, prepare a standard solution and perform a volumetric analysis and prepare organic compounds in a single step or two steps.
2. Formulate a method of preparation for a given alkane, alkene or alkyne and describe its reactions.
3. Explain postulates of quantum chemistry and derive the time independent Schrodinger wave equation as well as the Schrodinger wave equation for a particle in a one-dimensional box.
4. Explain and illustrate radial and angular wavefunctions for 1s, 2s and 2p
5. Illustrate the principles behind writing electronic configuration of atoms with elements upto atomic number 30
6. Discuss the periodicity of atomic, ionic and covalent radii, ionization energy, electron gain enthalpy and electronegativity in the s and p blocks. Compare the chemistry of hydrides, carbides, oxides and halides of p-block compounds.

7. Explain the reactivity of organic species and the mechanisms of elimination reactions establishing a firm foundation for the study of organic chemistry.

UNIT I **15 HOURS**

Basic laboratory practices, calibration of glassware (pipette, burette and volumetric flask), Sampling (solids and liquids), weighing, drying, dissolving. Acid treatment. Rules of work in analytical laboratory, General rules for performing quantitative determinations (volumetric and gravimetric). Safety in Chemical laboratory. Rules of fire prevention and accidents. First aid. Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents. **4hrs**

Language of analytical chemistry: Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques.

Choice of an analytical method. Significant figures.

Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples -mean, median, range, standard deviation and variance. External standard calibration - regression equation (least square method), correlation coefficient (R^2). Numerical problems. **8hr**s

Accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ), linear dynamic range (working range). **3hrs**

UNIT- II **15 HOURS**

Limitations of classical mechanics. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance. Quantum Mechanics. Schrödinger's wave equation, derivation (time independent). Significance of ψ and ψ^2. Eigen values and functions. Applications of Schrödinger's wave equation - Particle in a one-dimension box. **5hrs**

Quantum numbers and their significance. Quantum mechanical operators- (i) Hamiltonian operator; (ii) Laplacian operator. Normalized and orthogonal wave functions. Sign of wave functions. Postulates of quantum mechanics, Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. **7hrs**

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations. Electronic configurations of the elements (Z=1-30), effective nuclear charge, shielding/screening effect, Slater's rules. Variation of effective nuclear charge in Periodic Table. **3hrs**

UNIT -III **15 HOURS**

s, p, d and f-block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block elements:

(a) Atomic radii (van der Waals)
(b) Ionic and crystal radii.
(c) Covalent radii
(d) Ionization enthalpy, successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy
(e) Electron gain enthalpy; trends of electron gain enthalpy.
(f) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. **8hrs**

Trends in the chemistry of the compounds of groups 13 to 17 (hydrides, carbides, oxides and halides) are to be discussed. **7hrs**

UNIT- IV **15 HOURS**

Classification and nomenclature of organic compounds(mono and bifunctional, non aromatic), Hybridization, Shapes of organic molecules, Influence of hybridization on bond properties.

2hrs

Nature of bonding in Organic molecules

Formation of Covalent bond, localized and delocalized, conjugation and cross conjugation, concept of resonance, electronic displacements: Inductive effect, Electromeric effect, Resonance and Hyper conjugation, cross conjugation explanation with examples. Concept of aromaticity, Huckel rule, anti-aromaticity, non aromatic explanation with examples. Strengths of organic acids and bases: Factors affecting pK_a values-explanation based on inductive and resonance effects. Relative strength of aliphatic and aromatic carboxylic acids-Acetic acid and chloroacetic acid, acetic acid and propionic acid, acetic acid and benzoic acid, Relative strength of aliphatic and aromatic amines- methylamine and aniline. **5hrs**

Mechanisms of Organic Reactions

Notations used to represent electron movements and directions of reactions- curly arrows, formal charges. Types of bonds breaking- homolytic and heterolytic. Types of reagents- Electrophiles, nucleophiles. Types of organic reactions - substitution, addition, elimination, rearrangement, explanation with examples.

Chemistry of Aliphatic hydrocarbons, Carbon-Carbon Sigma bonds

Preparation of alkanes: Wurtz reaction, Wurtz-Fittig reaction, Corey House reaction, Free radical substitution, Halogenation- relative reactivity and selectivity **4hrs**

Carbon-carbon pi bonds

Formation of alkenes and alkynes by elimination reaction. Mechanism of E_1, E_2, reaction. Saytzeff and Hofmann eliminations. Addition of HBr to propene, Free radical addition of HBr to propene. Addition of halogens to alkenes-carbocation and halonium ion mechanism. Stereospecificity of halogen addition. Ozonolysis mechanism - ozonolysis of propene. Addition of hydrogen halides to alkenes, mechanism, regioselectivity and relative rates of addition. Hydrogenation, hydration, hydroxylation and epoxidation of alkenes, explanation with examples, 1,2 and 1,4- addition reactions in conjugated dienes. Diels-Alder reaction, Allylic and benzylic bromination and mechanism in propene, 1-butene, 1-toluene and

ethylbenzene
4hrs

References

1. Vogel's Textbook of Quantitative Chemical Analysis, J Mendham, R C Denney, J D Barnes and M J K Thomas, 6th edition, Pearson Education Pvt. Ltd.
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York.
3. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India.
4. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK.
5. Principles of Physical Chemistry, B S Puri, L R Sharma, M S Pathania, 48th Edition, Vishal Publishing Co.
6. Atkins' Physical Chemistry, P Atkins, J de Paula, J Keeler, International Eleventh Edition, Oxford Publications.
7. Physical Chemistry, D Ball, 2nd Edition, Cenage Learning.
8. Concise Inorganic Chemistry, J D Lee, 5th Edition, Wiley Publications.
9. Chemistry, R Chang, 9th Edition, Mc Graw Hill Publications
10. Organic Chemistry, R T Morrison, R. N. Boyd, S K Bhattacharjee, 7th Edition. Pearson Education.
11. Solomons's Organic Chemistry, T W G Solomon, C B Fryhle, S A Snyder, International Edition, Wiley Publications.
12. Finar, I. L. Organic Chemistry (Volume I), Pearson Education
13. McMurry, J. E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning.
14. Organic Reaction mechanism by V. K. Ahluwalia and K. Parashar (Narosa Publishers).
15. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. (Narosa Publishers)
16. A Guide book to mechanism in Organic Chemistry by Peter Sykes. Pearson

Practical Course 1: List of Experiments to be conducted

PART-A Analytical Chemistry

1. Calibration of glassware, pipette, burette and volumetric flask.
2. Determination of sodium carbonate and sodium bicarbonate in a mixture.
3. Determination of alkali present in soaps/detergents
4. Determination of iron(II) using potassium dichromate
5. Determination of oxalic acid using potassium permanganate solution
6. Determination of chlorine in bleaching powder using iodometric method.
7. Determination of alkali content in antacids
8. Standardization of silver nitrate and determination of chloride in a water sample

PART-B Organic Chemistry

1. Selection of suitable solvents for Purification/Crystallization of organic compounds.
2. Preparation of acetanilide from aniline using Zn/acetic acid (Green method).
3. Synthesis of p-nitro acetanilide from acetanilide using nitrating mixture.
4. Bromination of acetanilide (i) Conventional method and/or (ii) with ceric ammonium nitrate and potassium bromide (Green method).
5. Preparation of methyl m-nitro benzoate from methyl benzoate by Nitration method
6. Hydrolysis of methyl m-nitrobenzoate to m-nitro benzoic acid (Conventional method)
7. Bromination - Preparation of tribromophenol from phenol.
8. Preparation of dibenzalacetone (Green method).

BSc Semester 1 – Chemistry

Open Elective

Course Objectives (COs):

At the end of the course the student should be able to:

1. Enumerate the macro and micronutrients required for the body and their sources
2. Plan a basic diet for adults with different levels of activity as well as for patients with diabetes mellitus and cardiac issues
3. Explain the analysis of components in milk, coffee, list common preservatives, sweeteners, flavouring and colouring agents
4. Explain classification, qualities, additives in paints. Identify important pigments,
5. Classify dyes and discuss azo dyes
6. Discuss manufacture of fertilizers
7. Classification of polymers

Learning Outcomes (LOs):

At the end of the course the student will be able to:

1. Enumerate the macro and micronutrients required for the body and their sources and plan a basic diet for adults with no disease as well as for patients with diabetes mellitus and cardiac issues
2. Explain the analysis of components in milk, coffee, list common preservatives, sweeteners, flavouring and colouring agents.
3. Explain classification, qualities, additives in paints. Identify important pigments, Classify dyes and discuss azo dyes
4. Discuss manufacture of fertilizers and classification of polymers

Title of the Course: OE-1: CHEMISTRY IN THE WORLD AROUND US

UNIT-I – Food, Nutrition and Diet **15 HOURS**

Definition of food, food as source of nutrients. Dimensions of health and functions of food – Physical, social and mental health. Food guide – Basic food groups, my plate. Nutrient requirements: Factors affecting energy requirements. Basal metabolic rate, factors affecting BMR. Recommended dietary allowances (RDA). Phytonutrients: Sources and functions of

phytates, tannins and polyphenols. **3hrs**

Macronutrients: Major sources of carbohydrates in diet. Composition and nutritive value of specific cereals (wheat, rice, maize, oats, rye & barley) and millets (pearl millet, finger millet, sorghum). Major sources of proteins in diet. Composition and nutritive value of milk, egg and certain beans such as lentils and peas. Toxic constituents of pulses. Major sources of fats in diet. Animal based fats (butter, lard, margarine). Plant based fats (groundnut, sesame, palm, coconut, sunflower, soya bean). Composition and nutritive value of certain nuts and oil seeds (almonds, cashews, walnut, flaxseed). **4hrs**

Micronutrients: Sources, functions, deficiencies and RDA of calcium, phosphorous, magnesium, iron, zinc, fluorine and iodine. Sources, functions, RDA, deficiencies and effect of excess of fat soluble vitamins (A, D, E, K) and water soluble vitamins (thiamine, riboflavin, niacin, B12, folic acid, biotin and vitamin C). **4hrs**

Balanced diet: Concept of balanced diet, food exchange list. Factors affecting meal planning and food related behaviour. Dietary guidelines for Indians and food pyramid. Glycemic index of common foods. Balanced diet for adults having sedentary/moderate/heavy activity. Basic meal plan for patients with Diabetes mellitus and cardiovascular disorder. **4hrs**

UNIT-II **15 HOURS**

Dairy Products, Beverages and Additives

Dairy Products: Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk.

Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, estimation of methyl alcohol in alcoholic beverages.

Food additives

Preservatives: sodium benzoate, propionates, sorbates, disulphites,

Artificial sweeteners: aspartame, saccharin, dulcin, sucralose and sodium cyclamate.

Flavours - Vanillin, alkyl esters (fruit flavours) and monosodium glutamate.

Artificial food colorants: Coal-tar dyes and non-permitted colours and metallic salts. **7hrs**

Chemistry of Cosmetics

What are cosmetics, Ingredients of cosmetics: water, emulsifiers, preservatives, thickeners, emollients, colouring agents, fragrance. Are cosmetics dangerous: Parabens, aluminium, triclosone formaldehyde, phthalates, lead, nano particles: ZnO and TiO_2 **4hrs**

Drugs

Structure and function of: Analgesics: aspirin, morphine; Anthelmintics drug: mebendazole; Antiallergic drug: Chloropheneramine maleate, Antibiotics: Pencillin V, Chloromycetin, Streptomycin; Anti-inflammatory agent: Oxypheno-butazone; Antimalarials: Primazuine phosphate, Chloroquine; Antifertility drug: Norethindrone **4hrs**

UNIT- III Industrial Chemistry **15 HOURS**

Paints & Pigments

White pigments (white lead, ZnO, lithopone, TiO_2). Blue, red, yellow and green pigments. Paints and distempers: Requirement of a good paint. Emulsions, latex; luminescent paints. Fire retardant paints and enamels, lacquers. solvents and thinners for paints.

3hrs Dyes

Colour and constitution (electronic concept). Classification of dyes. Methods of applying dyes to the fabrics. A general study of azo dyes, Mordant brown, Congo red and methyl orange. **3hrs**

Fertilizers

Classification of Fertilizers- Straight Fertilizers, Compound/Complex Fertilizers, Fertilizer Mixtures. Manufacture and general prosperities of Fertilizer products-

Urea and DAP. **2hrs**

Polymers

Types and classification of polymers. Source and general characteristics of natural and synthetic polymers. Typical examples of polymers used as plastics, in textiles, in electronic and automobile components, in the medical and aerospace materials. Problems of plastic waste management. Strategies for the development of environment friendly polymers **3hrs**

Soaps and Detergents

Types, structures and methods of use of soaps and detergents **2hrs**

Corrosion

Types and prevention, corrosion failure and analysis **2hrs**

References

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry- Ashtoush Kar.
3. Analysis of Foods – H.E. Cox: 13.
4. Chemical Analysis of Foods – H.E. Cox and Pearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4thed. New Age International (1998)
6. Physical Chemistry – P l Atkins and J. de Paula – 7thEd. 2002, Oxford University Press.
7. Handbook on Fertilizer Technology by Swaminathan and Goswamy, 6th ed. 2001, FAI.
8. Organic Chemistry by I. L. Finar, Vol. 1 & 2. 9. Polymer Science and Technology, J. R. Fired (Prentice Hall).