JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER

Programme: B.Sc. **Semester: I**

CHEMISTRY PAPER I

Course Code: 18ICH1 **No. of Hours: 60**

COURSE OBJECTIVES: By the end of the course students should be

- Thorough with all basic mathematical concepts required in the study of chemistry and be able to solve numericals based on equations studied.
- Familiar with concepts of Quantum Mechanics including Schrodinger wave equation for H atom and its application to the problem of 'particle in a one dimensional box'
- Able to Classify and write IUPAC names of bi-functional organic compounds.
- Thorough with basic concepts of organic reaction mechanisms, preparation and properties of hydrocarbons and understand stability of Cycloalkanes
- Familiar with techniques involved in qualitative and quantitative analysis
- Able to compare properties of s and p block elements
- Competent in the handling of volumetric glass ware and have expertise in preparation of a standard solution and carrying out a titration. (The laboratory component)

LEARNING OUTCOMES:

On completion of this course, the student should be able to:

- Write IUPAC names of bi-functional organic compounds.
- Understand the working of organic reactions
- Theoretically carry out simple reactions of hydrocarbons based on the properties learned
- Use the principles of Stoichiometry to carry out basic calculations for chemical reactions
- Apply the principles of volumetry in quantitative analysis
- Apply mathematical concepts in understanding physical chemistry
- Better understand the fundamentals of atomic structure.
- Carry out simple titrations to estimate secondary standards of acids, bases, oxidizing and reducing agents.

UNIT I

Chapter 1: MATHEMATICAL CONCEPTS **4 HRS**

Logarithmic relations: $\log_e x = 2.303 \log_{10} x$, $\log mn = \log m + \log n$, $\log m^n = n \log m$, $\log m/n = \log m - \log n$, Problems. Sketching of linear graphs and calculation of slopes (both positive and negative). Differentiation of functions: constant, x^n, $\sqrt{x}$, e^x, a^x, log x, ln x, maxima and minima, partial differentiation. Integration of relevant functions: x^2, 1/x, $1/x^2$, $\sqrt{x}$, sin x, e^x, constant.

Chapter 2: STOICHIOMETRY AND ANALYTICAL CHEMISTRY 11 HRS

Errors: Determinate and Indeterminate, Absolute and relative, Constant and Proportional; Precision and Accuracy, Significant Figures – rules for computing (Involving rounding off, addition, subtraction, multiplication and division). Problems.

Atomic mass, Avogadro number, gram atomic mass, weight average atomic mass, mole and molecular mass, problems. Units of concentration: normality, molarity, molality, mole fraction, and weight percentage. Problems. Equivalent mass: Equivalent mass of acids (HCl, H_2SO_4, H_3PO_4, $H_2C_2O_4$), bases (NaOH, $Ca(OH)_2$), salts (NaCl, Na_2CO_3), oxidizing agents (acidified, alkaline $KMnO_4$, $K_2Cr_2O_7$), Reducing agents (FAS, $FeSO_4$, $Na_2S_2O_3$) Problems.

Qualitative and quantitative analysis: Definition, Calibration of volumetric glassware (Burette, pipette and standard volumetric flask). Principle of volumetric analysis: Primary Standards – Conditions, Examples (PHP, Potassium dichromate, Oxalic acid, Zinc Sulphate and Sodium Chloride) and Secondary standards, Examples (NaOH, HCl, FAS, Potassium permanganate, EDTA, Silver Nitrate).

Types of Volumetric Analysis: (i) Acid base: Titration curve (pH vs. Volume of titrant), Theory of acid base indicators - Phenolphthalein, Methyl Orange. PHP vs. NaOH titration. (ii) Redox: Titration curve (Potential vs. volume of titrant), Redox indicators: Internal (Barium diphenylamine sulphonate), external (Potassium ferricyanide) and self indicators (Potassium permanganate). FAS vs. Potassium dichromate titration, Oxalate vs. Permanganate titration. (iii) Precipitation: Titration curve (Solubility product vs. volume of titrant), Argentometric titration: Mohr's indicator (potassium chromate), Silver nitrate vs. Chloride titration. (iv) Complexometric: Titration (only mention to be made)

UNIT II

Chapter 3: ATOMIC STRUCTURE & QUANTUM MECHANICS 10 HRS

Brief introduction. Derivation of expressions for radius and energy of Hydrogen atom, calculation of ionization energies of hydrogen and hydrogen like atoms (Li^{2+}, He^{+}). Idea of de Broglie matter waves, Heisenberg uncertainty principle, problems. Compton effect. Postulates of Quantum mechanics, wave equation, Hamiltonian operator, Eigen value and Eigen function, Schrödinger wave equation, Significance of Ψ, Ψ^2. Application of Schrödinger wave equation to i) a particle in one dimensional box with derivation ii) Hydrogen atom in terms of Cartesian co-ordinates (no derivation), conversion of Cartesian

co-ordinates into polar co-ordinates, Schrödinger wave equation in terms of polar co-ordinates, radial and angular wave functions, qualitative probability distribution curves of 1s, 2s, 2p, 3s, 3p and 3d.

UNIT III

Chapter 4: COMPARATIVE STUDY OF S AND P BLOCK ELEMENTS 10 HRS

s-block elements: comparative study of s-block elements w. r. t atomic size, melting and boiling points, ionization energy, electron affinity, electronegativity and flame colour. Solvation (H_2O and NH_3) of *s*–block element ions, complexation tendencies with reference to crown ethers (dibenzo-18-crown-6, dicyclohexyl-18-crown-6, benzo-12-crown-4) and cryptates (cryptand-222). Formation of organometallic compounds of alkali metals-preparation of $LiCH_3$, structure of tetrameric $LiCH_3$. Anomalous properties of Lithium-Differences between lithium and other alkali metals. Biological importance of alkali metals.

p-block elements: comparative study of groups 13-17 w. r. t atomic size, melting and boiling points, ionization energy, electron affinity, electronegativity.

Diagonal relationship between Li and Mg, Be & Al and B & Si and its cause.

Group16 (Chalcogens): Hydrides (thermal stability, covalent character, acidic character), Oxides: formation of monoxide, dioxide, trioxide and heptoxide, structure of SO_2 and SO_3 (gaseous), Oxyacids of Sulphur: Structure of H_2SO_3 and H_2SO_4. Anomalous properties of oxygen: dissimilarities with other elements of group 16 – physical state, oxidation state, covalency, existence of hydrogen bonding, nature of hydride.

Group 17 (Halogens): Hydrogen halides - formation, acidic properties, covalent character. Anomalous properties of fluorine: dissimilarities with other elements of group 17.

UNIT IV

Chapter 5: CLASSIFICATION AND NOMENCLATURE OF ORGANIC COMPOUNDS 3 HRS

Review of Introduction & IUPAC nomenclature of mono functional organic compounds.

IUPAC nomenclature of bi-functional organic compounds (aliphatic and phenyl ring). Common names , structures of radicals and radical functional names - one example of carbocation, carbanion, carbene and carbon free radical. Trivial names of alkenes, alkynes,

alcohols, ethers, aldehydes, ketones, esters and amines. Structures of common organic compounds - cycloalkanes, phenol, nitrobenzene, chlorobenzene, toluene, pyridine, pyrrole , furan and thiophene.

Chapter 6: BASICS OF ORGANIC REACTION MECHANISMS 7 HRS

Hybridisation in brief – sp^3 (methane), sp^2 (ethene) and sp (ethyne); types of bond cleavage, inductive effect, resonance effect, steric effect and hyperconjugation, reactive intermediates – structure and relative stabilities of carbocations, carbanions, carbon free radicals and carbenes, reactivity and selectivity of chlorination and bromination, types of attacking reagents - electrophilic and nucleophilic, types of organic reactions - addition, substitution, elimination, rearrangement and redox (reduction and oxidation) reactions with examples. Localized and delocalized chemical bonds.

UNIT V

Chapter 7: HYDROCARBONS (ALKANES, ALKENES, ALKYNES AND CONJUGATED DIENES) 12 HRS

Alkanes: Preparation of alkanes by Corey – House reaction; conversion of alkane to aromatic compounds via alkenes and alkynes - aromatization and pyrolysis of alkanes; conformational analysis of ethane, propane and n-butane (Sawhorse and Newmann Projection to be used).

Alkenes: General methods of preparation of alkenes: dehydration of alcohols, dehydro-halogenation of alkyl halides, Wittig reaction - stereo selectivity. Reactions of alkenes: Mechanism of electrophillic addition, addition of HX - Markownikoff's rule and anti-Markownikoff addition (peroxide effect) with mechanism; oxymercuration-demercuration, hydroboration-oxidation, catalytic hydrogenation, epoxidation; mechanism of: (i) oxidation with $KMnO_4$ and OsO_4 (ii) ozonolysis; industrial applications of ethene and propene.

Alkynes: General methods of preparation of alkynes – dehydrohalogenation of vicinal and geminal dihalides, preparation of higher alkynes from terminal alkynes; acidic nature of terminal alkynes (with ammoniacal $AgNO_3$ and ammoniacal Cu_2Cl_2), reactions of alkynes: electrophillic addition reaction (HCl), oxidation with $KMnO_4$, hydroboration-oxidation and hydrogenation (complete and partial).

Conjugated dienes: 1,3-butadiene - structure, stability of conjugated dienes, electron delocalisation, electrophilic attack on conjugated dienes, 1,2 and 1,4-addition, kinetic *vs.* thermodynamic control in 1,4-addition , epoxidation, substitution at allylic and vinylic

positions, Diels-Alder reaction: (i) 1,3-butadiene with maleic anhydride (ii) 1,3-cyclohexadiene with 1,2-dichloroethene.

Chapter 8: CYCLOALKANES 3 HRS

Nomenclature, relative stability – Baeyer's strain theory, and its limitations - heat of hydrogenation values, Sache-Mohr theory of strainless rings (cyclopropane, cyclobutane, cyclopentane and cyclohexane), conformations of cyclopentane and cyclohexane. The cyclopropane ring - banana bonds.

REFERENCES:

1. 1 B. R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 47th edition, 2017, Shoban Lal Nagin Chand and Co.
2. J. D. Lee, Concise Inorganic Chemistry. 5th edition, 2008, Wiley India Pvt. Ltd.
3. R. D. Madan, Modern Inorganic Chemistry, 2nd edition, 2002. S.Chand & Co.
4. R.T.Morrison, R.N.Boyd and S.K. Bhattacharjee, Organic Chemistry, 7th edition, 2010, Pearson Education.

   A. Bahl, Advanced Organic Chemistry, 11thedition, 1999, S Chand Publ.
5. P.Sykes. A Guide Book to Mechanism in Organic Chemistry, Orient Longman,1990
6. J. Mendham, R.C. Denny, J.D. Barnes, M. Thomas and B. Sivashankar, Vogel's Textbook of Quantitative Chemical Analysis, 6th edition, 2009, Pearson Education.
7. Gary D. Christian. Analytical chemistry, 6th Edition, 2008, ELBS publication.
8. T.W. Graham Solomons, Organic Chemistry, Global Edition – 2017

I B.SC., I SEMESTER, CHEMISTRY PRACTICAL – 1

DURATION: 3 HRS / WEEK **NO. OF UNITS: 15**

1. Calibration of volumetric glass ware (i) Pipette (ii) Burette (iii) standard flask.
2. Preparation of standard potassium hydrogen phthalate (PHP) and estimation of alkali.
3. Preparation of standard sodium oxalate and estimation of potassium permanganate.
4. Preparation of standard potassium dichromate and estimation of FAS using potassium ferricyanide as external indicator.
5. Preparation of standard potassium dichromate and estimation of FAS using barium diphenylamine sulphonate as internal indicator.
6. Preparation of standard potassium dichromate solution and estimation of sodium thiosulphate using starch indicator.
7. Preparation of standard potassium dichromate solution and estimation of iodine using starch indicator.
8. Determination of percentage of manganese dioxide from pyrolusite ore.
9. Determination of the percentage of available chlorine in the given sample of bleaching powder.
10. Determination of ferrous and ferric iron in a given mixture using standard potassium dichromate solution.
11. Determination of the amount of acetyl salicylic acid in commercial sample of aspirin by titrimetric method.

    Repetition and Tests.

REFERENCES:

1. P.K. Mani & A. O. Thomas, Text Book of Practical Chemistry, 4th edition, 1976, Scientific Publications.
2. M. J. Sienko, R.A. Plane, S.T.Marcus, Experimental Chemistry, 6th edition, 1985, McGraw-Hill Book Company.
3. Alexander Findlay, Findlay's Practical Physical Chemistry, 9th edition, 1972, Longman Group Limited.