WEST BENGAL STATE UNIVERSITY

DRAFT SYLLABUS IN CHEMISTRY

FOR

4-year Undergraduate Programme (Honours)

&

3-year Multidisciplinary UG Programme

UNDER

Curriculum and Credit Framework for Undergraduate Programmes (CCFUP)

w.e.f. the academic session of 2023-24

Major (Core Course) for HONOURS in CHEMISTRY

SEMESTER-I

DS-1

(Credits: Theory-03, Practicals-02)

Theory: 45 Lectures **Marks: 50**

All Units carry equal marks

Unit-1: Atomic Structure & Radioactivity

(15 Lectures)

Bohr's theory for hydrogen atom (simple mathematical treatment), its limitations and atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, Aufbau principle and its limitations. Wave mechanics: de Broglie wave equation, Qualitative idea of Heisenberg's Uncertainty Principle. Radial and Angular distribution curves. Shapes of s, p and d orbitals. Exchange energy (qualitative idea).

Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases.

Unit-2: Basics of Organic chemistry

(15 Lectures)

Nomenclature for acyclic compounds only (trivial and IUPAC), DBE, hybridization(sp", n= 1,2,3) of C, N, O, halogens, bond distance, bond angles, VSEPR, shapes of molecules, inductive and field effects, bond energy, bond polarity and polarisability, dipole moment, resonance, resonance energy, steric inhibition of resonance, hyperconjugation, $\boldsymbol{\pi}$-M.O diagrams of ethylene, butadiene, 1,3,5- hexatriene, allyl cation, allyl anion, allyl radical, HOMO and LUMO in ground and excited states, orbital pictures of allene, carbene(singlet and triplet), vinyl cyanide, Huckel's rule for aromaticity and antiaromaticity (neutral systems 4,6,8,10 annulene, charged systems 3,4,5,7 rings, Frost-diagram, melting point, boiling point, heat of hydrogenation, heat of combustion, hydrogen bonding (intra- and inter-molecular),

crown-ether, concepts of acidity, basicity. Reaction intermediate, carbocation, carbanion, radicals, carbene & stability and generation.

Unit-3: Kinetic Theory of Gas

(15 Lectures)

Concept of pressure and temperature. Nature of the distribution of velocities in one dimension (with derivation), extension to two and three dimensions (without derivation, expression by induction). Maxwell's distribution of speeds in one, two and three dimensions, calculations of average, root mean square and most probable values in each case. Graphical comparison of velocity and energy distribution.

Collision of gas molecules; collision diameter; collision number and mean free path; frequency of binary collisions (similar and different molecules); wall collision and rate of effusion. Viscosity of gases from kinetic theory of gas.

Reference Books:

1. Lee J. D. *Concise Inorganic Chemistry*, 5th Ed., Wiley India Pvt. Ltd., 2008.
2. Douglas, B. E. and McDaniel, D. H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970.
3. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS publications, 1962.
4. Atkins, P. *Shriver & Atkins' Inorganic Chemistry*, 5th Ed., Oxford University Press (2010).
5. Cotton, F.A., Wilkinson, G. and Gaus, P. L., *Basic Inorganic Chemistry 3rd Ed.*, Wiley India.
6. Sharpe, A. G., *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005.
7. Huheey, J. E.; Keiter, E. A. & Keiter, R.L., *Inorganic Chemistry, Principles of Structure and Radioactivity 4th Ed*., Harper Collins 1993, Pearson, 2006.
8. Atkins, P.W. & Paula, J. *Physical Chemistry*, Oxford Press 2006.
9. Mingos, D.M.P., *Essential trends in Inorganic Chemistry*, Oxford University Press (1998).
10. Winter, M. J., The Orbitron, http://winter.group.shef.ac.uk/orbitron/ (2002). An illustrated gallery of atomic and molecular orbitals.
11. Burgess, J., *Ions in solution: basic principles of chemical interactions*, Ellis Horwood (1999).
12. . Finar, I. L. Organic Chemistry (Vol- 1), 6th Edition, Pearson Education, 2002

13. 2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
14. 3. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
15. 4. Nasipuri, D. Stereochemistry of Organic Compounds, Wiley Eastern Limited.
16. 5. Graham Solomons, T.W. Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
17. 6. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
18. 7. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.
19. 8. Carey, F. A., Guiliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
20. Castellan, G. W. Physical Chemistry, Narosa
21. 3. McQuarrie, D. A. & Simons, J. D. Physical Chemistry: A Molecular Approach, Viva Press
22. 4. Engel, T. & Reid, P. Physical Chemistry, Pearson
23. 5. Levine, I. N. Physical Chemistry, Tata McGraw-Hill
24. 6. Maron, S. &Prutton Physical Chemistry
25. 7. Ball, D. W. Physical Chemistry, Thomson Press
26. 8. Mortimer, R. G. Physical Chemistry, Elsevier
27. 9. Laidler, K. J. Chemical Kinetics, Pearson
28. 10. Glasstone, S. & Lewis, G.N. Elements of Physical Chemistry
29. 11. Rakshit, P.C., Physical Chemistry Sarat Book House
30. 12. Zemansky, M. W. & Dittman, R.H. Heat and Thermodynamics, Tata-McGrawHill
31. 13. Rastogi, R. P. &Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas
32. 14. Klotz, I. M. & Rosenberg, R. M. Chemical Thermodynamics, Wiley

Practical

(60 Lectures/Contact hours) **Marks: 50**

1. **Preparation of Standard solutions**

a) Primary Standard: $K_2Cr_2O_7$, Oxalic Acid

b) Secondary Standard: $KMnO_4$, $Na_2S_2O_3$, Mohr's Salt

2. **Standardization of Secondary Standard Solution: ($KMnO_4$, $Na_2S_2O_3$, Mohr's Salt)**
3. **Identification of Pure Organic Compounds**

   Liquid compounds: methanol, ethanol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform, and nitrobenzene

   Solid compounds: oxalic acid, tartaric acid, succinic acid, resorcinol, urea, glucose, benzoic acid and salicylic acid.

   (Only unknown liquid and solid compounds as specified are to be written in laboratory notebook)

4. **Determination of boiling points of different Organic Compounds**

   Organic liquids with less than 135^0C boiling point may be taken for experiments. Boiling points of two unknown organic compounds should be noted with literature survey (Reference may be incorporated therein)

5. **Determination of molecular properties of liquids**

a. **Study of viscosity** of unknown liquid (glycerol, sugar) with respect to water.

b. Determination of **relative surface tension of a liquid** using Stalagmometer

Reference Book:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson, 2009
2. Practical Workbook Chemistry (Honours), UGBS, Chemistry, University of Calcutta, 2015.
3. Nad A. K., Mahapatra B. and Ghosal A. An Advanced Course in Practical Chemistry, New Central Book Agency (P) Ltd.
4. Ghosh S., Das Sharma M., Majumder D and Manna S. Chemistry in Laboratory, Santra Publication Pvt Ltd
5. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic
6. Analysis, CBS Publishers and Distributors.
7. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry Viva Books (2009)
8. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
9. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007)

10. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency
11. University Hand Book of Undergraduate Chemistry Experiments, edited by
12. Mukherjee, G. N., University of Calcutta
13. Levitt, B. P. edited Findlay's Practical Physical Chemistry Longman Group Ltd.
14. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.

SEMESTER-II

DS-2

(Credits: Theory-03, Practicals-02)

Theory: 45 Lectures **Marks: 50**

All Units carry equal marks

Unit-1: Acid-Base reactions

(15 Lectures)

Acid-Base concept: Arrhenius concept, theory of solvent system (H_2O, NH_3, SO_2 and HF), Bronsted-Lowry's concept, relative strength of acids, Pauling's rules. Lux-Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects. Superacids, proton affinity; HSAB principle. Acid-base equilibria in aqueous solution (Proton transfer equilibria in water), pH, buffer. Acid-base neutralization curves; indicator, choice of indicators. Solubility product, common ion effect and their application in analytical chemistry. (Gr. II A, B & Gr. III A, B).

Unit-2: Stereochemistry

(15 Lectures)

Stereochemistry of acyclic compounds: representation of molecules in Fischer, flying- wedge, Sawhorse and Newman formula and their translations, chirality, elements of symmetry, simple axis (C_n), plane of symmetry(σ), centre of symmetry(i), alternating axis of symmetry (S_n), asymmetry and dissymmetry, optical activity, specific rotation, molar rotation, specific rotation of mixture, Biot's law. Stereoisomerism: enantiomerism, diastereoisomerism, stereogenic centre, systems with chiral centres, stereogenic centres involving C=C, C=N, D/L, R/S, E/Z, syn/anti, cis/trans, meso/dl, threo/erythro nomenclature

Conformation: conformational nomenclature; eclipsed, staggered, gauche and anti, dihedral angle, torsional angle, Klyne-Prelog terminology, energy barrier of rotation, relative stability of conformers on the basis of steric effect, dipole-dipole interaction, hydrogen bonding, conformational analysis of ethane, propane, n-butane, 1,2-dihaloethane, 2-methylbutane, 1.2-glycols, invertomerism of trialkyl amines

Unit-3: Chemical kinetics

(15 Lectures)

Rate law, order and molecularity: Introduction of rate law, Extent of reaction; rate constants, order; Forms of rates of First, second and n-th order reactions; Pseudo first order reactions (example using acid catalyzed hydrolysis of methyl acetate); Determination of order of a reaction by half-life and differential method.

Role of T and theories of reaction rate: Temperature dependence of rate constant; Arrhenius equation, energy of activation; Rate-determining step and steady-state approximation – explanation with suitable examples; Collision theory; outline of Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment)

Homogeneous catalysis: Homogeneous catalysis with reference to acid-base catalysis; Primary kinetic salt effect; Enzyme catalysis.

Practical

(60 Lectures/Contact hours) **Marks: 50**

1. **Acid-Base Titration:**
   a) NaOH – Na_2CO_3 mixture
   b) Na_2CO_3 – $NaHCO_3$ mixture
   c) Oxalate – Oxalic Acid mixture
2. **Qualitative Analysis of Single Solid Organic Compounds**
   A. Detection of special elements (N, S, Cl, Br) by Lassaigne's test
   B. Solubility and classification (Solvents: water, 5% HCl, 5% NaOH, saturated $NaHCO_3$)
   C. Detection of the following functional groups by systematic chemical tests:
      Whether aromatic or not ?
      Hydrocarbon, aromatic amino (-NH_2), aromatic nitro (-NO_2), amido (-

$CONH_2$, including imide), anilido (CONHPH), phenolic -OH, carboxylic acid (-COOH), carbonyl (-CHO and >C=O), only one test for each functional group is to be reported.

D. Melting point of the given compound
E. Identification of the **Probable compound** through observed melting points and functional groups

3. Study of kinetics of simple chemical reactions

a. Study of kinetics of acid-catalyzed hydrolysis of methyl acetate
b. Study of kinetics of decomposition of H_2O_2

Reference Book:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson, 2009
2. Practical Workbook Chemistry (Honours), UGBS, Chemistry, University of Calcutta, 2015.
3. Nad A. K., Mahapatra B. and Ghosal A. An Advanced Course in Practical Chemistry, New Central Book Agency (P) Ltd.
4. Ghosh S., Das Sharma M., Majumder D and Manna S. Chemistry in Laboratory, Santra Publication Pvt Ltd
5. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic
6. Analysis, CBS Publishers and Distributors.
7. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry Viva Books (2009)
8. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
9. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007)
10. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency
11. University Hand Book of Undergraduate Chemistry Experiments, edited by
12. Mukherjee, G. N., University of Calcutta
13. Levitt, B. P. edited Findlay's Practical Physical Chemistry Longman Group Ltd.
14. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.

Minor Course in Chemistry for 4-year UG Programme (Honours in subjects other than Chemistry) & 3-year Multidisciplinary UG Programmes

SEMESTER-I

MA-1

(Credits: Theory-03, Practicals-02)

Theory: 45 Lectures **Marks: 50**

All Units carry equal marks

Unit-1: Inorganic Chemistry

(15 Lectures)

Atomic Structure

Bohr's theory for hydrogen atom (simple mathematical treatment), atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, Aufbau principle and its limitations.

Chemical Periodicity

Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity; periodic and group-wise variation of above properties in respect of s- and p- block elements.

Acids and bases

Brönsted-Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

Unit-2: Organic Chemistry

(15 Lectures)

Fundamentals of Organic Chemistry

Concept of hybridisation, Structure and shape of organic molecules on the basis of VBT. Electronic displacements: inductive effect, resonance and hyperconjugation; nucleophiles electrophiles; reactive intermediates: carbocations, carbanion.

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structures.

Alkanes(up to 5 Carbons): Preparation: catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: mechanism forfree radical substitution: halogenation.

Alkenes(up to 5 Carbons): Preparation: elimination reactions: dehydration of alcohols and dehydrohalogenation of alkyl halides; cis alkenes (partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: *cis*-addition (alkaline $KMnO_4$) and *trans*-addition (bromine) with mechanism, addition of HX [Markownikoff's (with mechanism) and anti-Markownikoff's addition], hydration, ozonolysis, oxymercuration-demercuration and hydroboration-oxidation reaction.

Alkynes(up to 5 Carbons): Preparation: acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alkaline $KMnO_4$.

Unit-3: Physical Chemistry

(15 Lectures)

Kinetic Theory of Gases and Real gases

Concept of pressure and temperature; Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Rate of effusion ; Nature of distribution of velocities, Maxwell's distribution of speed and kinetic energy; Average velocity, root mean square velocity and most probable velocity;

Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases

Deviation of gases from ideal behaviours; compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behaviour; Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states

Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only)

Liquids

Definition of Surface tension, its dimension and principle of its determination using stalagmometer; Viscosity of a liquid and principle of determination of coefficient of viscosity using Ostwald viscometer; Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

Reference books :

1. Poddar S. N. General and Inorganic Chemistry, Book Syndicate Pvt. Ltd.
2. Dutta R. L. & De G.S. Inorganic Chemistry (Vol I), The New Book Stall.
3. Lee, J. D. Concise Inorganic Chemistry, 5th Ed., Wiley India Pvt. Ltd., 2008.
4. Sen Gupta, S. Organic Chemistry, Oxford University Press.
5. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
6. Sen Gupta, S. Basic Stereochemistry of Organic molecules, Oxford University Press.
7. Rakshit P. C. Physical Chemistry, Sarat Book House.
8. Palit S. R. Elementary Physical Chemistry, Science Book Agency.
9. Pahari, S., Physical Chemistry New Central Book Agency.
10. Chugh, K.L., Agnish, S.L. A Text Book of Physical Chemistry, Kalyani Publishers.

Practical

(60 Lectures/Contact hours) **Marks: 50**

1. **Preparation of standard solution:**

   (a) Primary standard: $K_2Cr_2O_7$ and Oxalic acid

   (b) Secondary standard: $KMnO_4$, $Na_2S_2O_3$

   (c) Standardisation of secondary standard solution: $KMnO_4$, $Na_2S_2O_3$

1. **(A) Determination of single solid and liquid compounds:**

    (a) Oxalic acid, Resorcinol, Glucose, Salicylic acid, Benzoic acid.

    (b) Ethanol, Acetone, Aniline, Nitrobenzene, Benzaldehyde.

    (B) Preparation:

    (a) Green bromination of acetanilide

    (b) Dibenzalacetone

3. Determination of

(a) Relative viscosity of a solution

(b) Relative surface tension of a solution

Reference books :

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson, 2009
2. Practical Workbook Chemistry (Honours), UGBS, Chemistry, University of Calcutta, 2015.
3. Nad A. K., Mahapatra B. and Ghosal A. An Advanced Course in Practical Chemistry, New Central Book Agency (P) Ltd.
4. Ghosh S., Das Sharma M., Majumder D and Manna S. Chemistry in Laboratory, Santra Publication Pvt Ltd
5. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic
6. Analysis, CBS Publishers and Distributors.
7. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry Viva Books (2009)
8. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
9. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007)
10. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency
11. University Hand Book of Undergraduate Chemistry Experiments, edited by
12. Mukherjee, G. N., University of Calcutta
13. Levitt, B. P. edited Findlay's Practical Physical Chemistry Longman Group Ltd.
14. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.

SEMESTER-II

MA-2

(Credits: Theory-03, Practicals-02)

Theory: 45 Lectures **Marks: 50**

All Units carry equal marks

Unit-1: Inorganic Chemistry

Chemical bonding and molecular structure

(15 Lectures)

Ionic bonding: General characteristics of ionic bonding. Energy consideration in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Lande equation for calculation of lattice energy, Born Haber cycle and its application, polarizing power and polarizability, Fajan's rule, ionic character in covalent compounds, bond moment, dipole moment and percentage of ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

Redox reactions. Balancing of equations by oxidation number and ion-electron method, oxidimetry and reductimetry

Unit-2: Organic Chemistry

Stereochemistry

(15 Lectures)

Different types of isomerism: geometrical and optical isomerism, concept of chirality and optical activity (up to two carbon atoms), asymmetric carbon atom, elements of symmetry (plane and centre), interconversion of Fischer and Newman representations, enantiomerism and diastereomerism, *meso* compounds,*threo* and *erythro*, D and L, *cis* and *trans* nomenclature, CIP rules, R/S (upto 2 chiral carbon atoms)and*E*/*Z* nomenclature

Nucleophilic substitution and elimination reactions

Nucleophilic substitutions: S_N1 and S_N2 reactions, Eliminations: E1 and E2 reactions (elementary mechanistic aspects), Saytzeff and Hofmann eliminations, elimination, substitution vs elimination.

Unit-3: Physical Chemistry

(15 Lectures)

Chemical Energetics

Intensive and extensive variables, state and path functions, isolated, closed and open systems, zeroth law of thermodynamics, concept of heat, work internal energy and statement of first law, enthalpy, H, relation between heat capacities, calculations of q, w, U and H for the reversible, irreversible and free expansion of gases

Standard states, Heats of reaction, enthalpy of formation of molecules and ions and enthalpy of combustion and its applications, laws of thermochemistry, bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchoff's equation, and effect of pressure on enthalpy of reactions

Statement of the second law of thermodynamics, Concept of heat reservoirs and heat engines, Carnot cycle, Physical concept of Entropy, Carnot engine, refrigerator and efficiency, Entropy change of systems and surroundings for various processes and transformations, Auxiliary state functions (G and A) and criteria for spontaneity and equilibrium.

Chemical equilibrium

Thermodynamic conditions for equilibrium, degree of advancement, variation of free energy with degree of advancement, Equilibrium constant and standard Gibb's free energy change, Definitions of K_p, K_c and K_x and relation among them, Le Chatelier's principle.

Practical

(60 Lectures/Contact hours) **Marks: 50**

1. **Estimation of**
   (a) Fe^{2+} ion in Mohr's salt (permanganometry and dichromometry)
   (b) Cu^{2+} by iodometrically

2. **Analysis of unknown organic compounds:**
   Detection of special elements (N, Cl), Solubility, detection of functional groups (-COOH, -OH (phenolic), carbonyl , $-ArNH_2$, $-ArNO_2$)

3. **Determination of** solubility product of KHTa

Reference books :

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson, 2009
2. Practical Workbook Chemistry (Honours), UGBS, Chemistry, University of Calcutta, 2015.
3. Nad A. K., Mahapatra B. and Ghosal A. An Advanced Course in Practical Chemistry, New Central Book Agency (P) Ltd.
4. Ghosh S., Das Sharma M., Majumder D and Manna S. Chemistry in Laboratory, Santra Publication Pvt Ltd
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6. Analysis, CBS Publishers and Distributors.
7. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry Viva Books (2009)
8. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
9. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007)
10. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency
11. University Hand Book of Undergraduate Chemistry Experiments, edited by
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13. Levitt, B. P. edited Findlay's Practical Physical Chemistry Longman Group Ltd.
14. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.

Skill Enhancement Course in Chemistry

SEMESTER-I

SE-1–BASIC ANALYTICAL CHEMISTRY
(Credits: Theory-03)

Theory: 45 Lectures **Marks: 50**

Introduction

Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results from the point of view of significant figures.

Analysis of soil

Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators

1. Determination of pH of soil samples.
2. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water

Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

1. Determination of pH, acidity and alkalinity of a water sample.
2. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products

Nutritional value of foods, idea about food processing and food preservations and adulteration.

1. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
2. Analysis of preservatives and colouring matter.

Chromatography

Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

1. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).
2. To compare paint samples by TLC method.

Ion-exchange

Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Analysis of cosmetics

Major and minor constituents and their function

1. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
2. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration

Suggested Applications (Any one)

1. To study the use of phenolphthalein in trap cases.
2. To analyse arson accelerants.
3. To carry out analysis of gasoline.

Suggested Instrumental demonstrations

1. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
2. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
3. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drinks

Reference Books

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A., Holler, F.J. & Crouch, S. Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.
3. Skoog, D.A.; West, D.M. & Holler, F.J. Analytical Chemistry: An Introduction 6th
4. Ed., Saunders College Publishing, Fort Worth, Philadelphia (1994).
5. Harris, D. C. Quantitative Chemical Analysis, 9th ed. Macmillan Education, 2016.
6. Dean, J. A. Analytical Chemistry Handbook, McGraw Hill, 2004.
7. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India, 1992.
8. Freifelder, D.M. Physical Biochemistry 2nd Ed., W.H. Freeman & Co., N.Y. USA (1982).
9. Cooper, T.G. The Tools of Biochemistry, John Wiley & Sons, N.Y. USA. 16 (1977).
10. Vogel, A. I. Vogel‟s Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.
11. Mendham, J., A. I. Vogel‟s Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
12. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).
13. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

SEMESTER-II

SE-2–ANALYTICAL and CLINICAL BIOCHEMISTRY
(Credits: Theory-03)

Theory: 45 Lectures **Marks: 50**

Review of Concepts from Core Course

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle.
Isolation and characterization of polysachharides.
Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β- pleated sheets, Isolation, characterization, denaturation of proteins.
Enzymes: Nomenclature, Characteristics (mention of Ribozymes), and Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry.
Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications.
Lipoproteins: Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones.
Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy.
Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

Biochemistry of disease: A diagnostic approach by blood/ urine analysis.

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.
Urine: Collection and preservation of samples. Formation of urine. Composition and estimation of constituents of normal and pathological urine.

Reference Books

1. Cooper, T.G. Tool of Biochemistry. Wiley-Blackwell (1977).
2. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009).
3. Varley, H., Gowenlock, A.H & Bell, M.: Practical Clinical Biochemistry, Heinemann, London (1980).
4. Devlin, T.M., Textbook of Biochemistry with Clinical Correlations, John Wiley & Sons, 2010.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.
6. Talwar, G.P. & Srivastava, M. Textbook of Biochemistry and Human Biology, 3rd Ed. PHI Learning.
7. Nelson, D.L. & Cox, M.M. Lehninger Principles of Biochemistry, W.H. Freeman, 2013.
8. O. Mikes, R.A. Chalmers: Laboratory Handbook of Chromatographic Methods, D. Van Nostrand & Co., 1961.

Multidisciplinary Course (MDC) in Chemistry

(This course refers to the "MDC" course in Tables 1, 1A and 2 corresponding to structure of the 4-year UG programme (Honours) and 3-year UG programme. This course can only be selected for study by students who have not studied Chemistry at the higher secondary level)

MD-1 OR MD-2

(Credits: Theory-03)

Lectures: 45 **Marks: 50**

BASIC CONCEPTS OF CHEMISTRY

Importance of Chemistry, Nature of matter, States of matter, solids, liquids, gases, classification of matter: mixture, pure substance; Properties of matter and their measurement: Mass, weight, volume, density and temperature. Uncertainty in measurement: precision and accuracy. Laws of chemical combinations: Law of conservation of mass, law of definite proportions, law of multiple proportions, Avogadro's law, Dalton's atomic theory, Atomic and molecular masses, Mole concept and molar mass, percentage composition, Empirical formula and molecular formula, Stoichiometry and stoichiometric calculations, Molarity, mole fraction and molality

STRUCTURE OF ATOM

Discovery of sub-atomic particles: electrons, proton, Rutherford's nuclear model of atom and its' drawbacks, atomic number, mass number, Isobars and isotopes, Bohr's model for hydrogen atom

THERMODYNAMICS

The system and the surroundings, types of systems, state of the system, heat, work, internal energy, First law of thermodynamics.

CHEMICAL EQUILIBRIUM

Law of mass action, idea of chemical equilibrium, Le Chatelier's principle, its applications

ORGANIC COMPOUNDS

Introduction to haloalkanes, Methods of preparation of haloalkanes; Introduction to alcohols, phenols and ethers with suitable examples, their preparation (Reaction mechanisms not required); Introduction to aldehydes, ketones and carboxylic acids with suitable examples, their preparations.

ACIDS, BASES AND BUFFER

Introduction to acids and bases, Arrhenius and Lewis concepts, neutralization reactions, acid-base titration

References

1. NCERT Class XI and XII textbooks in chemistry
2. ISC Class XI and XII textbooks in chemistry