DEPARTMENT OF CHEMISTRY
B.N.COLLEGE (AUTONOMOUS), DHUBRI, ASSAM

Syllabus for B.Sc.in Chemistry
(Four Year Degree Course)

Approved by the Board of Studies in Chemistry held on 18.12.2024

PROPOSED SCHEME FOR BSC IN CHEMISTRY (For 1st & 2nd Semester)

SEMESTER	MAJOR	MINOR	SEC	MDC
I	General Chemistry I	General Chemistry I	General Practices in Chemistry	Basic Concepts of Chemistry - I
II	General Chemistry II	General Chemistry II	Chemistry of Soil and Water	Basic Concepts of Chemistry - II
III				
IV				
V				
VI				

SEMESTER 1

CORE COURSE

PAPER NAME: GENERAL CHEMISTRY I
PAPER CODE: CHE-DSC-141
Total Credit: 4 (Theory: 3 + Practical: 1)

THEORY: 3 CREDITS **TOTAL LECTURES: 45**

Course Objectives:

This course aims at giving students the understanding of the basic constituents of matter in terms of electronic structure and reactivity. Knowledge of structure and bonding to be dealt with basic quantum chemistry treatment and Periodic classification of elements in the periodic table and changes in properties along the periods and groups to be studied in detail. This course also aims to explain students with introduction to organic compounds, electron displacement, types of reagents, reaction intermediates and chemistry of aliphatic hydrocarbons. Further, this course strives to educate the students on fundamental topics namely, states of matter- gaseous state along with ionic equilibria.

Course Outcome:

After successfully completing the course, the students will be able to:

- Remember and understand the concepts of atomic structure, periodic properties and chemical bonding. Recall the suffix and prefix of all functional groups.Define various terminologies related to Real gases, ideal gases and ionic equilibrium.
- Discuss type of reagents, electron displacement effects, reaction intermediates and mechanisms.
- Apply the knowledge of atomic structure, periodic properties and bonding in predicting the structure of atomic orbitals, periodicity of elements and nature of chemical bonds. Use electron displacement effects to the stability of reaction intermediates. Determine the structure of simple organic compounds and formulate the synesthetic route of simple organic compounds.Apply ideal gas equations and Henderson equation to solve the related problems Relate the variables related to kinetic gas equation and various types of equilibrium. Justify real gas deviation from ideal behaviour. Investigate pH and pOH
- Analyses the stability of atomic orbitals, periodicity of elements and covalent character of bonds. Evaluate the electronegativity values and extent of polarisation. Analyse the relative acidic and basic strength of organic acids and bases.

Unit	Contents	Contact hours	Marks
Unit I: Atomic Structure	Review of Bohr's theory and its limitations; de-Broglie's concept of dual character of matter; Heisenberg's Uncertainty Principle; Schrodinger wave equation (derivation not required);Eigenfunction, significance of ψ and ψ^2, quantum numbers and their significance; radial and angular wave functions (derivations not required), probability distribution curves; atomic-orbitals; shapes of *s*, *p* and *d*-orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations. Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy.	7	12
Unit II: Periodic Properties	Effective Nuclear Charge, shielding effect, Slater rules, penetrating power of orbitals and shielding effect. Definition, affecting factors, periodic trends including irregularities in periodic trends of the following properties of elements of *s* &*p*- blocks:(a) Atomic radii and Ionic radii (b)Ionization Energy (c) Electron Affinity (d) Electronegativity. Scales of electronegativity. Inert pair effect.	3	5
Unit III: Chemical Bonding I	Basic idea of ionic bond, covalent bond and coordinate bond. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules, polarization. General characteristics of ionic compounds, Lattice energy and solvation energy, Born Lande equation, Kapustinski equation, Madelung constant, Born-Haber's cycle.	5	8
Unit IV: Basic Organic Chemistry	**Organic Compounds:** Recapitulation of IUPAC nomenclature, Hybridization and its influence on bond properties. **Electronic Displacements:** Inductive, Electrometric, Mesomeric, Resonance and Hyper-conjugation. Dipole moments; Organic acids& bases and their relative strength. **Cleavage of Bonds:** Homolytic and Heterolytic cleavages, Electrophiles and Nucleophiles, Nucleophlicity and basicity; Types, shape and their relative stability of Reactive Intermediates: Carbocations, Carbanions, Free radicals, Carbenes,	6	10

	Benzyne.		
Unit V: Chemistry of Aliphatic Hydrocarbons	**(a) Alkanes:** Preparation: Wurtz, Kolbe, Corey-House Reaction, Physical Properties, Chemical Reactions: Free radical substitution: Halogenation-relative reactivity and selectivity. **(b) Alkenes:** Preparation by elimination reaction (Saytzeff' rule), Witting reaction, Pyrolysis of esters (Hoffmann's rule). Electrophilic addition and its mechanism: Addition of hydrogen halides, (Markovnikov's and anti Markovnikov's addition), hydration, *cis*-addition (alkaline $KMnO_4$), *trans*-addition (Br_2), ozonolysis, allylic and benzylicbromination (NBS). **(c) Alkynes:** Preparation by elimination, Acidity, Alkylation of terminal alkynes, Conversion into *cis-alkenes* (Partial catalytic hydrogenation), *trans*-alkenes (Birch reduction) and higher alkynes, Hydration.	9	15
Unit VI: Kinetic molecular model of Ideal gas	Postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence; relation between mean free path and coefficient of viscosity; variation of viscosity with temperature and pressure; Maxwell distribution and its use in evaluating molecular velocities (i) average, (ii) root mean square, (iii) most probable and (iv) average kinetic energy.	5	8
Unit VII: Real Gases	Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, Virial equation of state; calculation of Boyle temperature. Isotherms of real gases, continuity of states, critical state, relation between critical constants and van der Waals constants, Reduced equation of state and law of corresponding state.	5	9
Unit VIII: Ionic equilibria	Strong, and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-,and di- protic acids. Salt hydrolysis, pH for different salts. Buffer solutions;	5	8

	derivation of Henderson equation and its applications; buffer capacity, buffer action and applications of buffers in analytical chemistry. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves Theory of acid–base indicators; selection of indicators and their limitations		

Reference books:

1. D. Shriver, P. W. Atkins, H. C. Langford, *Inorganic Chemistry*, 5th Edition, W. H. Freeman & Co.
2. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, *Inorganic Chemistry* (Principles of Structure and Reactivity), 5th Edition, Pearson Education.
3. A. K. Das, *Fundamental Concepts of Inorganic Chemistry*, Volume 1, 3rd Edition, CBS Publishers & Distributors Pvt. Ltd.
4. J. D. Lee, *Concise Inorganic Chemistry*, 5th Edition, Pearson Education.
5. R. T. Morrison, R. N. Boyd& S. K. Bhattacharjee, *Organic Chemistry*, 7th Edition, Pearson Education.
6. T. W. Graham Solomons, *Organic Chemistry*, John Wiley & Sons, Inc.
7. P. Sykes, *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
8. P.Y. Bruice, *Organic Chemistry*, 7th Edition, Pearson Education.
9. J. Clayden, N. Greeves& S. Warren, *Organic Chemistry*, 2nd Edition, Oxford University Press.
10. J. Keeler, J. de Paula &P. Atkins, *Atkin's Physical Chemistry*, 12th Edition, Oxford University Press.
11. B. R. Puri, L. R. Sharma, M. S. Pathania, *Principles of Physical Chemistry*, 48th Edition, Vishal Publishing Co.
12. K. L. Kapoor, *A Textbook of Physical Chemistry*, Volume 1, 6th Edition, McGraw Hill Education.

PRACTICAL: 1 CREDIT TOTAL LECTURES: 30

Course Objectives:

The laboratory course is designed to introduce students to various laboratory apparatus, preparation of standard solutions and measurement of some physical properties.

Course Outcome:

After successfully completing the course, the students will be able to:

- Learn and use the common laboratory apparatus in various experiments.
- Learn the process of purification of organic compounds by recrystallization.
- Understand the preparation of standard solution in different concentration units.

- Apply the knowledge to determine water of crystallisation of hydrated salts, surface tension and viscosity of simple liquids.

Experiments:

1. Calibration of common laboratory apparatus.
2. Preparation of primary standard Oxalic Acid solution and standardization of NaOH solution with this.
3. Determination of water of crystallisation of a hydrated salt by ignition and weighing.
4. Purification of organic compounds by recrystallization and to check the purity by determination of melting point.
5. Determination of surface tension of a given liquid with respect to water at room temperature using stalagmometer.
6. Determination of viscosity of a given liquid with respect to water using Ostwald viscometer.

Reference Books:

1. A. I. Vogel, *A Test book of Quantitative Inorganic Analysis* (Rev. by GH Jeffery and others) 5th Edition.
2. A. I. Vogel, *Elementary Practical Organic Chemistry*, Part 2: Qualitative Organic Analysis, Pearson Education.
3. F. G. Mann, & B. C. Saunders, *Practical Organic Chemistry*, Pearson Education.
4. V. K. Ahluwalia & S. Dhingra, *Comprehensive Practical Organic Chemistry: Qualitative Analysis*, University Press

SKILL ENHAMCEMENT COURSE

PAPER NAME: BASIC LAB PRACTICES IN CHEMISTRY-I
PAPER CODE: CHE-SEC-131
Total Credits: 3 (Theory: 2 + Practical: 1)

THEORY: 2 Credits **TOTAL LECTURES: 30**

Course Objectives:

This course aims at giving students the basic understanding of a chemistry laboratory and safety issues. The knowledge of various laboratory apparatus and reagents will be discussed. They will be familiarized with the concept of solution and its components along with the physicochemical principles used in a Laboratory.

Course Outcome:

After completing this course, the students will be able to:

- Remember and understand the physicochemical principles used in chemistry laboratory work.
- Apply practical skills with the understanding of chemistry laboratory practices.

Unit	Contents	Contact hours	Marks
Unit1: Chemistry Laboratory	General introduction to chemistry lab, safety rules and precautions in chemistry laboratories, storage, ventilation, lighting, fumes, cupboard, hazards, precautions, maintenance of laboratory, cleaning of laboratories, apparatus and preparation room.	3	5
Unit2: Lab Apparatus	(A) **Glass apparatus:** Beaker, test tube, boiling tube, conical flask, filtration flask, round bottom flask, flat bottom flask, funnel, separating funnel, watch glass, measuring cylinder, desiccator, measuring cylinder, glass rod, glass tube. (B) **Volumetric and Heating apparatus:** Volumetric apparatus: Volumetric flask, burette, pipette, electronic balance. Heating apparatus: Bunsen burner, water bath, sand bath, hot air oven, heating mantle. (C) **Miscellaneous Apparatus:** Buchner funnel, burner, china dish, wire gauze, vacuum pumps, crucibles, pestle and mortar, thermometer, pH meter, Kipp's apparatus, mechanical shaker.	4	6

Unit3: Laboratory Reagents and Solvents	**Reagents**: Classification of reagents according to their action; (i) acids (ii) bases (iii) salts (iv) complexing agents (v) oxidizing and reducing agents (vi) precipitating agents (vii) chelating agents. Each type to be explained with at least one suitable example. Primary and secondary standard reagents, standardisation of solutions. **Solvents:** Solute, Solvent & Solution, classification of solvents (i) Protic and aprotic (ii) Acidic, basic amphiprotic and neutral (iii) Aqueous and non-aqueous (iv) Polar and nonpolar. Each type is to be explained with at least one example	11	18
Unit4: Solution Preparation	Solutions, components of a solution, types of solution, solubility, concentration terms - percentage, ppm, ppb, g/L, molarity, normality, molality, calculation of masses and volumes for preparation of solutions. Buffer solutions: definition types and preparation	7	12
Unit5: Physicochemical Principles used in Chemistry Laboratory	Basic principles involved in analysis of cations and anions, Common ion effect, solubility product. Principles involved in the separation of cations in groups and choice of group reagents.	5	9

PRACTICAL: 1 CREDIT **TOTAL LECTURES: 30**

Course Objectives:

The laboratory course will cover the preparation of primary and secondary standard solution, standardization process, preparation and measurement of pH of buffer solution.

Course Outcome:

After completing this course, the students will be able to:

- Learn and usethe chemical balance.
- Understand the preparation of standard solution in different concentration units.
- Apply the knowledge to prepare the buffer solution and to examine the pH of solution.

Experiments:

1. Introduction to the use of Chemical Balance.
2. Preparation of normal and molar solution of primary and secondary standard

i. Primary standard: Preparation of. $H_2C_2O_4$solution
ii. Secondary standard: Preparation of NaOH solution

3. Standardisation of NaOH solution with standard $H_2C_2O_4$ solution.
4. Preparation of acetate buffer solution, measurement of their pH and comparison with experimental values.

Reference Books:

1. J. P. Seiler, *Good Laboratory Practices: the Why and How*, Springer-Verlag Berlin and Heidelberg GmbH & Co. K, 2nd Edition, 2005.
2. G. Y. Garner, M. S. Barge, P. J. Ussary, *Good Laboratory Practice Standards: Application for field and Laboratory studies*, Wiley VCH.

MULTIDISCIPLINARY COURSE

PAPER NAME: BASIC CONCEPTS OF CHEMISTRY - I
PAPER CODE: CHE-MDC-131
Total Credit: 3 (Theory: 3)

THEORY: 3 CREDITS **TOTAL LECTURES: 45**

Course Objectives:
This course aims to familiarize students with the Contribution of India in modern chemistry along with some basic ideas

Course Outcome:
After successfully completing the course, the students will be able to

- Recognise the contribution of great Indian chemists in the world
- Understand some basic ideas of Chemistry.
- Analyse the basic constituents of matters

Unit	Contents	Contact hours	Marks
Unit I: Modern Indian Chemistry	Sir Acharya Prafulla Chandra Ray – Father of Indian Chemistry: His contributions in chemical research, and development of Indian chemical industry, Ray's classification of five stages in development of Chemistry in India	3	5
Unit II: Great Indian Chemists and Their Contributions	Works and Contribution of Nobel laureate Professor Har Govind Khorana, Prof C N R Rao, Dr. Shanti Swarup Bhatnagar, Dr. Sima Chatterjee, Nobel laureate Venkatraman Ramakrishnan, Dr. Kamala Sohonie, Dr. Yellapragada Subba Rao, Dr. Darshan Ranganathan.	12	20
Unit III: Introduction of Chemistry	Matter, elements, atoms and molecules. Matter and its classification, Fundamental particles (electron proton, neutron), Atomic number and Mass number, Isotope, Isobar, Isotone, Importance of chemistry.	15	25
Unit IV: Introduction to Elements	Periodic Table, Groups, Periods, Metals, Non-metals and Metalloids, Uses of some elements in day today life (Sodium, Silver, Gold, Platinum, Copper, Tin, Magnesium, Iron etc.), Adverse effect of some elements (Arsenic, Fluorine, Cadmium, Lead etc.)	15	25

Reference Books:

5. Basic Chemistry, 5th Edn. K. Timberlake and W. Timberlake, Pearson
6. History of Chemistry in Ancient and Medieval India, P. C. Ray, Editor P. Ray and B.G. Guha.
7. Chemical Research of Sir P. C. Ray, S. Goswami and S. Bhattacharya, Resonance, 2001.
8. Life and Experiences of a Bengali Chemist, Vol I and II, P. C. Ray.

SEMESTER 2

CORE COURSE

PAPER NAME: GENERAL CHEMISTRY II
PAPER CODE: CHE-DSC-142
Total Credit: 4 (Theory: 3 + Practical: 1)

THEORY: 3 CREDITSTOTAL LECTURES: 45

Course Objectives:

This course aims to extend the concepts of chemical bonding and introduces the coordination chemistry. The students will be familiarized withthe chemistry of aromatic hydrocarbonswith special focus on benzene, its properties and reactivity. The knowledge of stereochemistry of organic compounds to be studied. The course covers the liquid state and chemical thermodynamics in details.

Course Outcome:

After successfully completing the course, the students will be able to:

- Memorize and understand the concepts of various theories of chemical bonding and coordination chemistry. Outline Huckel's rule, aromatic electrophilic substitution reaction, CIP sequence rule. Describe basic stereo chemical phenomena, three dimensional projection formulae.To define various terminologies regarding liquid state and thermodynamics
- Explain the role of ligands, central metal ions and coordination numbers in determining the structure and isomerism in coordination compounds. Explain aromatic character in heterocyclic compounds, Categorize aromatic, anti-aromatic, enantiomers, diastereomers, atropisomers etc. Explain various concepts like surface tension, viscosity, enthalpy, entropy, and Gibbs free energy
- Use nomenclature rules to name coordination compounds. Implement the VBT, MOT, and VSEPR theories of chemical bonding for the interpretation of chemical properties and structure in homo and heteronuclear diatomic molecules.
- Compare and contrast the strengths and weaknesses of VBT and MOT in describing molecular bonding. Relate thermodynamic functions to equilibrium and spontaneity of processes. Establish relationships between various thermodynamic properties andformulate Mathematical relationships between thermodynamic quantities. Compare directive influence and orientation of functional group in mono and di-substituted benzene. Design inter conversion of aromatic compounds. Apply the laws of thermodynamics and thermodynamic relationships,
- Evaluate the effectiveness of VBT, MOT and VSEPR theory and weak chemical forces in explaining observed molecular properties and the stability and reactivity of coordination complexes based on their structural features.

Unit	Contents	Contact hours	Marks
Unit I: Chemical Bonding II	Valence bond theory (Heitler London approach), Hybridization, types, orientation of hybrid orbitals; Bent's rule, Resonance and resonance energy. Molecular orbital theory, molecular orbital diagram of homonuclear (N_2, O_2) and heteronuclear (CO, NO, CN^-, HCl) diatomic molecules. Ionic character in covalent compounds: Bond moment and dipole moment, ionic character from dipole moment and electronegativities. Valence shell electron pair repulsion (VSEPR) theory, shapes of simple molecules and ions containing lone pairs and bond pairs of electrons. Weak Chemical forces and their effects on melting and boiling points and solubility.	9	15
Unit II: Coordination Chemistry	Definition and terminology; Ligands and their classification; Werner's Theory; IUPAC nomenclature of coordination compounds; Isomerism in coordination compounds. Stereochemistry of complexes with coordination number 4, 5 and 6.	6	10
Unit III: Aromatic Hydrocarbons	Hückel's rule of aromaticity, Aromatic character of arenes and heterocyclic compounds with suitable examples. Preparation (of benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid; Reactivity (of benzene): Electrophilic aromatic substitution and its mechanism: nitration, halogenation and sulphonation, Friedel-Craft's reaction (alkylation and acylation). Directing effects of the functional groups.	6	10
Unit IV: Stereochemistry of Organic Compounds	Concept of isomerism, Structural projections: Flying Wedge, Newmann, Sawhorse and Fischer representations and their interconversions. **Geometrical isomerism:** Restricted rotation about C=C bonds, Physical & Chemical properties of Geometrical isomers, Cis–trans and, syn-anti isomerism, E/Z notations with C.I.P rules. **Optical Isomerism**:Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Diastereomers, Meso compounds, Racemic mixture and resolution, Threo & Erythro forms, Relative and absolute configuration: D/L and R/S designations. Optically active molecules without chiral centre,	9	15

	Atropisomerism.		
Unit V: Liquid State	Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination; Effect of addition of various solutes on surface tension and viscosity; Temperature variation of viscosity of liquids and comparison with that of gases; Qualitative discussion of structure of water	7	12
Unit VI: Chemical Thermodynamics	Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions.	8	13

Reference books:

1. R. Gopalan& V. Ramalingam, *Concise Coordination Chemistry*, 1st Edition, Vikash Publishing House.
2. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, *Inorganic Chemistry* (Principles of Structure and Reactivity), 5th Edition, Pearson Education.
3. A. K. Das & M. Das, *Fundamental Concepts of Inorganic Chemistry*, Volume 4, 1st Edition, CBS Publishers & Distributors Pvt.Ltd..
4. J. D. Lee, *Concise Inorganic Chemistry*, 5th Edition, Pearson Education.
5. R. T. Morrison, R. N.Boyd& S. K. Bhattacharjee, *Organic Chemistry*, 7thEdition, Pearson Education.
6. T. W. G. Solomons, C. B. Fryhle, S. A. Snyder, *Organic Chemistry*, John Wiley & Sons, Inc.
7. P. Sykes, *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
8. P. Y. Bruice, *Organic Chemistry*, 7th Edition, Pearson Education.
9. J. Clayden, N. Greeves& S. Warren, *Organic Chemistry*, 2nd Edition, Oxford University Press.

10. E. L. Eliel & S. H. Wilen, *Stereochemistry of Organic Compounds*, Wiley London, 1994.
11. D. Nasipuri, *Stereochemistry of Organic Compounds: Principles and Applications*, 4th Edition, New Age International Publishers.
12. P. S. Kalsi, *Stereochemistry Conformation and Mechanism*, New Age International,
13. S. Sengupta, *Basic Stereochemistry of Organic Molecules*, Oxford higher education.
14. P. Atkins, J. de Paula, J. Keeler, *Atkin's Physical Chemistry*,12th Edition, Oxford University Press.
15. B. R. Puri, L. R. Sharma, M. S. Pathania, *Principles of Physical Chemistry*, 48th Edition, Vishal Publishing Co.
16. K. L. Kapoor, *A Textbook of Physical Chemistry*, Volume 1, 6th Edition, McGraw Hill Education.
17. I. N. Levine, *Physical Chemistry*, 6th Edition, Tata McGraw Hill.

PRACTICAL: 1 CREDIT **TOTAL LECTURES: 30**

Course Objectives:

The laboratory course will cover the preparation of coordination complex,detection of elements in organic sample along with its unsaturation and aromaticity, preparation and measurement of pH of buffer solution and determination of heat capacity.

Course Outcome:

After successfully completing the course, the students will be able to:

- Apply the knowledge in the preparation of co-ordination compounds.
- Apply the knowledge in the determination of hardness of water by EDTA titration
- Execute the knowledge in the detection of elements, unsaturation and aromaticity of organic compounds.
- Apply the knowledge to prepare the buffer solution and to examine the pH of solution.
- Execute the knowledge to determine the heat capacity of a calorimeter.

Experiments:

1. Synthesis of co-ordination compounds:
   a. Preparation of Tris(thiourea)Cu(II) sulphate.
   b. Preparation of Potassiumtrioxalatochromate(III).
2. Determination of hardness of water by EDTA titration.
3. Detection of presence of unsaturation and aromaticity in an organic sample.
4. Detection of extra elements N, S and halogens in an organic sample.
5. Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

6. Preparation of the following buffer solutions and determination of their pH using pH meter.
   (i)Sodium acetate-acetic acid
   (ii) Ammonium chloride-ammonium hydroxide

Reference Books:

1. A. I. Vogel, A Test book of Quantitative Inorganic Analysis (Rev. by GH Jeffery and others) 5th Edition.
2. A. I. Vogel, *Elementary Practical Organic Chemistry*, Part 2: Qualitative Organic Analysis, Pearson Education.
3. F. G. Mann & B. C. Saunders, *Practical Organic Chemistry*, Pearson Education (2009)
4. V. K. Ahluwalia & S. Dhingra, Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

SKILL ENHANCEMENT COURSE

PAPER NAME: CHEMISTRY OF SOIL AND WATER
PAPER CODE: CHE-SEC-132
Total Credits: 3 (Theory: 2 + Practical: 1)

THEORY: 2 Credits **TOTAL LECTURES: 30**

Course Objectives:

This course aims to extend the concept of soil and water chemistry to the students.

Course Outcome:

After successfully completing the course, students will be able to:

- Remember and understand the basic concepts of soiland pure water, their components and different properties
- Apply the knowledge of water and soil to analyze causes of their pollution and its control.
- Evaluate the quality of soil and water samples practically in the laboratory.

Unit	Contents	Contact hours	Marks
Unit 1: Chemistry of Soil	Definition of soil, soil formation, characteristics of soil (soil texture and soil structure), Composition of soil (Inorganic and organic components, water and air in soil), Soil organisms, soil profile, soil reactions: cation and anion exchange reactions, soil pH, essential elements, macro and micro nutrients, basic ideas of soil analysis. Soil pollution: Soil pollutants, sources and classification, causes of soil pollution, nutrient leaching, acidification, salinity and alkalinity, metal contamination, controlling soil pollution.	15	25
Unit 2: Chemistry of Water	Definition of pure water, pH, acidity and alkalinity of water, dissolved oxygen (DO), salinity, hardness and conductivity of water. Water pollution: Water pollutants, sources and classification, organic water pollutants (oxygn demanding waste, synthetic organic chemicals, pesticides, pathogens and plant nutrients), radioactive pollution of water. Sampling of water, water purification methods.	15	25

PRACTICAL: 1 Credit TOTAL LECTURES: 30

Course Objectives:

The laboratory course will cover the determination of some water parameter, like pH, TDS and total hardness. The pH of a soil and the calcium and magnesium present in the soil will be estimated.

Course Outcome:

After successfully completing the course, students will be able to:

- Execute the knowledge in the determination of pH, TDS and total hardness of water samples.
- Execute the knowledge in the determination calcium and magnesium present in soil samples.

Experiments:

1. Determination of pH and TDS of different water samples.
2. Determination of total hardness of water.
3. Determination of pH of different soil samples.
4. Estimation of Calcium and Magnesium present in soil samples.

Reference Books:

1. S. M. Khopkar, *Basic Concepts of Analytical Chemistry*, New Age International Publisher, 2009.
2. D. A. Skoogs, D. M. West and F. J. Holler, *Fundamentals of Analytical Chemistry*, 9th Edition, Brooks/Cole Cengage Learning.

MULTIDISCIPLINARY COURSE

PAPER NAME: BASIC CONCEPTS OF CHEMISTRY - II
PAPER CODE: CHE-MDC-132
Total Credit: 3 (Theory: 3)

THEORY: 3 CREDITS **TOTAL LECTURES: 45**

Course Objectives:
This course aims to familiarize students with the relevance of chemistry in everyday life.

Course Outcome:
After successfully completing the course, the students will be able to

- Understand some basic ideas of Chemistry in terms of organic molecules, acid-base and biomolecules.
- Understand and apply the basic knowledge of environment

Unit	Contents	Contact hours	Marks
Unit I: Introduction to Organic Chemistry	Classification of organic compounds, aliphatic and aromatic hydrocarbons, Alkane, Alkene, Alkyne and Benzene Introduction to petrol, diesel, kerosene, naptha, coal tar, CNG, LPG, PNG etc.	15	25
Unit II: Acid, Base and Salt	Introduction to acids, bases and salts. pH-scale, significance of pH. pH of some common fruits, vegetables and soft drinks.	9	15
Unit III: Environmental Chemistry	Ozone layer and ozone layer depletion, Greenhouse gases, fog, Acid rain, Type of pollution and causes.	12	20
Unit IV: Biomolecules	Carbohydrates, Amino Acids, Proteins, Vitamins, Nucleic acids (DNA and RNA) and Enzymes.	9	15

Reference Books:

1. Basic Chemistry, 5th Edn. K. Timberlake and W. Timberlake, Pearson
2. Basics of Environmental Chemistry, Notion Press, K Nagaraj.
3. Text-Book on Organic Chemistry, S. Chand & Company Ltd, B. S. Bhal and Arun Bhal