DEPARTMENT OF CHEMISTRY

COURSE CURRICULUM & MARKING SCHEME

B.Sc. I, II, III, IV Semester

CHEMISTRY

(Based on Choice Based Credit System)

SESSION : 2023-24

ESTD : 1958

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG, 491001 (C.G.)

(Former Name – Govt. Arts & Science College, Durg)

NAAC Accredited Grade A+, College with CPE - Phase III (UGC), STAR COLLEGE (DBT)

Phone : 0788-2212030

Website - www.govtsciencecollegedurg.ac.in, Email – autonomousdurg2013@gmail.com

SYLLABUS

DEPARTMENT OF CHEMISTRY

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG (C.G.)

CBCS Syllabus
for
B.Sc. (Chemistry) Semester I & II
(Based on NEP-2020, UGC-LOCF& Revised according to CG Govt. HE Scheme)

Session 2023-24

DEPARTMENT OF CHEMISTRY
GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG
Approved Syllabus for
B.Sc. CHEMISTRY by the members of Board of Studies for Session 2023-24
Scheme and Syllabus for B.Sc. Year 1 (Semester I & II)

Scheme for B.Sc. Program with Chemistry - First Year
(with 3 Subjects A, B*, C*Subject A-Chemistry)

Semester	Discipline Specific Course/ Core Course DSC (Credit-4)	Generic Elective Course GEC (Credit-4)	Skill Enhancement Course SEC (Credit-2)	Ability Enhancement Course AEC (Credit-2)	Value Added Course VAC (Credit-2)	Total Credits
1	Chemistry 1 Fundamentals of Chemistry - I (Th=3, P=1) SubjectB1 (Th=3, P=1) Subject C1(Th=3, P=1)	Choose any one course other than DSC (Th=3, P=1)	Choose 1 from pool of SEC (Th=1, P=1)	Hindi Language (Th-2)	Sports (for Bio Group)/ Yoga (for Maths Group (Th=1, P=1)	22
2	Chemistry 2 Fundamentals of Chemistry - II (Th=3 P=1) SubjectB2 (Th=3 P=1) Subject C2(Th=3,P=1)	Choose any one course other than DSC (Th=3, P=1)	Choose 1 from pool of SEC (Th=1, P=1)	English Language(Th -2)	Sports/Yoga (Th=1, P=1)	22
Students on exit shall be awarded undergraduate certificate (in the field of Multidisciplinary Study) after securing the requisite 44 credits in Semester I and II						

*Maths/Physics/Botany/Zoology/Microbiology/Zoology/Geology/Biotechnology/Biochemistry/IndustrialChemistry/Anthropology

DEPARTMENT OF CHEMISTRY
GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG
Approved Syllabus for
B.Sc. CHEMISTRY by the members of Board of Studies for the Session 2023-24
Scheme and Syllabus for B.Sc. Year 1 (Semester I & II)

Courses and Marking Scheme for First-year B.Sc. with Chemistry

Year	Sem.	Course Code	Paper Title	Theory/ Practical	Credits	Marks	Sem End	IA
Certificate in Science								
Discipline Specific Courses – DSC (Core Courses)								
I	I	BCHC 101	Fundamentals of Chemistry - I	Theory	3	75	60	15
		BCHL 101	Lab Course - 1	Practical	1	25		
	II	BCHC 201	Fundamentals of Chemistry - II	Theory	3	75	60	15
		BCHL 201	Lab Course -2	Practical	1	25		
	Skill Enhancement Courses - SEC							
	I & II	BCHS 01	Good lab practices in Chemistry	Theory	1	25	20	05
				Practical	1	25		
		BCHS 02	Water remediation and conservation studies	Theory	1	25	20	05
				Practical	1	25		

Note: Semester End – 80% and Internal Assessment (IA) – 20% (Weightage of marks internal examinations will be included as per guidelines of Autonomous Examination Cell)
Minimum Pass: **40% End Semester and IA separately**

DEPARTMENT OF CHEMISTRY
GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG
Approved Syllabus for
B.Sc. CHEMISTRY by the members of Board of Studies for the Session 2023-24
Scheme and Syllabus for B.Sc. Year 1 (Semester I & II)

LIST OF COURSES OFFERED BY DEPARTMENT OF CHEMISTRY
For students opting B.Sc. with Chemistry (First Year)

Discipline Specific Courses/Core Papers DSC (Credits: 04 each; T= Theory. P = Practical)

1. BCHC 101: Fundamentals of Chemistry - I (T- 3, P- 1); BCHL 101: Practical
2. BCHC 201: Fundamentals of Chemistry - II (T- 3, P-1); BCHL 201: Practical

Skill Enhancing Courses SEC (Credits:02)

1. BCHS 01: Good lab practices in Chemistry (T- 1, P- 1)
2. BCHS 02: Water remediation and conservation studies (T- 1, P- 1)

For students opting UG without Chemistry

Generic Electives Courses GEC (Credits: 04 each; T= Theory. P = Practical)

1. BCHC 101: Fundamentals of Chemistry - I (T- 3, P- 1); BCHL 101: Practical
2. BCHC 201: Fundamentals of Chemistry - II (T- 3, P-1); BCHL 201: Practical

The syllabus for B.Sc. (Chemistry) Semester I & II is hereby approved for the Session 2023-24
NAME AND SIGNATURE:

Chairperson /H.O.D	Departmental members:
Subject Expert	.....
(University Nominee)	.....
Subject Expert.....	.....
Subject Expert.....	.....
	.....
Representative.....	.....
(Industry)	.....
Representative.....	.....
(Alumni)	.....
Representative.....	.....
(Student)	.....
Representative	.....
(Professor Science Faculty Other Dept.)	.....
	.....

B.Sc. Semester - I (CHEMISTRY)

B.Sc. (with CHEMISTRY)

Programme Specific Outcome (PSO):

Upon completion of the B.Sc. Degree (with Chemistry), the students will be able to:

PSO1: Understand the fundamentals/concepts/theories in various branches of chemistry.

PSO2: Compare and justify various aspects, deduce and derive expressions, reaction mechanisms.

PSO3: Apply the principles/concepts and rules in finding their solutions.

PSO4: Carry out experiments, record the observations, understand handling of apparatus/instruments.

B. Sc. Semester - I (CHEMISTRY)

2023-24

Core Course - I (Theory)

DSC-1/GEC-1

BCHC 101: FUNDAMENTALS OF CHEMISTRY - I

Course Outcome (CO):

After completion of the course, students would be able to:

CO1: Explain atomic structure, wave mechanical concept and electronic configuration and discuss about periodic properties and their variations along periods and groups.

CO2: Explain chemical bonding involved in ionic and covalent compounds.

CO3: Discuss the basic concepts of organic reactions, reaction mechanism, reaction intermediates, various types of organic reactions, define terminology associated with stereochemistry, impact of chirality on optical activity and geometrical isomerism.

CO4: Describe the kinetic molecular model of a gas, laws related to ideal gases and interpret behaviour of real gases.

CO5: Discuss the chemistry of liquid state and solid state and its application.

B. Sc. Semester - I (CHEMISTRY)
2023-24
Core Course - 1 (Theory)
DSC-1/GEC-1
BCHC 101: FUNDAMENTALS OF CHEMISTRY - I

[Credits -03]

UNIT – I ATOMIC STRUCTURE AND PERIODICITY

Atomic Structure: Bohr's theory, its limitation and atomic spectrum of hydrogen atom. General idea of de-Broglie matter-waves, Heisenberg uncertainty principle, Schrödinger wave equation, significance of Ψ and Ψ^2, radial and angular wave functions and probability distribution curves, quantum numbers, atomic orbital and shapes of s, p, d orbitals, Aufbau and Pauli exclusion principles, Hund's Multiplicity rule, electronic configuration of the elements.

Periodicity of Elements: The long form of periodic table. Detailed discussion of the following periodic properties of the elements, with reference to s and p- block. Trends in periodic table and applications in predicting and explaining the chemical behavior.

a) Atomic and ionic radii,
b) Ionization enthalpy,
c) Electron gain enthalpy,
d) Electronegativity, Pauling's, Mullikan's, Allred Rochow's scales.
e) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

UNIT – II CHEMICAL BONDING

Ionic bond: Ionic Solids - Ionic structures, radius ratio & co-ordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy Born- Haber cycle, Solvation energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rule, Ionic character in covalent compounds: Bond moment and dipole moment, Percentage ionic character from dipole moment and electronegativity difference, Metallic bond-free electron, Valence bond & band theories. Intermolecular Forces – various types.

Covalent bond: Lewis structure, Valence bond theory and its limitations, Concept of hybridization, Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O, NH_3, PCl_3, PCl_5, SF_6. H_3O^+, SF_4, ClF_3, and ICl_2^- Molecular orbital theory. Bond order and bond strength, Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, F_2, CO, NO.

UNIT – III BASICS OF ORGANIC CHEMISTRY

Fundamentals: Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric

effects, hyperconjugation and their applications; Dipole moment. Electrophiles and Nucleophiles; Nucleophilicity and basicity; Homolytic and Heterolytic cleavage, Generation, shape and relative stability of Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes and Benzynes. Introduction to types of organic reactions: Addition, Elimination and Substitution reactions.

Stereochemistry: Fischer Projection, Newman and Sawhorse Projection formulae and their inter-conversions; Geometrical isomerism: 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, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

UNIT – IV GASEOUS STATE CHEMISTRY

Kinetic molecular model of a gas: Postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path; Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Joule Thomson effect, Liquification of gases.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor (Z), and its variation with pressure and temperature for different gases. Causes of deviation from ideal behaviour. Vander Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); calculation of Boyle temperature. Isotherms of real gases and their comparison with Vander Waals isotherms, continuity of states, critical state, relation between critical constants and Vander Waals constants, law of corresponding states.

UNIT – V LIQUID AND SOLID-STATE CHEMISTRY

Liquid state: Structure of liquids, Properties of liquids, viscosity and surface tension. Effect of addition of various solutes on surface tension and viscosity, Explanation of cleansing action of detergents.

Solid state: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, crystal systems and Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Crystal defects.

RECOMMENDED BOOKS/REFERENCES

Inorganic Chemistry

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D. Lee, ELBS.

3. Concepts of models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and Alexander, John Wiley.
4. Inorganic Chemistry, D.E. Shriver, P.W. Atkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W.W. Porterfield, Addison Wesley.
6. Inorganic Chemistry, A.G. Sharp, ELBS.
7. Inorganic Chemistry, G.L. Micssles and D.A. Tarr, Prentice Hall.
8. Advanced Inorganic Chemistry, Satya Prakash.
9. Advanced Inorganic Chemistry, Agrawal & Agrawal.
10. Advanced Inorganic Chemistry, Puri & Sharma, S. Chand.
11. Inorganic Chemistry, Madan, S. Chand.

Organic Chemistry

1.Organic Chemistry, Morrison and Boyd, Prentice-Hall.
2.Organic Chemistry, L.G. Wade Jr. Prentice-Hall.
3.Fundamentals of Organic Chemistry, Solomons, john Wiley.
4. Organic Chemistry, Vol.-I, II & III S.M. Mukherjee, S.P. Singh and R.P. Kapoor, Wiley-Eastern (New-Age).
5.Organic Chemistry, FA Carey, MC Graw Hill.
6.Organic Chemistry, P.L. Soni.
7.Organic Chemistry, Bahl & Bahl.

Physical Chemistry

1. Physical Chemistry, R.A. Alberty, Wiley Eastern.
2. The elements of Physical Chemistry, P.W. Atkins, Oxford.
3. Physical Chemistry, Puri and Sharma, S. Chand.
4. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press(2006).
5. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
7. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
8. G. M. Barrow, Tata McGraw Hill (Fifth Edition) (2007)

Question Paper Format and Distribution of Marks

1. The question paper will be divided into three Sections - A, B & C.
2. Section A shall contain very short answer type questions (answer in one or two sentences) or objective type questions. (**No Multiple-choice, no 'Fill in the blank' type Questions**)
3. Section B shall contain short answer type questions with the limit of 150 words.
4. Section C shall contain long answer/descriptive type questions. The students are required to answer precisely, and the answer should not exceed the limit of 350 words.
5. The scheme of marks for **End Semester Exam** should be as follows :

Question Type	MM 60 (Marks x No. of Questions)
A (Very short Answer)	1 x10 = 10
B (Short Answer)	3 x5 = 15
C (Long Answer)	7 x5= 35
Total	60

B.Sc. Semester - I (CHEMISTRY)
2023-24
Core Course - I (Practical)
DSC-1/GEC-1
BCHL 101: LAB COURSE - 1

Course Outcome:

After completion of the course, the students would be able to:

CO1: Determine the concentration of unknown solution by titration.

CO2: Identify laboratory glass wares and apparatus and its uses and understand various scientific techniques in organic chemistry.

CO3: Perform experiments based on physical aspects and calculate parameters.

B.Sc. Semester - I (CHEMISTRY)
2023-24
Core Course - I (Practical)
DSC-1/GEC-1
BCHL 101: LAB COURSE - 1

[Credits -01]

The following experiments are to be conducted during the curriculum.

1. INORGANIC CHEMISTRY

[A] Acid-BaseTitrations

1. Standardization of sodium hydroxide by oxalic acid solution.
2. Determination of strength of HCl solution using sodium hydroxide as intermediate.
3. Estimation of carbonate and hydroxide present together in mixture.
4. Estimation of carbonate and bicarbonate present together in a mixture.
5. Estimation of free alkali present in different soaps/detergents

[B] RedoxTitrations

1. Standardization of $KMnO_4$ by oxalic acid solution.
2. Estimation of Fe(II) using standardized $KMnO_4$ solution.
3. Estimation of oxalic acid and sodium oxalate in a given mixture.
4. Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) as external indicator.

[C] Iodo / IodimetricTitrations

1. Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution iodimetrically.
2. Estimation of (a) arsenite and (b) antimony iodimetrically.
3. Estimation of available chlorine in bleaching powder iodometrically.
4. Estimation of Copper and Iron in mixture by standard solution$K_2Cr_2O_7$usingsodium thiosulphate solution as titrants.

2. ORGANIC CHEMISTRY

1. Demonstration of laboratory Glasswares and Equipments.
   - Calibration of the thermometer w.r.t. Naphthalene, Acetanilide, Urea, Water
2. Purification of organic compounds by crystallization using different solvents.
   - Phthalic acid from hot water (using fluted filter paper and stemless funnel).
   - Acetanilide from boiling water.
   - Naphthalene from ethanol.
   - Benzoic acid from water.
3. Determination of the melting points of organic compounds.
   Naphthalene, Benzoic acid, Urea, Succinic acid, Cinnamic acid, Salicylic acid, Acetanilide, m-Dinitrobenzene, p-Dichlorobenzene, Aspirin.
   - Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.
   - Urea – Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1).

4. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method).
   - Ethanol, Cyclohexane, Toluene, Benzene.

   i. Distillation (Demonstration)
   - Simple distillation of ethanol-water mixture using water condenser.
   - Distillation of nitrobenzene and aniline using air condenser.

   ii. Sublimation
   - Camphor, Naphthalene, Phthalic acid and Succinic acid.

   iii. Decolorisation and crystallization using charcoal.
   - Decolorisation of brown sugar with animal charcoal using gravity filtrations crystallization and decolorisation of impure naphthalene (100 g of naphthalene mixed with 0.3 g of Congo red using 1 g of decolorizing carbon) from ethanol.

3. PHYSICAL CHEMISTRY

1. Surface tension measurements.
   - Determine the surface tension by (i) drop number (ii) drop weight method.
   - Surface tension composition curve for a binary liquid mixture.

2. Colloids
   - To prepare colloidal solution of silver nanoparticles (reduction method) and other metal nanoparticles using capping agents.

Note: Experiments may be added/ deleted subject to availability of time and facilities

B.Sc. (CHEMISTRY)
2023-24
Skill Enhancement Course – 1 (SEC-1)
BCHS 01: GOOD LAB PRACTICES IN CHEMISTRY
THEORY AND PRACTICAL

[Credits -02 (Th-01, Practical-01); 30 hrs.]

Course outcome:

After completing the course students will be able to:

CO1: Understand general laboratory practices
CO2: Prepare standard BCsolutions
CO3: Handle glasswares and chemicals
CO4: Explore various research issues and their solutions
CO5: Apply practical skills in Chemistry

THEORY

A. Common calculations in chemistry laboratories. Understanding the details on the label of reagent bottles.

Inorganic and organic reagents (Baeyer's reagent, Nessler's reagent, Fehling solution A and B, Shiff's reagents, Tollen's reagent, Molish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, Dimethyl glyoxime, H_2S gas); chemicals such as acids, bases, indicators, etc. used in chemistry lab for qualitative analysis .

B. Molarity and normality of common acids and bases. Preparation of solutions – solid and liquids, Molar, Molal and Normal solutions, Dilutions. Percentage solutions.

PRACTICAL

A. Technique and uses of handling glass wares; calibrations, knowledge about common toxic chemicals and safety measures in their handling.

B. Qualitative test of CO_3^{2--}, CH_3COO^-, SO_4^{2-}, Cl^-, NO_3^-, NH_4^+, Cu^{2+}, Fe^{3+}, Ni^{2+}, Ba^{2+}, Mg^{2+}

Or

Preparation of standard solutions of solids and liquids – Normal, Molar and percentage solutions; dilutions.

C. Qualitative elemental analysis for Nitrogen, Sulphur, Halogen in organic compounds.

Or

Preparation of inorganic and organic reagents - Baeyer's reagent, Nessler's reagent, Fehling solution A and B, Shiff reagents, Tollen's reagent, Molish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia and their application in analysis.

Reference Books

1. Seiler, J.P. (2005). Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 2nd ed.
2. Garner, W.Y., Barge M.S., Ussary. P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.

Distribution of Marks

Total Marks: 25 (80% End Semester Exam and 20% Internal Assessment)
Internal assessment – Assignment of 25 marks, Out of 10, five questions to be attempted
(Weightage of marks internal examinations will be included and Question Paper pattern as per guidelines of Autonomous Examination Cell)

B.Sc. (CHEMISTRY)
2023-24
Skill Enhancement Course – 2 (SEC-2)
BCHS 02: WATER REMEDIATION AND CONSERVATION STUDIES THEORY AND PRACTICAL

[Credits -02 (Th-01, PR-01) 30 hrs.]

Course outcome:

After completing the course students will be able to:

CO1: Understand about Sources and Effect of Water Pollution

CO2: Learn about various control technique

THEORY:

Water Pollution

Sources of water pollutants, pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality.

Remediation Techniques

Remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonada techniques, reverse osmosis, activated charcoal detoxification, mechanisms of detoxification, bio-remediation, need of green chemistry, future scope.

Water Conservation

Introduction to water conservation and erosion of soil, forms of water erosion, factors affecting water erosion, types of water erosion, mechanics of water erosion control,

PRACTICAL:

Water analysis (pH, Conductivity, hardness, Acidity, Alkalinity etc.)

Case study/Project

Case study/Project on water pollution, water conservation and water quality.

Recommended Books/references:

1. Cittenden J. C. , Trussell J. R., Hand D. W., Howe K. J., Tchobanoglous G. , Water treatment: Principles and Design MWH publication.
2. De A. K. Environmental Chemistry, Wiley Eastern
3. Clarson D., Dara S. S. A text book of Environmental chemistry and pollution control, S. Chand Co. Soil and water analytical method
4. Edzwald J., Water Quality & Treatment: A Handbook on Drinking Water (Water Resources and Environmental Engineering Series)

Distribution of Marks

Total Marks: 25 (80% End Semester Exam and 20% Internal Assessment)

Internal assessment – Assignment of 25 marks, Out of 10, five questions to be attempted

(Weightage of marks internal examinations will be included and Question Paper pattern as per guidelines of Autonomous Examination Cell)

B.Sc. Semester - II (CHEMISTRY)

2023-24

Core Course - 2 (Theory)

DSC-2/GEC-2

BCHC 201: FUNDAMENTALS OF CHEMISTRY - II

Course Outcome (CO):

After completion of the course, students would be able to:

CO1: Explain propertiesof s and p- block elements and noble gases.

CO2: Interpret the reactions, properties and mechanisms of reactions involved in alkanes, alkenes and alkynes and understand the conformation of alkanes and cycloalkanes, Baeyer's strain theory and conformations of substituted cycloalkanes.

CO3: Describe the aromaticity and mechanisms of typical aromatic reactions.

CO4: Classify different colloids and discuss the principles, properties and application of colloids and liquid crystals adsorption and adsorption isotherms.

CO5: Define various terms associated with chemical kinetics, derive rate equations/rate laws and describe various theories of rate, types of catalysis, catalysts and its industrial applications.

B.Sc. Semester - II (CHEMISTRY)

2022-23

Core Course - 2 (Theory)

DSC-2/GEC-2

BCHC 201: FUNDAMENTALS OF CHEMISTRY - II

[Credits -03]

UNIT – I CHEMISTRY OF s-and p-BLOCK ELEMENTS

s-block: General concepts on group relationships and gradation properties. Comparative study, salient features of hydrides, solvation & complexation tendencies including their function in biosystems and introduction to alkyl and aryls,

p-block: General concepts on group relationships and gradation properties. Halides, hydrides, oxides and oxyacids of Boron, Aluminum, Nitrogen and Phosphorus. Boranes, borazines, fullerenes.

Noble gases: Chemical properties of the noble gases, chemistry of xenon, structure, bonding in xenon compounds.

UNIT – II CHEMISTRY OF ALIPHATIC HYDROCARBONS

Carbon-Carbon sigma bonds: Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation

Carbon-Carbon pi bonds: Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.
Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), oxidation, ozonolysis, reduction (catalytic and chemical), 1,2- and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.
Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

Cycloalkanes and Conformational Analysis: Conformational analysis of alkanes, ethane, butane and cyclohexane. Relative stability and Energy diagrams. Types of cycloalkanes and their relative stability, Baeyer strain theory: Theory of strainless rings, Chair, Boat and Twist boat conformation of cyclohexane with energy diagrams.

UNIT–III CHEMISTRY OF AROMATICHYDROCARBONSAND ALKYL/ARYL HALIDES

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism.

Halogenated Hydrocarbons:
Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent, nucleophile and temperature; nucleophilic substitution vs. elimination.
Aryl halides: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; SNAr, Benzyne mechanism.

UNIT-IV COLLOIDS, LIQUID CRYSTALS AND SURFACE CHEMISTRY
Colloids: Classification, optical, kinetic and electrical properties of colloids, coagulation, Hardy Schulze law, flocculation value, protection, gold number, Emulsion, micelles and types, Gel. Application of colloids.

Liquid crystals: Types, structure and applications.

Adsorption: Physical adsorption, chemisorption, adsorption isotherms (Langmuir and Freundlich). Nature of adsorbed state.

UNIT – V CHEMICAL KINETICS AND CATALYSIS
Chemical kinetics: Rate of reaction, factors influencing rate of reaction, rate law, rate constant, Order and molecularity of reactions, rate determining step, Zero, First and Second order reactions, Rate and Rate Law, methods of determining order of reaction, Chain reactions. Temperature dependence of reaction rate, Arrhenius theory, Physical significance of Activation energy, collision theory, demerits of collision theory.

Catalysis: Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristic of catalyst, Enzyme catalyzed reactions, Industrial applications of catalysis.

RECOMMENDED BOOKS/REFERENCES

Inorganic Chemistry

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D. Lee, ELBS.
3. Concepts of models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and Alexander, John Wiley.
4. Inorganic Chemistry, D.E.Shriver, P.W. Atkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W.W. Porterfield, Addison Wesley.
6. Inorganic Chemistry, A.G. Sharp, ELBS.
7. Inorganic Chemistry, G.L.Micssles and D.A.Tarr, Prentice Hall.
8. Advanced Inorganic Chemistry, Satya Prakash.
9. Advanced Inorganic Chemistry, Agrawal & Agrawal.
10. Advanced Inorganic Chemistry, Puri & Sharma, S. Chand.
11. Inorganic Chemistry, Madan, S.Chand.

Organic Chemistry

1.Organic Chemistry, Morrison and Boyd, Prentice-Hall.
2.Organic Chemistry, L.G. Wade Jr. Prentice-Hall.
3.Fundamentals of Organic Chemistry, Solomons, john Wiley.
4. Organic Chemistry, Vol.-I, II & III S.M. Mukherjee, S.P. Singh and R.P. Kapoor, Wiley-Eastern (New-Age).
5.Organic Chemistry, FA Carey, MC Graw Hill.
6. Introduction to Organic Chemistry, Struiweisser, Heathock and Kosover, Macmillan.
7.Organic Chemistry, P.L. Soni.
8.Organic Chemistry, Bahl & Bahl.
9.Organic Chemistry, Joginder Singh.

Physical Chemistry

1. Physical Chemistry, R.A. Alberty, Wiley Eastern.
2. The elements of Physical Chemistry, P.W. Atkins, Oxford.
3. Physical Chemistry, Puri and Sharma, S. Chand.
4. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press.
5. Ball, D. W. Physical Chemistry Thomson Press, India.
6. Castellan, G. W. Physical Chemistry 4th Ed. Narosa.
7. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA.
8. G. M. Barrow, Tata McGraw Hill (Fifth Edition).

Question Paper Format and Distribution of Marks

1. The question paper will be divided into three Sections - A, B & C.
2. Section A shall contain very short answer type questions (answer in one or two sentences) or objective type questions. (**No Multiple-choice questions, no 'Fill in the blank' type Questions**)
3. Section B shall contain short answer type questions with the limit of 150 words.
4. Section C shall contain long answer/descriptive type questions. The students are required to answer precisely, and the answer should not exceed the limit of 350 words.
5. The scheme of marks for **End Semester Exam** should be as follows :

Question Type	MM 60 (Marks x No. of Questions)
A (Very short Answer)	1 x10 = 10
B (Short Answer)	3 x5 = 15
C (Long Answer)	7 x5= 35
Total	60

B.Sc. Semester - II (CHEMISTRY)
2023-24
Core Course - 2 (Practical)
DSC-2/GEC-2
BCHL 201: LAB COURSE - 2

Course Outcome:

After completion of the course, the students would be able to:

CO1: Apply the various aspects of qualitative analysis in inorganic mixture.

CO2: Identify functional groups present in organic compounds.

CO3: Perform experiments based on physical aspects and calculate parameters.

B.Sc. Semester - II (CHEMISTRY)
2023-24
Core Course - 2 (Practical)
DSC-2/GEC-2
BCHL 201: LAB COURSE - 2

[Credits -01]

The following experiments are to be conducted during the curriculum.

1. INORGANIC CHEMISTRY
   Qualitative analysis (using H_2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding interfering, insoluble salts) out of the following:

   Cations : NH^{4+}, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Na^{+}

   Anions : CO_3^{2-} , SO_3^{2-}, SO_4^{2-}, S^{2-}, NO_3^{-}, CH_3COO^{-}, Cl^{-}, Br^{-}, I^{-}, $NO2^{-}$, (Spot tests may be carried out wherever feasible)

2. ORGANIC CHEMISTRY
   Qualitative Analysis

   Detection of elements (N, S and halogens) and functional groups (Phenolic, Carboxylic, Carbonyl, Esters, Carbohydrates, Amines, Amides, Nitro and Anilide) in simple organic compounds.

3. PHYSICAL CHEMISTRY

1. Viscosity measurement using Ostwald's viscometer.
   - Determination of viscosity of aqueous solutions of (i) sugar (ii) ethanol at room temperature.
   - Study of the variation of viscosity of sucrose solution with the concentration of solute.
   - Viscosity Composition curve for a binary liquid mixture.

2. Chemical Kinetics
   - To determine the specific rate of hydrolysis of methyl/ethyl acetate catalysed by hydrogen ions at room temperature.
   - To study the effect of acid strength on the hydrolysis of an ester.
   - To compare the strengths of HCl & H_2SO_4 by studying the kinetics of hydrolysis of ethylacetate.

Note: Experiments may be added/ deleted subject to availability of time and facilities.

B.Sc. (CHEMISTRY)
2023-24
Skill Enhancement Course – 1 (SEC-1)
BCHS 01: GOOD LAB PRACTICES IN CHEMISTRY
THEORY AND PRACTICAL

|Credits -02 (Th-01, Practical-01); 30 hrs.|

Course outcome:

After completing the course students will be able to:

CO1: Understand general laboratory practices
CO2: Prepare standard BCsolutions
CO3: Handle glasswares and chemicals
CO4: Explore various research issues and their solutions
CO5: Apply practical skills in Chemistry

THEORY

A. Common calculations in chemistry laboratories. Understanding the details on the label of reagent bottles.
Inorganic and organic reagents (Baeyer's reagent, Nessler's reagent, Fehling solution A and B, Shiff's reagents, Tollen's reagent, Molish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, Dimethyl glyoxime, H_2S gas); chemicals such as acids, bases, indicators, etc. used in chemistry lab for qualitative analysis .

B. Molarity and normality of common acids and bases. Preparation of solutions – solid and liquids, Molar, Molal and Normal solutions, Dilutions. Percentage solutions.

PRACTICAL

A. Technique and uses of handling glass wares; calibrations, knowledge about common toxic chemicals and safety measures in their handling.

B. Qualitative test of CO_3^{2--}, CH_3COO^-, SO_4^{2-}, Cl^-, NO_3^-, NH_4^+, Cu^{2+}, Fe^{3+}, Ni^{2+}, Ba^{2+}, Mg^{2+}

Or

Preparation of standard solutions of solids and liquids – Normal, Molar and percentage solutions; dilutions.

C. Qualitative elemental analysis for Nitrogen, Sulphur, Halogen in organic compounds.

Or

Preparation of inorganic and organic reagents - Baeyer's reagent, Nessler's reagent, Fehling solution A and B, Shiff reagents, Tollen's reagent, Molish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia and their application in analysis.

Reference Books

1. Seiler, J.P. (2005). Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 2nd ed.
2. Garner, W.Y., Barge M.S., Ussary. P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.

Distribution of Marks

Total Marks: 25 (80% End Semester Exam and 20% Internal Assessment)
Internal assessment – Assignment of 25 marks, Out of 10, five questions to be attempted
(Weightage of marks internal examinations will be included and Question Paper pattern as per guidelines of Autonomous Examination Cell)

B.Sc. (CHEMISTRY)
2023-24
Skill Enhancement Course – 2 (SEC-2)
BCHS 02: WATER REMEDIATION AND CONSERVATION STUDIES THEORY AND PRACTICAL

[Credits -02 (Th-01, PR-01) 30 hrs.]

Course outcome:

After completing the course students will be able to:

CO1: Understand about Sources and Effect of Water Pollution

CO2: Learn about various control technique

THEORY:

Water Pollution

Sources of water pollutants, pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality.

Remediation Techniques

Remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonada techniques, reverse osmosis, activated charcoal detoxification, mechanisms of detoxification, bio-remediation, need of green chemistry, future scope.

Water Conservation

Introduction to water conservation and erosion of soil, forms of water erosion, factors affecting water erosion, types of water erosion, mechanics of water erosion control,

PRACTICAL:

Water analysis (pH, Conductivity, hardness, Acidity, Alkalinity etc.)

Case study/Project

Case study/Project on water pollution, water conservation and water quality.

Recommended Books/references:

1. Cittenden J. C. , Trussell J. R., Hand D. W., Howe K. J., Tchobanoglous G. , Water treatment: Principles and Design MWH publication.
2. De A. K. Environmental Chemistry, Wiley Eastern
3. Clarson D., Dara S. S. A text book of Environmental chemistry and pollution control, S. Chand Co. Soil and water analytical method
4. Edzwald J., Water Quality & Treatment: A Handbook on Drinking Water (Water Resources and Environmental Engineering Series)

Distribution of Marks

Total Marks: 25 (80% End Semester Exam and 20% Internal Assessment)
Internal assessment – Assignment of 25 marks, Out of 10, five questions to be attempted

(Weightage of marks internal examinations will be included and Question Paper pattern as per guidelines of Autonomous Examination Cell)

The syllabus for B.Sc. (Chemistry) Semester I & II is hereby approved for the Session 2023-24

NAME AND SIGNATURE:

	Departmental members:
Chairperson /H.O.D	.....
Subject Expert	.....
(University Nominee)	.....
Subject Expert.....	.....
Subject Expert.....	.....
	.....
Representative.....	.....
(Industry)	
Representative.....	.....
(Alumni)	.....
Representative.....	.....
(Student)	.....
Representative	.....
(Professor Science Faculty Other Dept.)	.....
	.....
	.....
	.....

DEPARTMENT OF CHEMISTRY

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG (C.G.)

CBCS Syllabus
for
B.Sc. (Chemistry) Semester III & IV
(Based on NEP-2020, UGC-LOCF& Revised according to CG Govt. HE Scheme)

Session 2023-24

DEPARTMENT OF CHEMISTRY
GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG
Approved Syllabus for
B.Sc. CHEMISTRY by the members of Board of Studies for Session 2023-24
Scheme and Syllabus for B.Sc. Year 2 (Semester III & IV)

Scheme for B.Sc. Program with Chemistry - Second Year
(with 3 Subjects A, B*, C*Subject A-Chemistry)

Semester	Discipline Specific Course/ Core Course DSC (Credit-4)	Generic Elective Course GEC/ Discipline Specific Elective DSE (Credit-4)	Skill Enhancement Course SEC (Credit-2)	Ability Enhancement Course AEC (Credit-2)	Value Added Course VAC (Credit-2)	Total Credits
3	Subject A3: Chemistry 3 **Concepts in Chemistry - I** (Th=3, P=1) Subject B3 (Th=3, P=1) Subject C3 (Th=3, P=1)	Choose one from a pool of courses DSE-1 A/B/C Or Choose one from a pool of courses GEC-3 (Th=3, P=1)	Choose 1 from pool of SEC (Th=1, P=1) Or Internship/ Apprenticeship /Project/ Community outreach (2)	EVS Theory (2)	Choose one from a pool of courses (2)	**22**
4	Subject A4: Chemistry 4 **Concepts in Chemistry - II** (Th=3, P=1) Subject B4 (Th=3, P=1) Subject C4 (Th=3, P=1)	Choose one from a pool of courses DSE-2 A/B/C Or Choose one from a pool of courses GEC-4 (Th=3, P=1) (Th=3, P=1)	Choose 1 from pool of SEC (Th=1, P=1) Or Internship/ Apprenticeship /Project/ Community outreach (2)	EVS Project (2)	Choose one from a pool of courses (2)	**22**

Students on exit shall be awarded undergraduate Diploma (in the Field of Multidisciplinary study) after securing the requisite 88 credits on completion of Semester IV
(Total Credits: Sem 1 - 22, Sem 2 – 22, Sem 3 – 22 and Sem 4 – 22; TOTAL - 88 credits)

***Subjects B/C:**
Maths/Physics/Botany/Zoology/Microbiology/Zoology/Geology/Biotechnology/Biochemistry/ Industrial Chemistry/Anthropology

DEPARTMENT OF CHEMISTRY
GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG
Approved Syllabus for
B.Sc. CHEMISTRY by the members of Board of Studies for the Session 2023-24
Scheme and Syllabus for B.Sc. Year 2 (Semester III & IV)

Courses and Marking Scheme for Second-year B.Sc. with Chemistry

Year	Sem.	Course Code	Paper Title	Theory/ Practical	Credits	Marks	Sem End	IA
For Diploma								
Discipline Specific Courses – DSC (Core Courses)/Generic Elective Course - GEC								
2	III	BCHC 301	Concepts in Chemistry - I	Theory	3	75	60	15
		BCHL 301	Lab Course - 3	Practical	1	25		
	IV	BCHC 401	Concepts in Chemistry - II	Theory	3	75	60	15
		BCHL 401	Lab Course - 4	Practical	1	25		
2	**Skill Enhancement Courses - SEC**							
	III & IV	BCHS 01	Good lab practices in Chemistry	Theory	1	25	20	05
				Practical	1	25		
		BCHS 02	Water remediation and conservation studies	Theory	1	25	20	05
				Practical	1	25		
Discipline Specific Electives – DSE (Core Courses)								
2	III	BCHE 301	Environmental Chemistry	Theory	3	75	60	15
		BCEL 301	Lab Course - 1	Practical	1	25		
	IV	BCHE 401	Analytical Chemistry	Theory	3	75	60	15
		BCEL 401	Lab Course -2	Practical	1	25		

Note: Semester End – 80% and Internal Assessment (IA) – 20% (Weightage of marks internal examinations will be included as per guidelines of Autonomous Examination Cell)
Minimum pass requirement : 40% in End Semester and IA separately.

DEPARTMENT OF CHEMISTRY
GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG
Approved Syllabus for
B.Sc. CHEMISTRY by the members of Board of Studies for Session 2023-24
LIST OF COURSES OFFERED BY DEPARTMENT OF CHEMISTRY
(B.Sc. Year 2 – Semester III & IV)

For students opting B.Sc. with Chemistry

Discipline Specific Courses/Core Papers DSC (Credits: 04 each; T= Theory. P = Practical)

1. BCHC 301: Concepts in Chemistry - I (T- 3, P- 1); Practical: BCHL - 03
2. BCHC 401: Concepts in Chemistry - II (T- 3, P-1); Practical: BCHL - 04

Discipline Specific Elective DSE (Credits: 04 each; T= Theory. P = Practical)

1. BCHE 301: Environmental Chemistry (T- 3, P- 1); Practical: BCEL- 01
2. BCHE 401: Analytical Chemistry (T- 3, P-1); Practical: BCEL- 02

Skill Enhancing Courses SEC (Credits:02)

1. BCHS 01: Good lab practices in Chemistry (T- 1, P- 1)
2. BCHS 02: Water remediation and conservation studies (T- 1, P- 1)

For students opting UG without Chemistry

Generic Electives Courses GEC (Credits: 04 each; T= Theory. P = Practical)

1. BCHC 301: Concepts in Chemistry - I (T- 3, P- 1); Practical: BCHL - 03
2. BCHC 401: Concepts in Chemistry - II (T- 3, P-1); Practical: BCHL - 04

The syllabus for B.Sc. (Chemistry) Semester III & IV is hereby approved for the Session 2023-24

NAME AND SIGNATURE:

Chairperson /H.O.D	Departmental members:
Subject Expert ..... (University Nominee)	.....
Subject Expert.....	.....
Subject Expert.....	.....
	.....
Representative..... (Industry)	.....
Representative..... (Alumni)	.....
Representative..... (Student)	.....
Representative ..... (Professor Science Faculty Other Dept.)	.....

B.Sc. (with CHEMISTRY)

Programme Specific Outcome (PSO):

Upon completion of the B.Sc. Degree (with Chemistry), the students will be able to:

PSO1: Understand the fundamentals/concepts/theories in various branches of chemistry.

PSO2: Compare and justify various aspects, deduce and derive expressions, reaction mechanisms.

PSO3: Apply the principles/concepts and rules in finding their solutions.

PSO4: Carry out experiments, record the observations, understand handling of apparatus/instruments.

B. Sc. Semester - III (CHEMISTRY)
2023 - 24
Core Course – 3 (Theory)
DSC-3/GEC-3
BCHC 301: CONCEPTS IN CHEMISTRY - I

Course Outcome (CO):

After completion of the course, students would be able to:

CO1: Explain the electronic configuration, characteristics and behaviour of transition elements and compare their properties.

CO2: Discuss the features, properties, similarities of lanthanide and actinide series elements.

CO3: Illustrate preparation and properties of alcohol, ethers and epoxides, explain structure, bonding and reactions of phenols.

CO4: Explain the structure, mechanism of nucleophilic addition reactions and interpret reactivity of carbonyls.

CO5: Discuss the laws of thermodynamics, determine the thermodynamic properties, apply concepts of thermochemistry.

B. Sc. Semester - III (CHEMISTRY)
2023-24
Core Course – 3 (Theory)
DSC-3/GEC-3
BCHC 301: CONCEPTS IN CHEMISTRY - I

[Credits -03]

UNIT – I CHEMISTRY OF TRANSITION SERIES ELEMENTS

Transition Elements: Position in periodic table, electronic configuration, General characteristics, *viz.*, atomic and ionic radii, variable oxidation states, ability to form complexes, formation of coloured ions, magnetic and catalytic behaviour. General comparative treatment of 4d and 5d elements with their 3d analogues with respect to ionic radii, oxidation states and magnetic properties.

UNIT – II CHEMISTRY OF LANTHANIDE & ACTINIDE ELEMENTS

Electronic configuration, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence, extraction and isolation of lanthanides, lanthanide compounds: oxides, hydroxides and halides

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from uranium fuel rods, similarities between the latter actinides and the latter lanthanides.

UNIT – III CHEMISTRY OF ALCOHOLS, ETHERS, EPOXIDES AND PHENOLS

Alcohols: Nomenclature, preparation by reduction, Grignard reagent and hydrolysis. Bouvaelt-Blanc reduction for the preparation of alcohols, relative reactivity of 1°, 2°, 3°alcohols and properties – esterification, acylation, SN1 and SN2, dehydration, oxidation. Dihydric alcohols – methods of formation, manufacture, chemical reactions of glycols - Oxidation by periodic acid and lead tetraacetate and pinacol-pinacolone rearrangement. Trihydric alcohols - Nomenclature, methods of formation, manufacture, synthesis, chemical reactions of glycerol, properties – reaction with oxalic acid and fermentation.

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$

Phenols: Structure and bonding in phenols, physical properties and acidic character, Comparative acidic strength of alcohols and phenols, acylation, carboxylation and oxidation. Mechanism of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesh, Lederer-Manasse, Reimer-Tiemann and coupling reaction.

UNIT – IV CHEMISTRY OF CARBONYL COMPOUNDS

Aldehydes and ketones: Nomenclature, structure and reactivity of carbonyl group. General methods of preparation of aldehydes and ketones.

Mechanism of nucleophilic addition to carbonyl groups: Benzoin, Aldol, Perkin and Knoevenagel condensation. Condensation with ammonia and its derivatives, Wittig reaction, Mannich reaction, Beckmann and Benzil- Benzilic rearrangement.

Use of acetate as protecting group, Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen reduction, Wolf-Kishner reaction, LiAlH4 and NaBH4 reduction. Halogenation of enolizable ketones, An introduction to α,β-unsaturated aldehydes and ketones.

UNIT-V THERMODYNAMICS-I

Concepts in Thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems; Zeroth law of thermodynamics. First law: Concept of heat, work, internal energy and statement of first law; enthalpy, Relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases under isothermal and adiabatic conditions. Joule-Thomson expansion, inversion temperature of gases, expansion of ideal gases under isothermal and adiabatic condition.

Thermochemistry: Laws of 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, Adiabatic flame temperature, explosion temperature.

RECOMMENDED BOOKS/REFERENCES

Inorganic Chemistry

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D. Lee, ELBS.
3. Concepts of models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and Alexander, John Wiley.
4. Inorganic Chemistry, D.E. Shriver, P.W. Atkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W.W. Porterfield, Addison Wesley.
6. Inorganic Chemistry, A.G. Sharp, ELBS.
7. Inorganic Chemistry, G.L. Micssles and D.A. Tarr, Prentice Hall.
8. Advanced Inorganic Chemistry, Satya Prakash.
9. Advanced Inorganic Chemistry, Agrawal & Agrawal.
10. Advanced Inorganic Chemistry, Puri & Sharma, S. Chand.
11. Inorganic Chemistry, Madan, S. Chand.

Organic Chemistry

1. Organic Chemistry, Morrison and Boyd, Prentice-Hall.
2. Organic Chemistry, L.G.Wade Jr. Prentice-Hall.
3. Fundamentals of Organic Chemistry, Solomons, john Wiley.
4. Organic Chemistry, Vol.-I, II & III S.M. Mukherjee, S.P. Singh and R.P. Kapoor, Wiley-Eastern (New-Age).
5. Organic Chemistry, FA Carey, MC Graw Hill.
6. Introduction to Organic Chemistry, Struiweisser, Heathock and Kosover, Macmillan.
7. Organic Chemistry, P.L. Soni.
8. Organic Chemistry, Bahl & Bahl.
9. Organic Chemistry, Joginder Singh.

Physical Chemistry

1. Physical Chemistry, R.A. Alberty, Wiley Eastern.
2. The elements of Physical Chemistry, P.W. Atkins, Oxford.
3. Physical Chemistry, Puri and Sharma, S. Chand.
4. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press(2006).
5. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
7. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
8. G. M. Barrow, Tata McGraw Hill (Fifth Edition) (2007)

Question Paper Format and Distribution of Marks

1. The question paper will be divided into three Sections - A, B & C.
2. Section A shall contain very short answer type questions (answer in one or two sentences) or objective type questions. (**No Multiple-choice questions, no 'Fill in the blank' type Questions**)
3. Section B shall contain short answer type questions with the limit of 150 words.
4. Section C shall contain long answer/descriptive type questions. The students are required to answer precisely, and the answer should not exceed the limit of 350 words.
5. The scheme of marks for **End Semester Exam** should be as follows :

Question Type	MM 60 (Marks x No. of Questions)
A (Very short Answer)	1 x10 = 10
B (Short Answer)	3 x 5 = 15
C (Long Answer)	7 x 5= 35
Total	60

B.Sc. Semester - III (CHEMISTRY)
2023-24
Core Course – 3 (Practical)
DSC-3/GEC-3
BCHL 301: LAB COURSE - 3

Course Outcome:

After completion of the course, the students would be able to:

CO1: Prepare standard solutions and determine the concentration of unknown solution by titration.

CO2: Identify unknown organic compounds by systematic qualitative analysis.

CO3: Determine physical property/ parameters such as solubility, heat of reaction, etc.

B.Sc. Semester - III (CHEMISTRY)
2023-24
Core Course – 3 (Practical)
DSC-3/GEC-3
BCHL 301: LAB COURSE - 3

[Credits -01]

The following experiments are to be conducted during the curriculum.

1. INORGANIC CHEMISTRY

A. Volumetric analysis

- Preparation of standard solutions of oxalic acid, potassium dichromate, EDTA, etc. and determine the concentration of unknown solution.

(a) Determination of acetic acid in commercial vinegar using NaOH.

(b) Estimation of ferrous & ferric by dichromate method.

(c) Estimation of hardness of water by EDTA.

(d) Determination of alkali content-antacid tablet using HCl.

(e) Estimation of calcium content in chalk as calcium oxalate by permanganometry.

(f) Estimation of copper using thiosulphate.

2. ORGANIC CHEMISTRY

- Detection of elements (X, N, S).
- Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols, nitro, amine, amide, and carbonyl compounds, carbohydrates)

3. PHYSICAL CHEMISTRY

- To determine the solubility of benzoic acid at different temperature and to determine ΔH of the dissolution process.
- To determine the enthalpy of neutralization of a weak acid/ weak base versus strong base/ strong acid and determine the enthalpy of ionization of the weak acid/ weak base.
- To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle.
- 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).

- Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

Note: Experiments may be added/ deleted subject to availability of time and facilities

Reference Books

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). 22
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).
5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011). Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
6. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York.
7. Vogel, Practical Inorganic Chemistry

B.Sc. Semester - III (CHEMISTRY)
2023 -24
Discipline Specific Elective Course - 1 (DSE-1)
BCHE 301: ENVIRONMENT CHEMISTRY

Course Outcome (CO):

After completion of the course, students would be able to:

CO1: Understand the composition of atmosphere, types of pollution, noise pollution and explain biogeochemical cycles.

CO2: Explain the chemical composition of atmosphere, atmospheric chemical phenomena and air pollution.

CO3: Describe hydrological cycle, understand water pollution and treatment process.

CO4: Discuss methods of determination of water quality parameters.

CO5: Explain the sources of soil pollution and solid waste treatment and management.

B.Sc. Semester - III (CHEMISTRY)
2023 -24
Discipline Specific Elective Course – 1
DSE-1 (Theory)
BCHE 301: ENVIRONMENT CHEMISTRY

[Credits -03]

UNIT – I ENVIRONMENT

Composition of atmosphere, temperature variation of earth atmospheric system (temperature vs. altitude curve), biogeochemical cycles of C, N, P, S and O system. Classification of pollution. Noise pollution.

UNIT – II ATMOSPHERE AND AIR POLLUTION

Chemical composition of atmosphere – particle, ions, and radicals in their formation, chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, and O and their effect, pollution by chemicals, CFC, Green House effect, acid rain, air pollution and control.

UNIT – III HYDROSPHERE AND WATER POLLUTION

Hydrological cycle, sources of aquatic pollution and water quality parameters – Dissolve oxygen, biochemical oxygen demand, chemical oxygen demand, types of pollutants, purification and treatment of municipal water and wastewater. Wastewater treatment procedure (primary, secondary and tertiary).

UNIT – IV AQUATIC CHEMISTRY

Water and its necessities, Determination of water quality parameters - conductivity, pH, alkalinity, hardness, Dissolve oxygen, biochemical oxygen demand, chemical oxygen demand. Analytical methods for the determination fluoride, chromium and arsenic, residual chlorine and chlorine demand,

UNIT – V SOIL POLLUTION AND SOLID WASTE TREATMENT

Soil around us; soil water characteristics; soil erosion; soil & pollution; water resources: irrigation and wetlands; soil pollution management; nuclear waste management; sewage treatment; solid waste management.

Recommended Books/References:

1. De. A. K. Environmental Chemistry, Wiley Eastern Ltd, 1990.
2. Miller T. G. Jr., Environmental Science, Wadsworth publishing House, Meerut.
3. Odum, E.P. (1971) Fundamentals of Ecology. Third Edition, W.B. Saunders Co., Philadelphia
4. S. E. Manahan, Environmental Chemistry, 1993, Boca Raton, Lewis publisher
5. Environmental Chemistry, Sharma and Kaur, 2016, Krishna publishers
6. Environmental Pollution, Monitoring and control, S.M. Khopkar, 2007, New Age International.
7. Environmental Chemistry, C. Baird, M. Cann, 5th Edn, 2012, W.H. Freeman publication.
8. Basic concepts of analytical chemistry: S. M. Khopkar, Wiley Eastern (1995)
9. G. S. Sodhi Fundamental Concepts of Environmental Chemistry (Third Edition) Narosa (2009).
10. Principles of instrumental analysis: D. A. Skoog, Fifth Edition, Sauns College Publishing (London)

B.Sc. Semester - III (CHEMISTRY)
2023 -24
Discipline Specific Elective Course - 1
DSE -1 (Practical)
BCEL 301: ENVIRONMENT CHEMISTRY

[Credits -01]

List of experiments

Determination of water quality parameters in following aspect:

1. Determination of dissolved oxygen in given water (chemical method/instrumentation method).
2. Determination of Biological Oxygen Demand (BOD).
3. Determination of Chemical Oxygen Demand (COD).
4. Finding out percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by titration method ($AgNO_3$) and potassium chromate).
6. Estimation of total alkalinity of water samples (carbonate, bicarbonate) by titration method.
7. Estimation of SPM in air samples.

Recommended books/Reference Books:

1. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, John Wiley & amp; Sons, Inc. Publishers, New Delhi.(2005 edition).
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
5. A. K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, Environmental Pollution Analysis: New Age Int. Publisher, New Delhi.

B.Sc. (CHEMISTRY)
2023-24
Skill Enhancement Course – 1 (SEC-1)
BCHS 01: GOOD LAB PRACTICES IN CHEMISTRY
THEORY AND PRACTICAL

[Credits -02 (Th-01, Practical-01); 30 hrs.]

Course outcome:

After completing the course students will be able to:

CO1: Understand general laboratory practices
CO2: Prepare standard solutions
CO3: Handle glasswares and chemicals
CO4: Explore various research issues and their solutions
CO5: Apply practical skills in Chemistry

THEORY

A. Common calculations in chemistry laboratories. Understanding the details on the label of reagent bottles.

Inorganic and organic reagents (Baeyer's reagent, Nessler's reagent, Fehling solution A and B, Shiff's reagents, Tollen's reagent, Molish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, Dimethyl glyoxime, H_2S gas); chemicals such as acids, bases, indicators, etc. used in chemistry lab for qualitative analysis .

B. Molarity and normality of common acids and bases. Preparation of solutions – solid and liquids, Molar, Molal and Normal solutions, Dilutions. Percentage solutions.

PRACTICAL

A. Technique and uses of handling glass wares; calibrations, knowledge about common toxic chemicals and safety measures in their handling.

B. Qualitative test of CO_3^{2--}, CH_3COO^-, SO_4^{2-}, Cl^-, NO_3^-, NH_4^+, Cu^{2+}, Fe^{3+}, Ni^{2+}, Ba^{2+}, Mg^{2+}

Or

Preparation of standard solutions of solids and liquids – Normal, Molar and percentage solutions; dilutions.

C. Qualitative elemental analysis for Nitrogen, Sulphur, Halogen in organic compounds.

Or

Preparation of inorganic and organic reagents - Baeyer's reagent, Nessler's reagent, Fehling solution A and B, Shiff reagents, Tollen's reagent, Molish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia and their application in analysis.

Reference Books

1. Seiler, J.P. (2005). Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 2nd ed.
2. Garner, W.Y., Barge M.S., Ussary. P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.

Distribution of Marks

Total Marks: 25 (80% End Semester Exam and 20% Internal Assessment)
Internal assessment – Assignment of 25 marks, Out of 10, five questions to be attempted

B.Sc. (CHEMISTRY)
2023-24
Skill Enhancement Course – 2 (SEC-2)
BCHS 02: WATER REMEDIATION AND CONSERVATION STUDIES
THEORY AND PRACTICAL
[Credits -02 (Th-01, PR-01) 30 hrs.]

Course outcome:
After completing the course students will be able to:

CO1: Understand about sources and effect of Water Pollution
CO2: Learn about various control technique

THEORY:

Water Pollution

Sources of water pollutants, pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality.

Remediation Techniques

Remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonada techniques, reverse osmosis, activated charcoal detoxification, mechanisms of detoxification, bio-remediation, need of green chemistry, future scope.

Water Conservation

Introduction to water conservation and erosion of soil, forms of water erosion, factors affecting water erosion, types of water erosion, mechanics of water erosion control,

PRACTICAL:

Water analysis (pH, Conductivity, hardness, Acidity, Alkalinity etc.)

Case study/Project

Case study/Project on water pollution, water conservation and water quality.

Recommended Books/references:

1. Cittenden J. C. , Trussell J. R., Hand D. W., Howe K. J., Tchobanoglous G. , Water treatment: Principles and Design MWH publication.
2. De A. K. Environmental Chemistry, Wiley Eastern
3. Clarson D., Dara S. S. A text book of Environmental chemistry and pollution control, S. Chand Co. Soil and water analytical method
4. Edzwald J., Water Quality & Treatment: A Handbook on Drinking Water (Water Resources and Environmental Engineering Series)

Distribution of Marks

Total Marks: 25 (80% End Semester Exam and 20% Internal Assessment)
Internal assessment – Assignment of 25 marks, Out of 10, five questions to be attempted

(Weightage of marks internal examinations will be included and Question Paper pattern as per guidelines of Autonomous Examination Cell)

B.Sc. Semester – IV CHEMISTRY)
2023-24
Core Course - 4 (Theory)
DSC - 4/GEC - 4
BCHC 401: CONCEPTS IN CHEMISTRY - II

Course Outcome (CO):

After completion of the course, students would be able to:

CO1: Name coordination compounds and explain isomerization and stereochemistry of complexes, discuss VBT and CFT.

CO2: Explain concepts and theories of acids and bases, HSAB, non-aqueous solvents.

CO3: Discuss the structure, bonding, mechanism, properties and preparation of carboxylic acid, carboxylic acid derivative, synthesis and properties of ethyl acetoacetate.

CO4: To have a firm foundation of thermodynamics and its applications, explain first and second laws, thermodynamic properties and calculate various thermodynamic functions.

CO5: To explain criteria of thermodynamic equilibrium, concept of fugacity, thermodynamic derivation of relations between the various equilibrium constants, and apply concept of ionic equilibria, salt hydrolysis and buffer solution.

B.Sc. Semester - IV (CHEMISTRY)
2023 - 24
Core Course - 4 (Theory)
DSC-4/GEC-4
BCHC 401: CONCEPTS IN CHEMISTRY - II

[Credits -03]

UNIT-I COORDINATION CHEMISTRY

Coordination compounds: Werner's theory and its experimental verification, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelates, polynuclear complexes.

Valence bond theory & Crystal field theory: VBT (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal Field Theory, Crystal field splitting and stabilization energy, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination.

UNIT – II ACIDS-BASES AND NON-AQUEOUS SOLVENTS

Concepts of acids and bases: Arrhenius, Bronsted-Lowry, conjugate acids and bases, relative strengths of acids and bases and Lewis concepts of acids and bases.

Hard and soft acids and bases (HSAB): Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, Applications of HSAB principle

Non-aqueous solvents: Physical properties of a solvent, types of solvents and their general characteristics, reaction in non-aqueous solvents with reference to liquid ammonia.

UNIT – III CARBOXYLIC ACIDS AND DERIVATIVES

Carboxylic acids: Preparation, Structure and bonding, Physical and chemical properties including, acidity of carboxylic acids, effects of substituents on acid strength, Hell-Volhard Zeilinsky reaction. Reduction of carboxylic groups, Mechanism of decarboxylation. Di carboxylic acids: Methods of formation and effect of heat and dehydrating agents, Hydroxyacids.

Carboxylic acid derivatives: Structure of acid chlorides, esters, amides and acid anhydrides, Relative stability of acyl derivatives. Physical properties, inter-conversion of acid derivatives by nucleophilic acyl substitution. Mechanism of acid and base catalyzed esterification and hydrolysis.

Organo-synthesis via enolates: Active methylene group, alkylation of diethylmalonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: The Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Robbinson annulations reaction.

UNIT –IV THERMODYNAMICS-II

Second Law of Thermodynamics: Spontaneous process, Second law, Statement of Carnot cycle and efficiency of heat engine, Carnot's theorem, thermodynamic state of temperature.

Concept of entropy: Entropy change in a reversible and irreversible process, entropy change in isothermal reversible expansion of an ideal gas, entropy change in isothermal mixing of ideal gases, physical signification of entropy, Molecular and statistical interpretation of entropy.

Gibbs and Helmholtz free energy: G and A, variation of G and A with pressure, volume, temperature, Gibbs-Helmholtz equation, Maxwell relations.

Third Law of Thermodynamics: Nernst Heat Theorem, Elementary idea of Third law of Thermodynamics, concept of residual entropy, calculation of absolute entropy of molecule.

UNIT –V CHEMICAL EQUILIBRIA AND IONIC EQUILIBRIA

Chemical equilibrium: Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Concept of Fugacity, Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exergonic and endergonic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Thermodynamic derivation of relations between the various equilibrium constants Kp, Kc and Kx. Le Chatelier principle (quantitative treatment). Equilibrium between ideal gas and a pure condensed phase.

Ionic equilibrium: Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono protic acids (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

RECOMMENDED BOOKS/REFERENCES

Inorganic Chemistry

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D. Lee, ELBS.
3. Concepts of models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and Alexander, John Wiley.
4. Inorganic Chemistry, D.E. Shriver, P.W. Atkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W.W. Porterfield, Addison Wesley.
6. Inorganic Chemistry, A.G. Sharp, ELBS.
7. Inorganic Chemistry, G.L. Micssles and D.A. Tarr, Prentice Hall.
8. Advanced Inorganic Chemistry, Satya Prakash.
9. Advanced Inorganic Chemistry, Agrawal & Agrawal.
10. Advanced Inorganic Chemistry, Puri & Sharma, S. Chand.
11. Inorganic Chemistry, Madan, S. Chand.

Organic Chemistry

1. Organic Chemistry, Morrison and Boyd, Prentice-Hall.
2. Organic Chemistry, L.G. Wade Jr. Prentice-Hall.
3. Fundamentals of Organic Chemistry, Solomons, john Wiley.
4. Organic Chemistry, Vol.-I, II & III S.M. Mukherjee, S.P. Singh and R.P. Kapoor, Wiley-Eastern (New-Age).
5. Organic Chemistry, FA Carey, MC Graw Hill.
6. Introduction to Organic Chemistry, Struiweisser, Heathock and Kosover, Macmillan.
7. Organic Chemistry, P.L. Soni.
8. Organic Chemistry, Bahl & Bahl.
9. Organic Chemistry, Joginder Singh.

Physical Chemistry

1. Physical Chemistry, R.A. Alberty, Wiley Eastern.
2. The elements of Physical Chemistry, P.W. Atkins, Oxford.
3. Physical Chemistry, Puri and Sharma, S. Chand.
4. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press.
5. Ball, D. W. Physical Chemistry Thomson Press, India.
6. Castellan, G. W. Physical Chemistry 4th Ed. Narosa.
7. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA.
8. G. M. Barrow, Tata McGraw Hill (Fifth Edition).

Question Paper Format and Distribution of Marks

1. The question paper will be divided into three Sections - A, B & C.
2. Section A shall contain very short answer type questions (answer in one or two sentences) or objective type questions. (**No Multiple-choice questions, no 'Fill in the blank' type Questions**)
3. Section B shall contain short answer type questions with the limit of 150 words.
4. Section C shall contain long answer/descriptive type questions. The students are required to answer precisely, and the answer should not exceed the limit of 350 words.
5. The scheme of marks for **End Semester Exam** should be as follows :

Question Type	MM 60 (Marks x No. of Questions)
A (Very short Answer)	1 x10 = 10
B (Short Answer)	3 x5 = 15
C (Long Answer)	7 x5= 35
Total	60

B.Sc. Semester - IV (CHEMISTRY)
2023-24
Core Course - 4 (Practical)
DSC-4/GEC-4
BCHL 401: LAB COURSE - 4

Course Outcome:

After completion of the course, the students would be able to:

CO1: Apply the various aspects of qualitative analysis in inorganic mixture and identify radicals including interfering radicals.

CO2: Separate components of mixture by paper chromatography, prepare simple organic compounds.

CO3: Perform experiments based on physical aspects and calculate parameters.

B.Sc. Semester - IV (CHEMISTRY)
2023-24
Core Course - 4 (Practical)
DSC-4/GEC-4
BCHL 401: LAB COURSE - 4

[Credits -01]

The following experiments are to be conducted during the curriculum.

1. INORGANIC CHEMISTRY

Qualitative semimicro analysis of mixtures containing 5 radicals. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

CO_3^{2-}, NO^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, As^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}.

Mixtures should preferably contain one interfering anion, or insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) or combination of anions e.g. CO_3^{2-} and SO_3^{2-}, NO_2^- and NO_3^-, Cl^-, Br^-, and I^-.

2. ORGANIC CHEMISTRY

Preparation of Organic Compounds: (i) m-dinitrobenzene, (ii) Acetanilide, (iii) Bromo/Nitro-acetanilide (iv) Oxidation of primary alcohols-Benzoic acid from benzyl alcohol, (v) azo dye.

3. CHROMATOGRAPHY

Principles involved in chromatographic separations. Paper chromatographic separation of following: i. Ni (II) and Co (II) ii. Fe (III) and Al (III) iii. Pb (II) and Ag (I) iv. Dye mixture

4. PHYSICAL CHEMISTRY

- Determination of the transition temperature of the given substance by thermometric/ dialometric method (e.g. $MnCl_2.4H_2O/SrBr_2.2H2O$).
- Determination of molecular weight by Rast Camphor and Landsberger method.
- Distribution of acetic/ benzoic acid between water and cyclohexane.
- Study the equilibrium of at least one of the following reactions by the distribution method:

  (i) $I_2(aq.) + I^- \rightarrow I_3^-(aq.)$

  (ii) $Cu^{2+}(aq.) + nNH_3 \rightarrow Cu(NH_3)_n$

Note: Experiments may be added/ deleted subject to availability of time and facilities.

Reference Books

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). 22
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).
5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011). Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
6. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York
7. Vogel, Practical Inorganic Chemistry

B.Sc. Semester - IV (CHEMISTRY)
2023 -24
Discipline Specific Elective Course – 2 (DSE-2)
BCHE 401: ANALYTICAL CHEMISTRY

Course Outcome (CO):

After completion of the course, students would be able to:

CO1: Understand types of errors and determine statistical parameters.

CO2: Explain the theory, instrumentation and application of polarography and atomic spectroscopy.

CO3: Describe principle and application of thermal methods of analysis.

CO4: Discuss methods of chromatography and its application.

CO5: Describe methods of fuel and drug analysis.

B.Sc. Semester - IV (CHEMISTRY)
2023 -24
Discipline Specific Elective Course - 2
DSE-2 (Theory)
BCHE 401: ANALYTICAL CHEMISTRY

[Credits -03]

UNIT – I STATISTICAL METHODS IN CHEMICAL ANALYSIS

Theory of error and treatment of quantitative data, accuracy and precision, ways of expressing accuracy and precision, Normal error curve and its equation. Useful statistical tests with equation, est of significance, the F-test, the students t-test, the Chi-test, the correlation coefficient, confidence limit of the mean, comparison of two standard values, comparison of two standard values, comparison of standard deviation with average deviation, comparison of mean with true values, regression analysis (least square method).

UNIT – II POLAROGRAPHY AND ATOMIC SPECTROSCOPY

Current-voltage relationship, theory of polarographic waves, instrumentation, qualitative and quantitative applications.

Atomic absorption spectroscopy, theory and application (with some examples).

UNIT – III THERMAL ANALYSIS

Theory, methodology, instruments and applications of theromogravimetric analysis (TGA/DTA), and differential scanning calorimetry (DSC).

UNIT – IV CHROMATOGRAPHY

Principles of chromatography, paper, column and thin layer chromatography, Gas-liquid chromatography, HPLC.

UNIT-V ANALYSIS OF FUEL AND DRUGS

Fuel analysis: Solid, liquid and gaseous fuels, ultimate and proximate analysis of solid fuel, determination of calorific value of solid, liquid and gaseous fuels, Flash point and fire point.

Drug analysis: Classification of drugs, Analysis of some standard drug using various chromatographic techniques.

Recommended books/references:

1 Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2 Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing California, USA, 1988.
3.Christian, G.D, Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4 Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H: Freeman, 2016.
5 Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis
6 Mikes, O. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood John Wiley 1979.
7 Ditts, R.V. Analytical Chemistry; Methods of separation, van Nostrand, 1974.
8 Khopkar, S. M., Basic Concepts of Analytical Chemistry, New Age (Second edition) 1998

B.Sc. Semester - IV (CHEMISTRY)
2023 -24
Discipline Specific Elective Course - 2
DSE-2 (Practical)
BCEL 401: ANALYTICAL CHEMISTRY

[Credits -01]

List of experiments

1.Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures. Preparation of buffer solutions of different pH (i. Sodium acetate-acetic acid, ii. Ammonium chloride-ammonium hydroxide

2. Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

i. Ni (II) and Co (II)

ii. Fe (III) and Al (III)

3.Chromatographic separation of the active ingredients of plants, flowers and juices by TLC.

4. IR/DSC analysis of known polymer sample (for students demonstration only)

5. Determination of flash point & fire point of given fuel sample.

6. Determination of viscosity index, cloud point, pour point of given fuel sample.

7. Determination of calorific value of given fuel sample/coal sample using bomb calorimeter.

8. Proximate analysis of given coal sample.

9. Determination of the iodine number of oil.

10. Determination of the saponification number of oil.

Recommended books/Reference books:

Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
Jain, P.C. & Jain, M. Engineering Chemistry Dhanpat Rai & Sons, Delhi.
Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009
Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning, India Edition.

B.Sc. (CHEMISTRY)
2023-24
Skill Enhancement Course – 1 (SEC-1)
BCHS 01: GOOD LAB PRACTICES IN CHEMISTRY
THEORY AND PRACTICAL

[Credits -02 (Th-01, Practical-01); 30 hrs.]

Course outcome:

After completing the course students will be able to:

CO1: Understand general laboratory practices
CO2: Prepare standard solutions
CO3: Handle glasswares and chemicals
CO4: Explore various research issues and their solutions
CO5: Apply practical skills in Chemistry

THEORY

A. Common calculations in chemistry laboratories. Understanding the details on the label of reagent bottles.

Inorganic and organic reagents (Baeyer's reagent, Nessler's reagent, Fehling solution A and B, Shiff's reagents, Tollen's reagent, Molish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, Dimethyl glyoxime, H_2S gas); chemicals such as acids, bases, indicators, etc. used in chemistry lab for qualitative analysis .

B. Molarity and normality of common acids and bases. Preparation of solutions – solid and liquids, Molar, Molal and Normal solutions, Dilutions. Percentage solutions.

PRACTICAL

A. Technique and uses of handling glass wares; calibrations, knowledge about common toxic chemicals and safety measures in their handling.

B. Qualitative test of CO_3^{2--}, CH_3COO^-, SO_4^{2-}, Cl^-, NO_3^-, NH_4^+, Cu^{2+}, Fe^{3+}, Ni^{2+}, Ba^{2+}, Mg^{2+}

Or

Preparation of standard solutions of solids and liquids – Normal, Molar and percentage solutions; dilutions.

C. Qualitative elemental analysis for Nitrogen, Sulphur, Halogen in organic compounds.

Or

Preparation of inorganic and organic reagents - Baeyer's reagent, Nessler's reagent, Fehling solution A and B, Shiff reagents, Tollen's reagent, Molish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia and their application in analysis.

Reference Books

1. Seiler, J.P. (2005). Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 2nd ed.
2. Garner, W.Y., Barge M.S., Ussary. P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.

Distribution of Marks

Total Marks: 25 (80% End Semester Exam and 20% Internal Assessment)
Internal assessment – Assignment of 25 marks, Out of 10, five questions to be attempted

B.Sc. (CHEMISTRY)
2023-24
Skill Enhancement Course – 2 (SEC-2)
BCHS 02: WATER REMEDIATION AND CONSERVATION STUDIES
THEORY AND PRACTICAL
[Credits -02 (Th-01, PR-01) 30 hrs.]

Course outcome:
After completing the course students will be able to:

CO1: Understand about Sources and Effect of Water Pollution
CO2: Learn about various control technique

THEORY:

Water Pollution

Sources of water pollutants, pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality.

Remediation Techniques

Remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonada techniques, reverse osmosis, activated charcoal detoxification, mechanisms of detoxification, bio-remediation, need of green chemistry, future scope.

Water Conservation

Introduction to water conservation and erosion of soil, forms of water erosion, factors affecting water erosion, types of water erosion, mechanics of water erosion control,

PRACTICAL:

Water analysis (pH, Conductivity, hardness, Acidity, Alkalinity etc.)

Case study/Project

Case study/Project on water pollution, water conservation and water quality.

Recommended Books/references:

1. Cittenden J. C. , Trussell J. R., Hand D. W., Howe K. J., Tchobanoglous G. , Water treatment: Principles and Design MWH publication.
2. De A. K. Environmental Chemistry, Wiley Eastern
3. Clarson D., Dara S. S. A text book of Environmental chemistry and pollution control, S. Chand Co. Soil and water analytical method
4. Edzwald J., Water Quality & Treatment: A Handbook on Drinking Water (Water Resources and Environmental Engineering Series)

Distribution of Marks

Total Marks: 25 (80% End Semester Exam and 20% Internal Assessment)
Internal assessment – Assignment of 25 marks, Out of 10, five questions to be attempted

(Weightage of marks internal examinations will be included and Question Paper pattern as per guidelines of Autonomous Examination Cell)

The syllabus for B.Sc. (Chemistry) Semester III & IV is hereby approved for the Session 2023-24

NAME AND SIGNATURE:

Chairperson /H.O.D	Departmental members:
	.....
	.....
Subject Expert	.....
(University Nominee)	
Subject Expert.....	.....
Subject Expert.....	.....
Subject Expert.....	.....
Representative.....	.....
(Industry)	
Representative.....	.....
(Alumni)	
Representative.....	.....
(Student)	
Representative	.....
(Professor Science Faculty Other Dept.)	.....
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