St. Aloysius (Autonomous) College, Jabalpur
Department of Chemistry

MARKS SCHEME FOR BSc. I & II SEMESTER

COURSE CODE: S1 CHEMITRY

COURSE TYPE: FUNDAMENTALS OF CHEMISTRY& ANALYTICAL CHEMISTRY

COURSE TYPE: CORE COURSE **SUBJECT: CHEMISTRY**

MAXIMUM MARKS: 100 **CREDIT VALUE: 6**

TOTAL MARKS:

SUBJECT	EXAMINATION	MAX. MARKS	MIN. MARKS
CHEMISTRY	CCE EXAM	40	35
	FINAL EXAM	60	

ASSISMENT AND EVALUATION

Assessment and presentation	09
Class test-I	08
Class test-II	08
Overall performance throughout the year(attendance and behavior)	15
Total	**40**

Theory Paper:

SECTION WISE MARKS DISTRIBUTION

S. No.	SECTION	TOTAL NO. OF QUESTION	MARKS
1	A	Objective Question	6 X 1= 6
2	B	Short Answer Question	6 X 3 = 18
3	C	Long Answer Question	6 X 6= 36
		Total	**60**
	Internal and ExternalMarks	**Grand Total**	**40+ 60 =100**

Class	*CourseType*	*CourseCode*	*Course Title (Theory/Practical)*	*Marks*	
B.Sc. I Semester	Major/ Minor	ChemT1	Fundamentals of Chemistry	Max:100	Min:35

Course Objectives:

- To create an understanding of structure of atom and indicate the location of the nucleus, the shells, and the electronic orbitals and to calculate the maximum number of electrons that can occupy a specific shell
- To identify the various periodic properties of s and p block elements and their trends along the group and periods of the periodic table.
- To enable the students to identify and differentiate between the different types of chemical bonds/ parameters and create an understanding of various theories associated.
- To enable the students in identifying the properties of acids and bases and comparing the various models of acid- base.
- To understand the fundamentals of structure, shape and reactivity of organic molecules.
- To enable the students to understand the concept of stereochemistry and conformations.
- To gain knowledge about rate constants of various order reactions, half-life period, types of electrolytes, solubility product, degree of ionization and factors affecting it.

UNIT – I

Atomic Structure:

(a) Chemical Techniques in ancient India: general Introduction. Contribution of ancient Indian Scientists in chemistry e.g., metallurgy, yes, pigments, cosmetics, Ayurveda, Charak Sanhita.

(b) Review of Bohr's theory and its limitations. Atomic spectrum of Hydrogen. Dual nature of particles and waves, de Broglie's equation, Heisenberg's Uncertainty Principle and its significance. Quantum number and their significance. Rules for filling electrons in various orbitals, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau Principle and its limitations, Variation of orbital energy with atomic number. Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Keywords/Tags*:* Metallurgy, Dyes, Cosmetics, Charak Sanhita Hydrogen Spectrum, Hund's Rule,

UNIT - II

Elementary idea of the following properties of the elements with reference to s & p-block elements in periodic table. Effective nuclear number (EAN), Shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. Atomic radii (vander Waals) Ionic and crystal radii Covalent radii (octahedral and tetrahedral).Detailed discussion of the following properties of elements, with reference to s & p-blocks. Ionization energy – Successive ionization energy and factors affecting ionization energy. Applications of Ionization energy. Electronegativity-Pauling's/Mulliken's electronegativity scales. Variation of electro negativity with bond order, partial charge, hybridization.

Keywords/Tags: EAN, Atomic radii, Ionic radii, Crystal radii

UNIT – III

(a) Ionic Bonding: General Characteristics of Ionic Bonding.

Ionic Bonding and energy: lattice and salvation energies and their importance in the context of stability and solubility of ionic compounds. Statement of Born- Lande equation for calculation of lattice energy, Madelung constant, Born-Haber cycle and its applications. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules. Covalent bonding: Lewis structure, Valence bond theory (Heitler-London Approach).Hybridization-Concept, types (sp, sp^2, sp^3, dsp^2, d^2sp^3) with suitable example of inorganic and organic molecules. Ionic character in covalent compounds-dipole moment and percentage ionic character. Valence Shell Electron pair Repulsion (VSEPR) Theory: Assumption, need of theory, application of theory to explain geometries or shapes of some inorganic molecules and ions on the basis if VSEPR and hybridization with suitable examples of linear trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements such as: NH_3, H_2O, SF_4, ClF_3, PCl_5, SF_6, ClF_5, XeF_4.

(b) Molecular orbital (MO) concept of bonding

The approximations of the theory, Linear combination of Atomic Orbitals(LCAO) (elementary pictorial approach).Rules for the LCAO method, bonding and antibonding MOs. Characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals. Molecular orbital Diagram of homonuclear diatomic molecules:H_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2 and their ions. Molecular orbitals of heteronuclear diatomic molecules: CO, NO, CN, HF.

(c) Bond parameters: Definition and factors affecting- bond orders, bond lengths, bond angles.

Keywords/Tags: Ionic Bonding, Covalent Bonding, hybridization, VSEPR Theory, LCAO, MO diagram, Bond Parameters

UNIT – IV

Arrhenius concept, Bronsted_Lowry's concept, conjugate acids and bases, relative strength of acids, Lewis concept. pH, buffer solutions. Acid-base 3eutralization curves, Handerson equation. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values Indicator, choice of indicators.

Keywords/Tags: Acid-base concept, Bronsted-Lowry's concept, Conjugate Acids and Bases, pH, Buffer Solution, Indicator.

UNIT – V

(a) Fundamentals of Organic Chemistry

Structure, shape and reactivity of organic molecules: Physical Effects, Electronic Displacement: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of bonds: Homolysis and Heterolysis. Reactive Intermediates: Carbocations, Carbanions and free radicals. Nucleophiles and Electrophiles.

(a) Stereochemistry of Organic Compounds: Concept of isomerism

Geometrical isomerism: Determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

(b) Optical isomerism: Elements of symmetry, molecular chirality, enantiomers & their properties, stereogenic centre, optical activity of enantiomers. Concept of chirality (up to two carbon atoms): chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythroisomers, mesoisomer, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

(c) Conformations and Conformational analysis

Conformations of ethane, butane and cyclohexane. Interconversion of wedge Formula, Newman, Sawhorse and Fischer representations.

Keywords/Tags: Electronic Displacements, Nucleophiles, Electrophiles, Isomerism, Molecular Chirality, Enantiomers, Sequence Rules, Conformation

UNIT-VI:

(a) Chemical Kinetics:

Rate of reaction, Definition and difference of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation of half-life period. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

(b) Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionizations constant and ionic product of water. Common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for difficult salts. Solubility and solubility product of sparingly soluble salts-applications of solubility product.

Keywords/Tags: Order of Reaction, Molecularity Of Reaction, Arrhenius Equation, Activation Equation, Activation Energy, Electrolytes, Salt Hydrolysis, Solubility Product.

Course outcome:

By the end of this course student will be able to

- Gain a thorough knowledge about various theories and principles applied to reveal atomicstructure and quantum number
- Understand concepts of periodic properties of elements.
- Develop an understanding related to theories of chemical bonding
- Develop the Acid-Base concept and pH buffer
- Gain a thorough knowledge about factors responsible for reactivity of organic molecules.
- Develop an understanding related to basics and Mechanism of Chemical Kinetic

Reference Books:

1. Lee. J.D. Concise Inorganic Chemistry.ELBS, 1991.
2. Khera, H.C., Gurtu, J.N., Singh, J. Chemistry for B.Sc. I st Year, PragatiPrakashan.
3. Bariyar, A. &Goyal, S., B.Sc. Chemistry Combined. (In Hindi) Krishna Educational Publishers Year: 2019.
4. Puri, B. R. Pathania, M.S., Sharma, L. R., Principles of Physical Chemistry. Vishal Publishing Co. 2020
5. Gurtu, J. N,Gurtu A., Advanced Physical Chemistry. PragatiPrakashan, Meerut. ISBN: 9789386633347, 9386633345; Edition: IV, 2017
6. Day. M.C. and Selbin. J. Theoretical Inorganic Chemistry, ACS Publications 1962
7. Bahl, A &Bahl, B.S. Advanced Organic Chemistry. S. Chand, 2010.
8. Kalsi, P. S., Stereochemistry Conformation and Mechanism, New Age International, 2005.
9. Finar, I.L., Organic Chemistry (Vol. I&1).E.L.B.S.

Class	*CourseType*	*CourseCode*	*Course Title (Theory/Practical)*	*Marks*	
B.Sc. I Semester	Elective	ChemT2	Fundamentals of Chemistry	Max: 100	Min: 35

Course Objectives:

- To create an understanding of structure of atom and indicate the location of the nucleus, the shells, and the electronic orbitals and calculate the maximum number of electrons thatcan occupy a specific shell
- To identify the various periodic properties of s and p block elements and their trends along the group and periods of the periodic table.
- To enable the students to identify and differentiate between the different types ofchemical bonds/ parameters and create an understanding of various theories associated.
- To identify the properties of acids and bases and comparing the various models of acid-base.
- To understand the fundamentals of structure, shape and reactivity of organic molecules.
- To enable the students to understand the concept of stereochemistry and conformations.
- To gain knowledge about rate constants of various order reactions, half-life period, types of electrolytes, solubility product, degree of ionization and factors affecting it.

UNIT – I

Atomic Structure:

(a) Chemical Techniques in ancient India: general Introduction. Contribution of ancient Indian Scientists in chemistry e.g., metallurgy, yes, pigments, cosmetics, Ayurveda, Charak Sanhita.

(b) Review of Bohr's theory and its limitations. Atomic spectrum of Hydrogen. Dual nature of particles and waves, de Broglie's equation, Heisenberg's Uncertainty Principle and its significance. Quantum number and their significance. Rules for filling electrons in various orbitals, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau Principle and its limitations, Variation of orbital energy with atomic number. Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

(c) Elementary idea of the following properties of the elements with reference to s & p-block elements in periodic table. Effective nuclear number (EAN), Shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. Atomic radii (Vander Waals) Ionic and crystal radii Covalent radii (octahedral and tetrahedral).Detailed discussion of the following properties of elements, with reference to s & p-blocks. Ionization energy – Successive ionization energy and factors affecting ionization energy. Applications of Ionization energy. Electronegativity-Pauling's/Mulliken's electronegativity scales. Variation of electro negativity with bond order, partial charge, hybridization

***Keywords/Tags**:* Metallurgy, Dyes, Cosmetics, Charak Sanhita Hydrogen Spectrum, Hund's Rule, EAN, Atomic radii, Ionic radii, Crystal radii.

UNIT II

(a) Ionic Bonding: General Characteristics of Ionic Bonding.

Ionic Bonding and energy: lattice and salvation energies and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Lande equation for calculation of lattice energy, Madelung constant, Born-Haber cycle and its applications.Covalent character in ionic compounds,

polarizing power and polarizability.Fajan'srules.Covalent bonding: Lewis structure, Valence bond theory(Heitler-London Approach). Hybridization-Concept, types (SP,SP^2, SP^3, dSP^2, d^2SP^3) with suitable example of inorganic and organic molecules.Ionic character in covalent compounds-dipole moment and percentage ionic character.

Valence Shell Electron pair Repulsion (VSEPR) Theory: Assumption, need of theory, application of theory to explain geometries or shapes of some inorganic molecules and ions on the basis if VSEPR and hybridaization with suitable examples of linear trigonal planar, square planar, tetrahedral, trigonalbipyramidl and octahedral arrangements such as:NH_3, H_2O, SF_4, ClF_3, PCl_5, SF_6, ClF_5, XeF_4.

(b) Molecular orbital (MO) concept of bonding

The approximations of the theory, Linear combination of Atomic Orbitals(LCAO) (elementary pictorial approach).Rules for the LCAO method, bonding and antibonding MOs. Characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals. Molecular orbital Diagram of homonuclear diatomic molecules:H_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2 and their ions. Molecular orbitals of heteronuclear diatomic molecules: CO, NO, CN, HF.

(c) Bond parameters: Definition and factors affecting- bond orders, bond lengths, bond angles.

Keywords/Tags: Ionic Bonding, Covalent Bonding, hybridization, VSEPR Theory, LCAO, MO diagram, Bond Parameters

UNIT – III

(a) Fundamentals of Organic Chemistry

Structure, shape and reactivity of organic molecules: Physical Effects, Electronic Displacement: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of bonds: Homolysis and Heterolysis. Reactive Intermediates: Carbocations, Carbanions and free radicals. Nucleophiles and Electrophiles.

(b) Stereochemistry of Organic Compounds: Concept of isomerism

Geometrical isomerism: Determination of configuration of geometric isomers.E& Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Optical isomerism: Elements of symmetry, molecular chirality, enantiomers & their properties, stereogeniccentre, optical activity of enantiomers. Concept of chirality (up to two carbon atoms): chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythroisomers, mesoisomer, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

(c) Conformations and Conformational analysis

Conformations of ethane, butane and cyclohexane. Interconversion of wedge Formula, Newman, Sawhorse and Fischer representations.

Keywords/Tags: Electronic Displacements, Nucleophiles, Electrophiles, Isomerism, Molecular Chirality, Enantiomers, Sequence Rules, Conformation

UNIT – IV

(a) Arrhenius concept, Bronsted_Lowry's concept, conjugate acids and bases, relative strength of acids, Lewis concept. pH, buffer solutions. Acid-base neutralisation curves, Handerson equation. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values Indicator, choice of indicators.

(b) Chemical Kinetics: Rate of reaction, Definition and difference of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation of half-life period. Methods to determine the order of reactions. Effect of temperature on rate of

reaction, Arrhenius equation, concept of activation energy.

(c) Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionizations constant and ionic product of water. Common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for difficult salts. Solubility and solubilityproduct of sparingly soluble salts-applications of solubility product.

Keywords/Tags: Acid-base concept, Bronsted-Lowry's concept, Conjugate Acids and Bases, pH, Buffer Soluti Indicator, Order of Reaction, Molecularity Of Reaction, Arrhenius Equation, Activation Equation, Activation Ener Electrolytes, Salt Hydrolysis, Solubility Product

Course Outcomes:

By the end of this course student will be able to

- Gain a thorough knowledge about various theories and principles applied to reveal atomic structure and quant number
- Understand concepts of periodic properties of elements.
- Develop an understanding related to theories of chemical bonding
- Develop the Acid-Base concept and pH buffer
- Gain a thorough knowledge about factor responsible for reactivity of organic molecules.

Develop an understanding related to basics and Mechanism of Chemical Kinetic

Reference Books:

1. Lee. J.D. Concise Inorganic Chemistry.ELBS, 1991.
2. Khera, H.C., Gurtu, J.N., Singh, J. Chemistry for B.Sc. I st Year, PragatiPrakashan.
3. Bariyar, A. &Goyal, S., B.Sc. Chemistry Combined. (In Hindi) Krishna Educational Publishers Year: 2019.
4. Puri, B. R. Pathania, M.S., Sharma, L. R., Principles of Physical Chemistry. Vishal Publishing Co. 2020
5. Gurtu, J. N,Gurtu A., Advanced Physical Chemistry. PragatiPrakashan, Meerut. ISBN: 9789386633347, 9386633345; Edition: IV, 2017
6. Day. M.C. and Selbin. J. Theoretical Inorganic Chemistry, ACS Publications 1962
7. Bahl, A &Bahl, B.S. Advanced Organic Chemistry. S. Chand, 2010.
8. Kalsi, P. S., Stereochemistry Conformation and Mechanism, New Age International, 2005.
9. Finar, I.L., Organic Chemistry (Vol. I&1).E.L.B.S.

Class	*Course Type*	*CourseCode*	*Course Title (Theory/Practical)*	*Marks*	
B.Sc. I Semester	Major/Minor/ Elective	S1-CHEM1P	Qualitative and Quantitative Chemical Analysis (Practical)	Max: 100	Min: 35

General Objective:

- To enable the students to create an understanding about the laboratory practices, various laboratory techniques and analysis.
- To recognize safe laboratory practices, handling laboratory glassware, equipment, and chemical reagents.
- To identify elements and functional group in organic compounds.
- To enable the students to measure the pH of solutions and prepare buffer solution.
- To create an understanding about paper chromatography and spectroscopy through various experiments

EXTERNAL ASSESSMENT: 60 marks

1. Basic Analytical Exercises:

Calibration of different weights and glass apparatus (measuring cylinders, burette, pipette, volumetric flask)

- Preparation of solutions of different normality/ molarity by weighing and dilution

2. Qualitative Organic Analysis

- Detection of hetero elements (N, S, Cl, Br, I) in organic compounds
- Functional group tests for alcohol, aldehyde, carboxylic acid, carbohydrate, phenols,nitro, amine and amide

3. Quantitative Analysis of acid, alkali and buffer solutions

Ionic Equilibria

- Measurement of pH of different solutions of acids, alkalies using pH- meter (may use aerated drinks, fruit juices, shampoos and soaps
- Measurement of the pH of buffer solutions and comparisons of the values with theoretical values.
- Preparation of buffer solutions and determination of their pH and buffer capacity:

(1) Sodium acetate – acetic acid
(2) Ammonium chloride – ammonium hydroxide

4. Qualitative Analysis:

- Identification by determination of the R_f value of given organic/ inorganic compounds by paper chromatography

INTERNAL ASSESSMENT: **40 marks**

Internal assessment	Marks	External assessment	Marks
Chemical and Lab safety • Toxicity of the compounds used in chemistry laboratory • Safety symbols on labels of pack of chemicals and its meaning • What are MSDS sheets? Find out MSDS sheets of some hazardous chemicals ($K_2Cr_2O_7$, benzene, cadmiumnitrate, sodium metal etc.) • Precautions in handling and storage of hazardous substances like concentrated acids, ammonia, organic solvents etc.)	5	Viva- Voce on Practical	5
Attendance	5	Practical Record File	5
Assignment (Charts/ model seminar/Rural services/ Technology dissemination/ Report of Excursion/ Lab visits/ Survey/ Industrial visit)	30	Table work/Experiments	50
TOTAL	**40**		**60**

Course Outcomes: By the end of this course student will be able to

- Understand the importance of chemical safety and lab safety while performing experiments in laboratory
- Perform qualitative inorganic analysis
- Explain elemental analysis of organic compounds (non- instrumental)
- Gain a thorough knowledge about qualitative identification of functional group of organic compounds
- Understand the techniques of pH measurements
- Know the preparation on buffer solutions

Class	*Course Type*	*CourseCode*	*Course Title (Theory/Practical)*	*Marks*	
B.Sc. II Semester	Major/Minor	ChemT2	Analytical Chemistry	Max: 100	Min: 35

Course Objectives:

- To understand various basic mathematical parameters.
- To gain analytical competence through awareness about measurement units used in chemistry, concentration of solutions and Chemical Stoichiometry.
- To attain the essential knowledge of Operating system, MS-word, MS-excel, Power-point.
- To create an understanding of chemical equilibrium, equilibrium constant, Free energy and chemical potential.
- To understand chromatogram, ion exchange, column selection and adsorption.
- To gain knowledge of fundamental laws of absorption, UV- visible spectroscopy and IR spectroscopy.

UNIT – I

Mathematics for Chemists:

straight line equation Logarithmic relations, curves sketching, linear graphs and calculation of slopes, Differentiation of functions like k_x, e^x, x^n, sin x, log x; maxima and minima, partial differentiation. Integration of some useful/relevant functions.

Keywords/Tags: Linear graphs, Logarithmic relations, differentiation, Integration.

UNIT –II

Basic Analytical chemistry

Introduction to analytical Chemistry and its interdisciplinary nature. Concept of Sampling, Importance of accuracy. Precision and source of error in analytical measurements. Significant figures. Statistical term: mean .mean deviation, median, standard deviation, Numerical problems.

Calculation used in Analytical Chemistry

Some important unit of measurement-SI units, Distinction between mass and weight, mole, milli mole and Numerical problems.

Solution and their Concentrations- Concept of molarity, molality and normality. Expressing the concentration in parts per million(ppm), parts per billion(ppb), Numerical problems.

Chemical Stoichiometry- empirical and molecular formulas, stoichiometric calculation, Numerical problems.

Keywords/Tags: Accuracy, Precision, SI Units, unit of concentration, Chemical Stoichiometry.

UNIT – III

Computer for Chemists

Introduction to computer, Introduction to operating systems like-DOS, windows , Linus and Ubuntu. **Use of Computer Programs**, Running of standard programs and packages such as MS- word, MS-Excel, Power –point, Execution of linear regression x-y point . Use of software for drawing structures and Molecular formulae

Keywords/Tags: Operating system, MS-word, MS-excel, Power-point.

UNIT –IV

Chemical Equilibrium: Equilibrium constant and free energy , concept of chemical potential . thermodynamic derivation of law of chemical equilibrium . Temperature dependence of equilibrium constant: Vant Hoff reaction isochore, van't Hoff reaction isotherm . Le Chatelier's principal and its applications

Key/Tags: Chemical Equilibrium Equilibrium constant, Free energy, Chemical potential.

UNIT – V

Chromatography

Introduction .Principal and classification Mechanism of separation: adsorption. Partition and ion-exchange. Development of chromatograms: frontal elution and displacement methods. Paper Chromatography (ascending descending and circular), thin layer chromatography (TLC) and Column Chromatography (CC) and High Pressure Liquids Chromatography (HPLC), types of column and column selection , applications, limitation

Principle and Applications of: Flash – Chromatography, Ion-Exchange chromatography and Chiral chromatography.

Keywords/ tags: Chromatogram, ion exchange, Column Selection, Adsorption.

UNIT – VI

Spectral techniques of analysis

Basics of absorption spectroscopy: Electromagnetic radiation Spectral range. Absorbance. Absorptivity, Molar Absorptivity. Fundamental Laws of absorption. Lambert-Beer Law and its limitation. Constitution and working of photometer , spectrometer, colorimeter.

Ultraviolet (UV) absorption spectroscopy: Presentation and analysis of UV spectra. Types of electronic transition Effect of conjugation. Concept of chromophore and auxochrome,Bathochromic, hypsochromic. Hyperchromic and hypochromic shift. UV spectra of conjugated polyenes and enones.

Infra-red (IR) absorption spectroscopy: Molecular vibration. Hook's law, selection rules. Intensity and position of IR bands. Measurement of IR-spectrum. Finger print region, Characteristics absorption of various functional group and interpretation of IR spectra of simple organic compounds.

Keywords/Tags: Hypsochromic Hypochromic, absorption, spectrum.

Course outcome:

By the end of this course student will be able to

- Understand the basics of application of mathematics and computer in chemistry
- Gain a thorough knowledge about fundamentals of analytical chemistry and steps involved in analysis.
- Build the concepts of thermodynamics and chemical equilibrium
- Develop an understanding about principle of chromatography and spectroscopy and utilization of chromatographic and spectroscopic techniques in analysis.

Reference Books:

1. MitraSurbhi, Handbook of Computer Science & IT, Arihant, 2018
2. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007)
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, NewYork, 2004.
4. Barrow, G.M. Physical Chemistry. Tata McGraw-Hill (2007)
5. Atkins' Physical Chemistry. 10" Edition, Oxford University Press, 2014
6. Gurtu J.N, GurtuA..Advanced Physical Chemistry, PragatiPrakashan, Meerut.ISBN: 9789386633347, 9386633345: Edition: IV, 2017
7. Atkins, P. W. & Paula, J. Physical Chemistry, Oxford Press, 2006.
8. Finar, I.L. Organic Chemistry (Vol. I & I), E.L.B.S.
9. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
10. Banwell, Molecular Spectroscopy, 2017.
11. Silverstien Robert, Spectrometric identification of Organic Compounds, Wiley.2014
12. Dyer J.R.. Applications of Absorption Spectroscopy of Organic Compounds,2009

Class	*CourseType*	*CourseCode*	*Course Title (Theory/Practical)*	*Marks*	
B.Sc. II Semester	Elective	ChemT2	Analytical Chemistry	Max: 100	Min: 35

Course Objectives:

- To gain analytical competence through awareness about measurement units used in chemistry, concentration of solutions and Chemical Stoichiometry.
- To understand of chemical equilibrium, equilibrium constant, Free energy and chemicalpotential.
- To enable the students to understand chromatography, ion exchange, column selection and adsorption.
- To gain knowledge of fundamental laws of absorption, UV- visible spectroscopy and IR spectroscopy.

UNIT – I

(a) Mathematics for Chemists:

straight line equation Logarithmic relations, curves sketching, linear graphs and calculation of slopes, Differentiation of functions like k_x, e^x, x^n, sin x, log x; maxima and minima, partial differentiation. Integration of some useful/ relevant functions.

(b) Computer for Chemists

Introduction to computer, Introduction to operating systems like-DOS, Windows , Linus and Ubuntu. **Use of Computer Programs**, Running of standard programs and packages such as MS- word, MS-Excel, Power –point, Execution of linear regression x-y point. Use of software for drawing structures and Molecular formulae

Keywords/Tags: Linear graphs, Logarithmic relations, differentiation, Integration, Operating system, MS-word, MS-excel, Power-point.

UNIT- II

(a) Basic Analytical chemistry

Introduction to analytical Chemistry and its interdisciplinary nature. Concept of Sampling, Importance of accuracy. Precision and source of error in analytical measurements. Significant figures. Statistical term: mean .mean deviation, median, standard deviation, Numerical problems.

(b) Calculation used in Analytical Chemistry

Some important unit of measurement-SI units, Distinction between mass and weight, mole, milli mole and Numerical problems.

Solution and their Concentrations- Concept of molarity, molality and normality. Expressing the concentration in parts per million(ppm), parts per billion (ppb), Numerical problems.

(c) Chemical Stoichiometry- empirical and molecular formulas, stoichiometric calculation, Numerical problems.

Keywords/Tags: Accuracy, Precision, SI Units, unit of concentration, Chemical Stoichiometry.

UNIT – III

(a) Chemical Equilibrium:

Equilibrium constant and free energy, concept of chemical potential . thermodynamic derivationof law of chemical equilibrium . Temperature dependence of equilibrium constant: Vant Hoff reaction isochore, van't Hoff reaction isotherm. Le Chatelier's principal and its applications.

(b) Chromatography

Introduction .Principal and classification Mechanism of separation: adsorption. Partition and ion-exchange. Development of chromatograms: frontal elution and displacement methods. Paper Chromatography (ascending descending and circular), thin layer chromatography (TLC) and Column Chromatography (CC) and High Pressure Liquids Chromatography (HPLC), types of column and column selection , applications, limitation

Key/Tags: Chemical Equilibrium Equilibrium constant, Free energy, Chemical potential, Chromatogram, ion exchange, Column Selection, Adsorption.

UNIT – IV

Spectral techniques of analysis

Basics of absorption spectroscopy: Electromagnetic radiation Spectral range. Absorbance. Absorptivity, Molar Absorptivity. Fundamental Laws of absorption. Lambert-Beer Law and its limitation. Constitution and working of photometer, spectrometer, colorimeter.

Ultraviolet(UV) absorption spectroscopy: Presentation and analysis of UV spectra. Types of electronic transition Effect of conjugation. Concept of chromophore and auxochrome,Bathochromic, hypsochromic. Hyperchromic and hypochromic shift. UV spectra of conjugated polyenes and enones.

Infra-red (IR) absorption spectroscopy: Molecular vibration. Hook's law, selection rules. Intensity and position of IR bands. Measurement of IR-spectrum. Finger print region, Characteristics absorption of various functional group and interpretation of IR spectra of simple organic compounds.

Keywords/Tags: Hypsochromic Hypochromic, absorption, spectrum.

Course outcome:

By the end of this course student will be able to

- Gain a thorough knowledge about fundamental of analytical chemistry and steps involve in analysis.
- Build the concepts of Chemical equilibrium
- Develop an understanding about principle of chromatography and chromatography techniques and various techniques of spectroscopic Analysis.

Reference Books:

1. MitraSurbhi, Handbook of Computer Science & IT, Arihant, 2018
2. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007)
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, NewYork, 2004.
4. Barrow, G.M. Physical Chemistry. Tata McGraw-Hill (2007)
5. Atkins' Physical Chemistry. 10" Edition, Oxford University Press, 2014
6. Gurtu J.N, GurtuA..Advanced Physical Chemistry, PragatiPrakashan, Meerut.ISBN: 9789386633347, 9386633345: Edition: IV, 2017
7. Atkins, P. W. & Paula, J. Physical Chemistry, Oxford Press, 2006.
8. Finar, I.L. Organic Chemistry (Vol. I & I), E.L.B.S.
9. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
10. Banwell, Molecular Spectroscopy, 2017.
11. Silverstien Robert, Spectrometric identification of Organic Compounds, Wiley.2014
12. Dyer J.R.. Applications of Absorption Spectroscopy of Organic Compounds,2009

Class	*Course Type*	*CourseCode*	*Course Title (Theory/Practical)*	*Marks*	
B.Sc. II Semester	Major/Minor/ Elective	S1-CHEM 2P	Analytical processes and techniques	Max: 100	Min: 35

Course Objectives:

- To interpret results after collecting and analyzing information through scientific methods.
- To develop a clear understanding of the concept behind the preparation of solutions forvolumetric analysis.
- To enable the students to calibrate laboratory glassware and equipment
- To create a clear understanding of inorganic qualitative analysis.
- To create an understanding about paper chromatography and spectroscopy through various experiments
- To enable the students to construct scientific information clearly and accurately in oral and in written form

EXTERNAL ASSESSMENT: 60 marks

a. Qualitative Inorganic Analysis

Identification of simple inorganic mixture (5 radicals)with two/ three acidic and two/ three basic radicals(including typical combinations), special emphasis on learning theoretical concepts ofstrong, moderate and weak electrolytes, ionic product, common ion effect, solubility and solubility product.

b. Quantitative Analysis: Titrimetric Analysis

- Standardization of NaOH by oxalic acid
- Determination of carbonate and hydroxide present in mixture

c. Quantitative analysis by colorimetric:

- Verification of Beer- Lambert's law

d. Qualitative Analysis:

Identification by determination of the R_f value of given organic/ inorganic compounds by thin layer chromatography

INTERNAL ASSESSMENT: **40 marks**

Internal assessment	Marks	External assessment	Marks
Class Interaction on • Common glassware and lab ware for solution preparation and analysis • Numerical problem related to solution preparation • Any other discussion *Note: description to be written in practical records*	5	Viva- Voce onPractical	5
Attendance	5	Practical Record File	5
Assignment (Charts/ model seminar/ Rural services/ Technology dissemination/ Report of Excursion/ Lab visits/ Survey/ Industrial visit)	30	Table work/Experiments	50
TOTAL	**40**		**60**

Course Outcome: By the end of this course students will be able to-

- Build the concept of utilization of analytical methods in chemistry
- Learn the preparation of solutions of different concentrations
- Understand the reason of standardization of the solutions
- Develop an understanding for identification of organic compounds by chromatographic techniques
- Gain a thorough knowledge about analysis by spectral techniques