College of Arts, Science & Commerce (Autonomous)

SIES

RISE WITH EDUCATION

Sion (West), Mumbai – 400022.

Department of Chemistry

Program: B.Sc.

Course: Chemistry

Syllabus for F.Y.B.Sc. Semester I and II

(To be Implemented from 2021 – 2022)

Credit Based Semester and Grading System

Programme Specific Objectives (PSO)

PSO 1: Acquire sound foundation in the basics of chemistry, ability to comprehend the essential facts, principles, theories in physical chemistry, organic chemistry, inorganic chemistry and analytical chemistry.

PSO 2: Application of basic concepts to interpret derivations and solve numerical problems.

PSO 3: Acquire technical skills required to handle different instruments for qualitative and quantitative chemical analysis.

PSO 4: Ability to analyze the environmental aspect of the chemicals.

PSO 5: Acquire the concept of atomic and molecular orbital approach to study the applications in the chemistry of inorganic compounds.

POS 6: To outline the nature and basic concepts of bond formation, stereochemistry and reaction mechanism in organic chemistry.

	Semester – I: Course Outcome
CO 1	Apply and analyze the different laws of thermodynamics and its application.
CO 2	Explain the different concentration terms in solution with suitable numericals.
CO 3	Outline and analyze the various terms and concepts in chemical kinetics and liquid state.
CO 4	Outline the periodicity of elements and Interpret the trends in variation of periodic properties, inspect the basics of chemical bonding and ionic bond energies.
CO 5	Elaborate the periodicity of main group elements. Apply different methods for balancing the redox reactions.
CO 6	Ability to interpret the importance of protection and conservation of our environment and create awareness about the human activities which leads to the indiscriminate release of air pollutants into the environment.
CO 7	Apply IUPAC rule to interpret organic molecules name and structure, geometry with the concept of hybridization.
CO 8	Identify the stability of organic species with the help of various electronic effects and their applications in studying organic reaction mechanism.
CO 9	Draw the configuration of organic molecules in various projection formulae and interconvert them.
CO 10	Recognize and explain structural isomers, stereoisomers, identify the stereocenters in a molecule and assign the configuration of simple chiral compounds.
CO 11	Apply skills of observation, recording and analyzing data. Utilize various separation techniques and identify chemical species.

	Semester – II : Course Outcome
CO 1	Examine and analyze the deviations from ideal gas laws.
CO 2	Examine the different types of reactions and thermodynamic parameters involved.
CO 3	Explain and analyze the terms in ionic equilibria, molecular spectroscopy and solid state chemistry with suitable numericals.
CO 4	Create an awareness about curtailing the wastage of chemical reagents with the knowledge of various techniques involved during qualitative analysis with reference to the role of impregnated test papers.
CO 5	Examine the various acid base theories and their applications.
CO 6	Apply various theories to identify the shapes of covalent molecules. Interpret the applications of redox chemistry and examine redox stability in water.
CO 7	Describe the functional group transformation and plan simple synthesis of organic compounds with mechanism.
CO 8	Draw various conformations of alkanes/cycloalkanes and predict their relative stabilities.
CO 9	Identify aromaticity, anti-aromatic and non-aromatic compounds based on their structures
CO 10	Write the reactions and outline the mechanism of electrophilic aromatic substitution reactions. Predict the effect on the reactivity and orientation of substituents on electrophilic aromatic substitution in substituted benzene.
CO 11	Discuss Material Safety Data Sheets (MSDS) and apply during practical. Apply instrumental methods of chemical analysis.
CO 12	Discuss and apply correct techniques for organic and inorganic qualitative analysis

SEMESTER – I

Contents:		
Paper I	:	**General Chemistry**
SIUSCHE11.1	:	Chemical Thermodynamics and Chemical Calculations
SIUSCHE11.2	:	Atomic structure, Periodic table, periodicity and chemical bonding.
SIUSCHE11.3	:	Basics of Organic Chemistry
Paper II	:	**General Chemistry**
SIUSCHE12.1	:	Chemical Kinetics and Liquid states
SIUSCHE12.2	:	Comparative chemistry of main group elements and Redox reactions.
SIUSCHE12.3	:	Stereochemistry – I
Practical		
SIUSCHE1P	:	Chemistry Practical

SEMESTER – II

Contents:		
Paper I	:	**General Chemistry**
SIUSCHE21.1	:	Gaseous state and Chemical equilibria
SIUSCHE21.2	:	Qualitative analysis and Acid Base theories
SIUSCHE21.3	:	Chemistry of aliphatic hydrocarbons
Paper II	:	**General Chemistry**
SIUSCHE22.1	:	Ionic equilibria, Molecular Spectroscopy and Solid State Chemistry
SIUSCHE22.2	:	Chemical bonding and chemistry of oxidation reduction reactions
SIUSCHE22.3	:	Stereochemistry - II and Aromatic Hydrocarbons
Practical	:	
SIUSCHE2P	:	Chemistry Practical

F.Y.B.Sc. Chemistry Syllabus

SEMESTER I

Course Code	Unit	Topics	Credits	L/Week
SIUSCHE11	1	**Chemical Thermodynamics and Chemical Calculations**	2	1
		1.1 Chemical Thermodynamics		
		1.2 Chemical Calculations		
	2	**Atomic structure, Periodic Table, Periodicity and Chemical Bonding**		1
		2.1 Atomic structure		
		2.2 Periodic Table and Periodicity		
		2.3 Chemical Bonding		
	3	**Basics of Organic Chemistry**		1
		3.1 Classification and nomenclature of organic compounds		
		3.2 Bonding and structure of organic compounds		
		3.3 Fundamentals of organic reaction mechanism		
SIUSCHE12	1	**Chemical Kinetics and Liquid states**	2	1
		1.1 Chemical Kinetics		
		1.2 Liquid state		
	2	**Comparative Chemistry of Main Group Elements and Redox Reaction**		1
		2.1 Comparative Chemistry of Main Group Elements		
		2.2 Oxidation and Reduction		
	3	**Stereochemistry – I**		1
SIUSCHE1P		**Chemistry Practical**	2	6

Course Code: SIUSCHE11

Paper I

Credits:2 Credits (45 Lectures)

Unit – 1, 1L/Week		**15 L**
Course Code: SIUSCHE11.1		
1 Chemical Thermodynamics and Chemical Calculations		**15 L**
1.1	**Chemical Thermodynamics:** **Thermodynamic terms:** System, surrounding, boundaries, open, closed and isolated system, intensive and extensive properties, state functions and path functions, zeroth law of thermodynamics. **First law of thermodynamics:** Concept of heat (q), work (w), internal energy (U), statement of first law, enthalpy, relation between heat capacities, sign conventions, Calculations of heat (q), work (w), internal energy (U) and enthalpy (H), First law of thermodynamics for isothermal process, Adiabatic process, isochoric process, isobaric process. Relationship between ΔH and ΔU for chemical reaction. Work done in a chemical reaction. Qualitative discussion of Carnot cycle for ideal gas and mechanical efficiency. **Second law of thermodynamics:** Statement of second law of thermodynamics, concepts of entropy and free energy, spontaneity and physical significance of free energy. **Thermochemistry:** Heats of reactions, standard states, enthalpy of formation of molecules, enthalpy of combustion and its applications, Hess's law of constant heat summation, calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equation. (Numericals expected).	**10 L**
1.2	**Chemical Calculations:** Expressing concentration of solutions: Normality, molality, molarity, formality, mole fractions, weight ratio, volume ratio, weight to volume ratio, ppm, ppb, millimoles, milliequivalents. (Numericals expected).	**5 L**
Unit – 2, 1L/Week		**15 L**
Course Code: SIUSCHE11.2		
2 Atomic structure, periodic table, periodicity and chemical bonding.		**15 L**

2.1	**Atomic structure:** Rutherford's Atomic Model; Bohr's Theory; dual Nature of electrons; Heisenberg's Principle of uncertainty; Quantum Numbers, Aufbau principle, Pauli's Exclusion principle and Hund's rule, shapes of s, p and d - orbitals.	**4 L**
2.2	**Periodic Table and periodicity:** Long form of Periodic Table; Classification for elements as main group, transition and inner transition elements. Periodicity in the following properties: Atomic and ionic size, electron gain enthalpy, ionization enthalpy, effective nuclear charge (Slater's rule), electronegativity, Pauling, Mulliken and Allred - Rochow electronegativities. (Numerical problems expected, wherever applicable).	**5 L**
2.3	**Chemical Bonding:** **Ionic Bonding**: Types of chemical bond, Ionic Bond, Formation of Ionic Bond, Lattice Energy, Factors affecting lattice energy, Born – Landé Equation, Born – Haber Cycle and its Application, Solvation energy, Kapustinskii equation. Types of ionic crystals. (Numericals to be included).	**6 L**
Unit – 3, 1L/Week		**15 L**
Course Code: SIUSCHE11.3		
3 Basics of Organic Chemistry		**15 L**
3.1	**Classification and Nomenclature of Organic Compounds**: Review of basic rules of IUPAC nomenclature. Nomenclature of mono and bi-functional aliphatic compounds on the basis of priority order of the following classes of compounds: alkanes, alkenes, alkynes, halo alkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids and its derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles and amines, including their cyclic analogues. Nomenclature of aromatic compounds (mono and bi-functional).	**5 L**
3.2	**Bonding and Structure of organic compounds**: Overlap of atomic orbitals: Overlaps of atomic orbitals to form sigma and pi bonds. Hybridization: sp^3, sp^2, sp hybridization of carbon and nitrogen; sp^3 and sp^2 hybridization of oxygen in organic compounds, shapes and geometry of organic molecules. Shapes of molecules, Influence of hybridization on bond properties (as applicable to ethane, ethene, ethyne).	**4 L**
3.3	**Fundamentals of organic reaction mechanism:**	**6 L**

	Electronic Effects: Formal charge, Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications, dipole moment, organic acids and bases, their relative strengths (Aliphatic and aromatics). **Recapitulation of Arrows.** **Bond fission**: Homolytic and Heterolytic fission with suitable examples. Electrophiles and Nucleophiles, Nucleophilicity and basicity. **Carbocations, Carbanions and Free radicals**: Types (primary, secondary, tertiary, allyl, benzyl), their shape and relative stability.	

Course Code: SIUSCHE12

Paper II

Credits: 2 Credits (45 Lectures)

Unit – 1, 1L/Week		**15 L**
Course Code: SIUSCHE12.1		
1 Chemical Kinetics and Liquid states		**15 L**
1.1	**Chemical Kinetics:** Rate of reaction, rate constant, measurement of reaction rates. Order and molecularity of reaction. Integrated rate equation of first order reaction and integrated rate of second order reactions (with equal and unequal initial concentration of reactants). Determination of order of reaction by (a) Integration method (b) Graphical method (c) Ostwald's isolation method (d) Half time method. (Numerical expected)	**8 L**
1.2	**Liquid State:** Surface tension: Introduction, methods of determination of surface tension by drop numbermethod. Viscosity: Introduction, coefficient of viscosity, relative viscosity, specific viscosity,reduced viscosity, determination of viscosity by Ostwald viscometer. Refractive index: Introduction, molar refraction and polarizability, determination ofrefractive index by Abbe'srefractometer. Liquid crystals: Introduction, classification and structure of thermotropic phases (Nematic, smectic and cholesteric phases), applications of liquid crystals. (Numerical expected)	**7 L**

Unit – 2, 1L/Week		**15L**
Course Code: SIUSCHE12.2		
2 Comparative Chemistry of Main Group Elements and Redox Reaction		**15 L**
2.1	**Comparative chemistry of Main Group Elements** Metallic and non-metallic nature, oxidation states, anomalous behavior of second period elements, diagonal relationship. Inert pair effect, allotropy, catenation. Oxides of carbon, oxides and oxyacid's of Sulphur and Nitrogen with respect to environmental aspects.	**10 L**
2.2	**Oxidation and Reduction**: Oxidizing and Reducing agents, Oxidation number, Rules to assign Oxidation numbers with examples ions like oxalate, permanganate and dichromate. Balancing redox reactions by ion electron method and oxidation number method.	**5 L**
Unit – 3, 1L/Week		**15 L**
Course Code: SIUSCHE12.3		
3 Stereochemistry – I		**15 L**
3.1	**Stereochemistry I:** **Concept of isomerism**: Types of isomerism: constitutional isomerism (chain, position and functional) and stereoisomerism. Representation of configuration by Flying wedge, Fischer, Newman and Sawhorse Projection formulae. The interconversion of the formulae using suitable examples. **Geometrical isomerism** in cycloalkane, C = C and C = N systems, cis–trans and syn-anti isomerism E / Z notations with CIP rules. **Optical Isomerism**: Optical Activity, Specific Rotation, Chirality / Asymmetry, Enantiomers, Molecules with two similar and dissimilar chiral-centres, diastereoisomers, meso structures, erythro, threo, racemic mixture and resolution. **Relative and absolute configuration**: D/L and R/S designations.	**15 L**

SUGGESTED REFERENCE SIUSCHE11.1& SIUSCHE12.1

1. A text book of Physical Chemistry by K. L. Kapoor.
2. Essentials of Physical Chemistry by B.S. Bahl, Arul Bahl and G.D. Tuli.
3. Chemical Kinetics by Keith J. Laidler.
4. Mathematical preparation for Physical Chemistry by F. Daniel.
5. Principle of Physical Chemistry by Maron and Pruton.
6. Textbook of physical chemistry, 2nd Editionby Samuel Glasstone.

SUGGESTED REFERENCE SIUSCHE11.2 & SIUSCHE12.2

1. J. Barrett and A. Malati, 'Fundamentals of Inorganic Chemistry', East-West Press Edition (2006).
2. C.M. Day and Joel Selbin, 'Theoretical Inorganic Chemistry', Affiliated East West Press Pvt. Ltd., (1985).
3. J.D.Lee, Concise 'Inorganic Chemistry', 5th edition, Blackwell Science Ltd., (2005).
4. James E. Huheey, 'Inorganic Chemistry', 3rd edition, Harper & Row, Publishers, Asia, Pte Ltd., (1983).
5. R.J. Gillespie and I. Hargittai, The VSEPR Model of Molecular Geometry,Dover Publication,(2012).
6. J. Barrett, 'Inorganic Chemistry in Aqueous Solutions'; The Royal Society of Chemistry (2003).
7. T. Moeller and R. O'Connor, 'Ions in Aqueous Systems'; McGraw-Hill Book Company, (1972).
8. Gary L. Miessler, Donald A. Tarr, St. Olaf College, Northfield, Minnesota. Pearson Prentice Hall
9. Inorganic Chemistry, Catherine E. Housecraft and Alan G. Sharpe. Pearson Prentice Hall.

SUGGESTED REFERENCE S SIUS CHE11.3 & SIUSCHE12.3

1. Organic Chemistry: S.H. Pine McGraw Hill. Kogakusha Ltd.
2. Organic Chemistry: John McMurry 5th Edition Cornell University.
3. Advance Organic Chemistry:Jerry March, Wiley Eastern Ltd.
4. A guide to IUPAC Nomenclature of Organic Compound,: Richer Interscience Publications.
5. Organic Chemistry: T.W.G. Solomons, C. B. Fryhle, 2000 John Wiley and Sons.
6. Organic Chemistry: Morrison and Boyd, Allyn& Bacon Inc.
7. Organic Chemistry: Francis A. Carey, 1996 3rd Ed. McGraw Hill.
8. Fundamentals of Organic Chemistry: G. Mare Loudon, 2002 4th Edition.
9. Reaction Mechanism: Peter Sykes, 1999 Orient Longman.
10. Organic Chemistry: SeyhanN. Ege, 1984. D. C. Heath & Co.
11. Organic Reactions with Mechanism: S.P. Bhutani, Ane book Pvt. Ltd.
12. Stereochemistry of Organic Compound: E. L. Eliel and S.H. Wilen, Wiley.
13. Stereochemistry: V.M. Potapov, Mir Publishers, Moscow.
14. Stereochemistry Conformation and Mechanism: P.S. Kalsi, Wiley Eastern Ltd.
15. Stereochemistry of Organic Compound: Principles and Applications: D. Nasipuri, Wiley Eastern Ltd.
16. Stereochemistry and Mechanism: David Whittaker, Oxford Chem. Series.

Course Code: SIUSCHE1P

Paper I, II

Credits: 2 Credits (45 Lectures)

PRACTICAL COURSE CHEMISTRY LABORATORY

Course Code: SIUSCHE1P	
Unit	**Course Code: SIUSCHE1P1 (Paper – I)**
P1.1	**Physical Chemistry** 1. Calibration of volumetric apparatus. 2. To determine the rate constant for the hydrolysis of ester using HCl as catalyst. 3. To determine enthalpy of dissolution of salt (like KNO_3). 4. To prepare 0.1 N succinic acid and standardize sodium hydroxide of two different concentrations.
P1.2	**Inorganic Chemistry** 1. Commercial analysis of (any two) a) Mineral acid b) Organic acid c) Salt of weak acid and strong base. 2. Titration using double indicator: analysis of solution of $Na_2CO_3$and $NaHCO_3$.
	Course Code: SIUSCHE1P2 (Paper – II)
P2.1	**Inorganic Chemistry** 1. Gravimetric analysis a) To determine the percentage purity of sample of $BaSO_4$containing NH_4Cl. b) To determine the percentage purity of ZnO containing $ZnCO_3$.
P2.2	**Organic Chemistry** 1. Purification of any two organic compounds by recrystallization selecting suitable solvent. (Provide 1g.). **Learners are expected to report** a) Solvent for recrystallization. b) Mass and melting points of purified compound. **Learners should calibrate thermometer before determination of the melting point.** 2. Chromatography (Any one)

	a) Separation of a mixture of two sugars by ascending paper chromatography. b) Separation of a mixture of o-and p-nitrophenol by thin layer chromatography (TLC).

SUGGESTED REFERENCESIUSCHE1P

1. Fundamental of Analytical Chemistry – Skoog D.A. and West D.M. Saunders, College Publication.
2. Introduction to Instrumental Analysis, R. D. Brown, McGraw Hill.
3. Instrumental Methods of Analysis, H. H. Willard, L. L. Meritt and J. A. Dean, Affiliated East-West Press.
4. Quality in the Analytical Chemistry laboratory –Neil T. Crosby, Florence Elizabeth Prichard, Ernest J. Newman – John Wiley & Sons Ltd.
5. Principles and Practice of Analytical Chemistry-Fifield F.W. and Kealey D., Black well Science.
6. Analytical Chemistry, Christian, WSE / Wiley.
7. Basic concepts of Analytical Chemistry, S. M. Khopkar, New Age International (P) Ltd.
8. Quantitative Analysis, R.A Day &A.L. Underwood, Prentice Hall Publication.
9. Chemical Analysis in the laboratory - A Basic guide by Irene Muller-Harvey, Richard M. Baker, Royal Society of Chemistry.
10. Textbook of Quantitative Inorganic Analysis -Vogel A.I.

Section A.P1 and P2 are regular experiments.

Section B. List of Demo experiments: (minimum 01)

1. To study technique of pipetting.
2. To determine the viscosity of liquid by Ostwald viscometer.

Section C. Any one out of the following is compulsory.

1. Students should collect the information of at least five Nobel Laureates in Chemistry with their work. Students should submit detailed report.
2. Students who participate in the study tour must submit report.

SUGGESTED REFERENCE SIUSCHE1P

1. Fundamental of Analytical Chemistry-Skoog D.A. and West D.M. Saunders, College Publication.
2. Introduction to Instrumental Analysis, R. D. Brown, McGraw Hill.
3. Instrumental Methods of Analysis, H. H. Willard, L. L. Meritt and J. A. Dean, Affiliated East-West Press.
4. Quality in the Analytical Chemistry laboratory –Neil T. Crosby, Florence Elizabeth Prichard,

Ernest J. Newman – John Wiley & Sons Ltd.

5. Principles and Practice of Analytical Chemistry-Fifield F.W. and Kealey D, Black well Science.
6. Analytical Chemistry, Christian, WSE / Wiley.
7. Basic concepts of Analytical Chemistry, S. M. Khopkar, New Age International (P) Ltd.
8. Quantitative Analysis, R.A Day &A.L Underwood, Prentice Hall Publication.
9. Chemical Analysis in the laboratory –A Basic guide by Irene Muller-Harvey, Richard M. Baker, Royal Society of Chemistry.
10. Textbook of Quantitative Inorganic Analysis -Vogel A.I., 5th Edition.

F.Y.B.Sc. Chemistry Syllabus

SEMESTER II

Course Code	Unit	Topics	Credits	L/Week
SIUSCHE21	1	**Gaseous State and Chemical Equilibria**	2	1
		1.1 Gaseous State		
		1.2 Chemical Equilibria		
	2	**Qualitative Analysis and Acid Base Theories**		1
		2.1 Concept of Qualitative Analysis		
		2.2 Acid Base Theories		
	3	**Chemistry of Aliphatic Hydrocarbons**		1
		3.1 Carbon-Carbon sigma bonds		
		3.2 Carbon-Carbon pi bonds		
		3.3 Reactions of alkynes		
SIUSCHE22	1	**Ionic equilibria, Molecular Spectroscopy and Solid State Chemistry**	2	1
		1.1 Ionic Equilibria		
		1.2 Molecular Spectroscopy		
		1.3 Solid State Chemistry		
	2	**Chemical bonding and chemistry of oxidation reduction reactions**		1
		2.1 Chemical bond and Reactivity		
		2.2 Chemistry of oxidation reduction reactions		
	3	**Stereochemistry - II and Aromatic Hydrocarbons**		1
		3.1 Stereochemistry-II: Conformational Analysis of alkanes and cycloalkanes		
		3.2 Aromatic Hydrocarbons		
SIUSCHE2P		**Chemistry Practical**	2	6

Course Code: SIUSCHE21

Paper I

Credits: 2 Credits (45 Lectures)

Unit – 1, 1L/Week		**15 L**
Course Code: SIUSCHE21.1		
1 Gaseous State and Chemical Equilibria		**15 L**
1.1	**Gaseous State:** Ideal gas laws, kinetic theory of gases Maxwell-Boltzmann's distribution of velocities (qualitative discussion), ideal gases, real gases, compressibility factor, Boyle's temperature (Numericals expected). Deviation from ideal gas laws, reasons for deviation from ideal gas laws, van der Waals equation of state, Joule-Thomson effect: qualitative discussion and experimentation, inversion temperature. (Numericals expected).	**10 L**
1.2	**Chemical Equilibria:** Reversible and irreversible reactions, law of mass action, dynamic equilibria. Equilibrium constant (Kc and Kp), Application of equilibrium constant, relationship between Kc and Kp, Le Chatelier's principle, factors affecting chemical equilibrium and application (Numericals expected)	**5 L**
Unit – 2, 1L/Week		**15 L**
Course Code: SIUSCHE21.2		
2 Qualitative Analysis and Acid Base Theories		**15 L**
2.1	**Concept of Qualitative Analysis:** Types of qualitative analysis: Macro analysis, semi-micro analysis, micro analysis and ultra-micro analysis. Testing of Gaseous Evolutes, Role of Papers impregnated with reagents inqualitative analysis (with reference to papers impregnated with starch iodide, potassium dichromate, lead acetate, dimethylglyoxime and oxine reagents). Precipitation equilibria, effect of common ions, uncommon ions, oxidation states,buffer action, complexing agents on precipitation of ionic compounds. (Balancedchemical equations and numerical problems expected.)	**7 L**

2.2	**Acid Base Theories:** Arrhenius theory, Lowry-Bronsted concept, Lewis concept, Solvent-Solute system (auto ionization) concept of acids and bases, Lux Flood concept, Hard and Soft acids and bases (HSAB). Applications of HSAB concept. Applications of acid base chemistry in: i) Understanding organic reactions like Friedel Craft's (acylation/alkylation) reaction ii) Volumetric analysis with special reference to calculation of titration curve involving strong acid and strong base.	**8 L**
Unit – 3, 1L/Week		**15 L**
Course Code: SIUSCHE21.3		
3 Chemistry of Aliphatic Hydrocarbons		**15 L**
3.1	**Saturated Hydrocarbons:** Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz - Fittig Reactions. Free radical substitutions: Halogenation -relative reactivity and selectivity.	**3 L**
3.2	**Unsaturated Hydrocarbons:** Formation of alkenes and alkynes by elimination reactions: Mechanism of E1, E2, reactions. Saytzeff and Hofmann rule. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), Oxymercuration - demercuration reaction, Mechanism of hydroboration-oxidation, ozonolysis, Reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2 and 1, 4 addition reactions in conjugated dienes and Diels-Alder reaction, Allylic and benzylic bromination using N-bromosuccinimide and mechanism e.g. propene, 1-butene, toluene, ethylbenzene.	**10 L**
3.3	**Reactions of alkynes:** Acidity of alkynes, Electrophilic addition reactions to alkynes, Hydration reactions of alkyne to form carbonyl compounds, Alkylation of terminal alkynes.	**2 L**

Course Code: SIUSCHE22

Paper II

Credits:2 Credits (45 Lectures)

Unit – 1, 1L/Week		**15 L**
Course Code: SIUSCHE22.1		
1 Ionic equilibria, Molecular Spectroscopy and Solid State Chemistry		**15 L**
1.1	**Ionic Equilibria:** Strong, moderate and weak electrolytes. Degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water, ionization of weak acids and bases, pH scale, common ion effect and its applications, dissociation constants of mono-, di- and triprotic acid (exact treatment for monoprotic acid) (Numericals expected). Buffers: Introduction, types of buffers, derivation of Henderson equation for acidic and basic buffers, buffer action, buffer capacity (Numericals expected).	**7 L**
1.2	**Molecular Spectroscopy:** Electromagnetic radiation, electromagnetic spectrum, Planck's equation. Interaction of electromagnetic radiation with matter: Absorption, emission, scattering, fluorescence, electronic, vibrational and rotational transitions, Beer-Lambert's law (Numericals expected).	**3 L**
1.3	**Solid State Chemistry:** Types of solids, crystal lattice, lattice points, unit cell, space lattice and lattice plane. Laws of crystallography: Law of constancy of interfacial angle, laws of symmetry and law of rational indices (Numericals expected).	**5 L**
Unit – 2, 1L/Week		**15 L**
Course Code: SIUSCHE22.2		
2 Chemical bonding and chemistry of oxidation reduction reactions.		**15 L**
2.1	**Chemical Bond and Reactivity:** Types of covalent bonds, comparison between ionic and covalent bonds, polarizability (Fajan's Rule) and shapes of molecules. Lewis dot structure, Valence bond theory, hybridization, Sidgwick Powell Theory, basic VSEPR theory for ABn type molecules with and without lone pair of electrons, applications and limitations of VSEPR theory and isoelectronic principles.	**7 L**

2.2	**Chemistry of oxidation reduction reactions** Reduction potentials, Electrochemical series and its applications. Redox stability in water i) Latimer and Frost Diagrams (Ebsworth diagram) ii) pH dependence of redox potentials. Applications of redox chemistry i) Extraction of elements: (example: isolation of copper by auto reduction) ii) Redox reagents in volumetric analysis: a) I_2b) $KMnO_4$ iii) Titration curves: (x) Single electron systems as in Ce(IV) against Fe(II). (y) Multi electron systems as in $KMnO_4$ against Fe(II).	**8 L**
Unit – 3, 1L/Week		**15 L**
Course Code: SIUSCHE22.3		
3 Stereochemistry - II and Aromatic Hydrocarbons		**15 L**
3.1	**Stereochemistry – II** **Conformational Analysis of alkanes and cycloalkanes:** Conformation analysis of alkanes, Relative stability with energy diagrams. Types of cycloalkanes and their relative stability, types of strains, Baeyer strain theory, Conformation analysis of cyclohexane: Chair, Boat and Twist boat forms, Relative stability with energy.	**5 L**
3.2	**Aromatic Hydrocarbons** **Aromaticity**: Nomenclature, Huckel's rule: benzenoid, non-benzenoid aromatic compounds and heterocyclic compounds with suitable examples. Anti-aromaticity and non-aromaticity with suitable example. Electrophilic aromatic substitution with their mechanism. Activating / deactivating effects and orienting effect in substituted benzene.	**10 L**

SUGGESTED REFERENCE SIUSCHE21.1 & SIUSCHE22.1

1. Principle of the Solid state by H. V. Keer.
2. A text book of Physical Chemistry by Negi Anand.
3. Physical Chemistry by Thomas Engel and Philip Reid.
4. Physical Chemistry by G. W. Castellan.
5. Principle of Physical Chemistry by Maron and Pruton.

SUGGESTED REFERENCE SIUSCHE21.2 & SIUSCHE22.2

1. B.Douglas, D.H. McDaniel and J.J.Alexander, *Concepts and Models of Inorganic Chemistry*, 2nd

edition, John Wiley & Sons, (1983).

2. GaryWulfsberg, *Inorganic Chemistry*; Viva Books PA Ltd., New Delhi; (2002).
3. W. W. Porterfield, *Inorganic Chemistry-An Unified Approach*, Academic press (1993).
4. D.F.Shriver, P.W.Atkins and C.H. Langford, Inorganic Chemistry, 3rd edition Oxford University Press, (1999).
5. AsimK.Das, *Fundamental Concepts of Inorganic Chemistry*,(Volumes-I,II and III) CBS Pub. (2000).
6. N.N.Greenwood and A.Earnshaw, Chemistry of Elements, Pergamon, (1984).
7. P. K. Dutta, 'General and Inorganic Chemistry',Levant Books,15thEdition, (2003).

SUGGESTED REFERENCE SIUSCHE21.3 & SIUSCHE22.3

1. Organic Chemistry: T.W.G.Solomons, C.B.Fryhle, 2000 John Wiley and Sons.
2. Organic Chemistry: Morrison and Boyd Allyn & Bacon Inc.
3. Organic Chemistry: Francis A. Carey, 1996 3rd Ed. McGraw Hill.
4. Fundamentals of Organic Chemistry:G.Mare Loudon, 2002 4th Ed.
5. Reaction Mechanism: Peter Sykes, 1999 Orient Longman.
6. Advance Organic Chemistry: Jerry March, Wiley Eastern Ltd.
7. Organic Chemistry:SeyhanN.Ege, 1984. D.C.Heath& Co.
8. Organic Reactions with Mechanism: S.P.Bhutani,Ane book Pvt. Ltd.
9. Stereochemistry of Organic Compound: E. L. Eliel and S.H. Wilen, Wiley.
10. Stereochemistry: V. M. Potapov, Mir Publishers, Moscow.
11. Stereochemistry Conformation and Mechanism: P.S. Kalsi, Wiley Eastern Ltd.
12. Stereochemistry of Organic Compound: Principles and Applications: D. Nasipuri, Wiley Eastern Ltd.
13. Stereochemistry and Mechanism: David Whittaker, Oxford Chem. Series.

Course Code: SIUSCHE2P

Paper I, II

Credits: 2 Credits (45 Lectures)

PRACTICAL COURSE CHEMISTRY LABORATORY:

Course Code: SIUSCHE2P	
Unit	**Course Code: SIUSCHE2P1 (Paper – I)**
P1.1	**Physical Chemistry** 1. To investigate reaction between $K_2S_2O_8$ and KI (with equal initial concentration). 2. To determine dissociation constant of weak acid (Ka) using Henderson's equation and the method of incomplete titration using a pH meter. 3. To verify Beer-Lambert's law, using $KMnO_4$ solution by colorimetric method. 4. To standardize commercial sample of HCl using borax and to write material safety data of the chemicals involved.
P2.2	**Inorganic Chemistry** **1. Qualitative analysis: (at least 4 mixtures to be analyzed)** Semi-micro inorganic qualitative analysis of a sample containing two cations and two anions. Cations (from amongst): Pb^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Cu^{2+}, Cd^{2+}, Fe^{2+}, Ni^{2+}, Al^{3+}, Cr^{3+}, Mn^{2+}, Mg^{2+}, K^+, NH_4^+. Anions (From amongst):CO_3^{2-}, S^{2-}, SO_3^{2-}, NO_2^-, NO_3^-, Cl^-, Br^-, I^-, SO_4^{2-}. (*Scheme of analysis should avoid use of sulphide ion in any form for precipitation / separation of cations.)*
	Course Code: SIUSCHE2P2 (Paper – II)
P2.1	**Inorganic Chemistry** **1. Redox Titration:** To determine the percentage of copper(II) present in a given sample by titration against a standard aqueous solution of sodium thiosulfate (iodometry titration)
P2.2	**Organic Chemistry** **Characterization of organic compound containing C, H, (O), N, S, X elements.** (minimum 6 compounds)

Section A. P1 and P2 are regular experiments

Section B. List of Demo experiments: (minimum 01)

1. To prepare the stock solution.
2. To compare the density of different liquids.

Section C. Any one out of the following is compulsory.

1. Students should collect the information of at least five pioneering institutes in research and their work. Report that in fair journal.
2. Students who participate in the study tour must submit report.

SUGGESTED REFERENCE SIUSCHE2P

1. Fundamental of Analytical Chemistry-Skoog D.A. and West D.M. Saunders, College Publication.
2. Introduction to Instrumental Analysis, R. D. Brown, McGraw Hill.
3. Instrumental Methods of Analysis, H. H. Willard, L. L. Meritt and J. A. Dean, Affiliated East-West Press.
4. Quality in the Analytical Chemistry laboratory –Neil T. Crosby, Florence Elizabeth Prichard, Ernest J. Newman – John Wiley & Sons Ltd.
5. Principles and Practice of Analytical Chemistry-Fifield F.W. and Kealey D, Black well Science.
6. Analytical Chemistry, Christian, WSE / Wiley.
7. Basic concepts of Analytical Chemistry, S. M. Khopkar, New Age International (P) Ltd.
8. Quantitative Analysis, R.A Day &A.L Underwood, Prentice Hall Publication.
9. Chemical Analysis in the laboratory –A Basic guide by Irene Muller-Harvey, Richard M. Baker, Royal Society of Chemistry.
10. Textbook of Quantitative Inorganic Analysis -Vogel A.I.

MODALITY OF ASSESSMENT

I] THEORY EXAMINATION PATTERN:

(A)Semester End Internal Assessment - 40 Marks

Internal Assessment	Marks
Class test	**20**
Assignment / Case Study / Project / Presentation/etc.)	**15**
Active participation and overall conduct in class	**05**
Total Marks	**40**

(B)Semester End Theory Assessment - 60 Marks

Duration - **Semester End Theory** examinations shall be of **2 Hours** duration

Theory question paper pattern:

1. There shall be **four** questions.
2. Each unit there will be one question with **15** Marks each & fourth one will be based on all the three units with 15Marks.
3. All questions shall be **compulsory** with internal choices within the questions.

   Question 1 (Unit-1)

   Question 2 (Unit-2)

   Question 3 (Unit-3) &

   Question 4 (combined units) will be of **15** Marks with internal options.
4. All Questions may be sub divided into sub questions of **five** marks each.
5. Please ensure that the allocation of marks depends on the number of lectures allotted for each topic.

Marks distribution pattern for theory examination:

Semester End Examination	Paper I	Paper II	Grand Total
Internal Assessment	**40**	**40**	**80**
Theory	**60**	**60**	**120**
Total Marks	**100**	**100**	**200**

II] PRACTICAL EXAMINATION PATTERN:

Scheme of examination: There will be no internal assessment for practical.

A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a **certified journal** at the time of practical examination or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of that semester of F.Y.B.Sc. Chemistry as per the minimum requirement.

The duration of the practical examination will be three and half hours per experiment. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of chemistry.

Note: Minimum 75% experiments of prescribed syllabus should be completed in the 1st and 2nd semester. Certified journal is a must to be eligible to appear for the semester end practical examination, failing which they will not be allowed to appear for the examination.

Semester end practical examination: 50 Marks per Paper

Sr. No.	Practical Examination	Marks		Total
		Paper I	Paper II	
1.	Experimental work	40	40	80
2.	Journal	05	05	10
3.	Viva Voce	05	05	10
Practical Marks		50	50	100

Overall Examination and Marks Distribution Pattern

Semester End Examination	Paper I	Paper II	Grand Total
Internal Assessment	40	40	80
Theory	60	60	120
Practical	50	50	100
Total Marks	150	150	300