S.P. Mandali's
Ramnarain Ruia Autonomous College

Syllabus for F.Y.B.Sc
Programme – B.Sc.
Course: Chemistry (RUSCHE)

(Credit Based Semester and Grading System with effect from the academic year 2019–2020)

Course Objectives and Outcomes

The outcome of the course should be as per the objectives outlined for the degree course in chemistry**.**

The objectives underlined are equated with the acquisition of following criteria viz. the knowledge gained, skills acquired and the exposure gained.
On the knowledge front, the understanding of the student about the subject should be dependent on the courses undertaken, credits obtained , the contents of the course and the evaluation done for the student over the period of three years.

Through the three years of the degree course the students should be well acquainted with the fundamental topics in physical chemistry, such as thermodynamics, kinetics, catalysis , structure and bonding, phenomena at the atomic, subatomic and the molecular level.

In the realm of inorganic chemistry the student should gain the knowledge of the chemistry of the elements and their compounds, the methods of obtaining them , large scale manufacture of bulk and fine chemicals. The preparation and the properties of special materials synthesized and the chemistry of the complexes and their utility in different fields. The student should be introduced to the concept of the behaviour of the groups of atoms.

In chemistry of organic compounds, the student must understand the course of the reactions that they will undergo, the routes of synthesis of different types of materials and their characteristics. The side canvass of organic chemistry from the bio molecules on one side of the spectrum to the polymers and compounds developed and synthesized as per the demand or the requirements . The journey should cover different fields like food, petrochemicals, polymers and speciality compounds. The student should know the synthesis; both on the laboratory scale and the manufacture of the same and the parameters involved in the large scale of preparation.

The student should get introduced to the techniques used in analytical chemistry such as optical ,electroanalytical, separation methods , radioanalytical and miscellaneous methods including the classical methods of analysis.

The student should learn about the basic principles involved in the instrumentation and the field to which the techniques become applicable. The student should also learn the limitations with respect to a measurement and the concentration level at which the technique becomes applicable.

The skills acquired in the practical component of the three year course will include the use of methods of identification , separation, characterisation and estimation of the components present. It will include familiarity of the student with the techniques to be adopted depending on the organic or inorganic origin of the material.

The student should also develop the necessary skills to determine the parameters like the rate of a reaction, the equilibrium constant, the solubility, the characterisation of the complexes and the determination of the properties of the materials like polymers and catalysts.
The student should get hands on training in the various analytical techniques learnt in the course of three years through the prior use of the instruments such as conductometers, potentiometers, colorimeters, pH meters, separation instruments.

The third aspect of exposure should be covered through three steps.
a) The **certificate courses** made available to the students at each year such as ‘ Certificate course in basic analytical chemistry’; ‘ Certificate Course in basic Instrumentation’ etc.
These will make the students gain additional information and skills that cannot be imparted through the regular coaching.

b) The **project work** that the student will take for each year should teach the student the non chemistry aspects of the work mainly getting along with the colleagues working in a group the group ethics and so on.

c) The **internship** that can be given to some selected students, if not all, should be the best exposure that is available especially for the students who seek employment immediately after graduation.

The graduate program in Chemistry aims at equipping the student in whatever endeavour that he / she undertakes after the graduation. It is envisaged that after the graduation the student either goes for higher studies or seeks a Job or totally changes the direction of navigation to opt for a totally different shore.

The graduate programme so proposed in Chemistry should be able to equip the student with basic requirements for all the three aspects mentioned above.

The expected outcome for the same can be under the category of basic knowledge, skills developed and exposure .

1. As far as the basic foundation of the subject is concerned the student should gain the fundamental knowledge of the main chemistry branches as Physical , organic , analytical and inorganic.
2. On the front of the skill development after graduation the student should be able to identify and separate components of organic or inorganic origin and develop the necessary skill for operation and handling of the instruments.
3. In the span of three years the student should take advantage of the certificate courses offered by the department to supplement the gains through the regular theory and practicals. The department should also provide opportunities to the students through the projects undertaken and the internships made available to the students to make the best use of the summer vacation.

Semester-I

1. Paper-I: Physical Chemistry.
2. Paper-II: Unit I and II Inorganic Chemistry and Unit III- Organic Chemistry.

Semester-II

1. Paper-I: Organic Chemistry.
2. Paper-II: Unit I and II Inorganic Chemistry and Unit III- Physical Chemistry.

SEMESTER I

Course Code	Unit	TITLE	Credits	L / Week
	I	Chemical calculations		**1**
	II	Gaseous State Solid State		**1**
	III	Chemical Kinetics Liquid State		**1**
RUSCHE101			**2**	
	I	Atomic structure Periodic Table and periodicity of Properties Chemistry of s-block elements		**1**
	II	Chemical Bond and Reactivity		**1**
	III	Nomenclature of Organic Compounds Bonding and Structure of organic Basic concepts involved in organic reaction mechanism.		**1**
RUSCHE102			2	
RUSCHEP101		Chemistry Practicals	2	**6**

SEMESTER II

Course Code	Unit	TITLE	Credits	L / Week
	I	Stereochemistry		**1**
	II	Chemistry of Aliphatic Hydrocarbons		**1**
RUSCHE201	**III**	Aromatic Hydrocarbons	**2**	**1**
	I	Concept of Qualitative Analysis Acid-Base Theories		**1**
	II	Oxidation Reduction Chemistry Study of Oxides of carbon, Oxides of Sulfur and Nitrogen with respect to their Environmental impact	2	**1**
RUSCHE202`	**III**	Thermodynamics		**1**
RUSCHEP201		Chemistry Practicals	2	**6**

Detail Syllabus
Academic Year 2019-20
SEMESTER-I
Course Code- RUSCHE101
Paper-I (Physical Chemistry)
Credits: 2

Learning Objectives:

The basic objective of the first unit of this paper is to recapitulate the various aspects of chemical calculations by student. Also, the various units of concentration and concept of milimoles and miliequivalence must be learns by them. The concept of stoichiometry and problems based on it is discussed profusely. The second unit of this paper significantly underlines the various states of matter viz. gaseous state and liquid state. The student learns elaborately the various aspects of these states. The third unit makes student aware of the solid state and the concept of chemical kinetics.

Learning Outcome :

- The student will be able to
- perceive the concept of mole and its relation with molar mass and do the calculations based on that.
- Understand and apply the units of volume and mass based units of concentration
- understand the concept of stoichiometry and will be able to solve the problems on it.
- understand the concept of standardization and its significance.
- understand kinetic theory of gases and various gas laws.
- understand the difference between real gas and ideal gas.
- understand the characteristics of liquid state, physical properties and the concept of viscosity and surface tension and its determination.
- understand the rate of reaction and determination of molecularity of a reaction.

Unit I	**1.1 Chemical calculations:** **1.1.1** Mole concept, relation with molar mass, conversion of amount into mole and vice versa, relation with the number of particles present. **1.1.2** Amount and concentration, volume based units for concentration, molarity, normality, formality, mass based unit for concentration - molality and mole fraction, ppm and ppb, concept of milimoles and miliequivalents **1.1.3** Problem solving based on various concentration units **1.1.4** Stoichiometry and calculations based on it, concept of limiting reactant and yield for a chemical reaction. **1.1.5** Calculations based on stoichiometry. **1.1.6** Primary standards, properties of primary standards, primary standards for different types of titrations, secondary standards, standardization, standard solutions.	**(15L)**
Unit II	**2.1 Gaseous State:** **2.1.1** Postulates of kinetic theory of gases and Gas Laws	**(10L)**

	2.1.2 Ideal and real gases, deviations from the gas laws, reasons for the deviations, compressibility factor, Boyle temperature. **2.1.3** Volume correction and pressure correction, van der Waals equation of state, use of the equation to explain the deviations from the gas laws. **2.1.4** Problem solving based on gaseous laws and van der Waals equation of state **2.1.5** Joule-Thomson effect, Joule-Thomson coefficient, inversion temperature, Linde's process of liquefaction of gases. **2.1.6** Maxwell - Boltzmann's distribution of velocities, the graphical presentation and its interpretation, average velocity, most probable velocity and R.M.S. velocity. **2.2 Solid state** **2.2.1** Solid state and its characteristics, crystalline and amorphous solids. **2.2.2** Space lattice and unit cell. **2.2.3** Laws of crystallography, law of constancy of interfacial angles, law of symmetry, axes, planes and centre of symmetry. **2.2.4** Law of rationality of indices, Weiss coefficients, Miller indices, 100, 110 and 111 planes in a crystal.	**(5L)**
Unit III	**3.1 Chemical Kinetics:** **3.1.1** Rate of a reaction, rate constant and measurement of reaction rates. **3.1.2** Order and molecularity of reaction. **3.1.3** Integrated rate equation for zero, first and second order reactions (with equal and unequal initial concentration of the reactants). **3.1.4** Kinetic characteristics of zero, first and second order reactions. **3.1.5** Numerical problems based on zero, first and second order reactions. **3.1.6** Methods for the determination of the order of a reaction (a) Integration method (b) Graphical method (c) Half time method (d) Ostwald's isolation method (e) differential method. **3.2 Liquid State:** **3.2.1** Introduction to liquid state, characteristics of liquid state, physical properties of the liquids. **3.2.2** Determination of surface tension by drop number method using stalagmometer. **3.2.3** Surface active solutes and surface tension, applications of surface tension measurement. **3.2.4** Viscosity: Introduction, coefficient of viscosity. **3.2.5** Determination of coefficient of viscosity by Ostwald viscometer. **3.2.6** Applications of viscosity measurement. **3.2.7** Problem solving on surface tension and viscosity measurements.	**(8L)** **(7 L)**

SEMESTER-I
Paper-II (Inorganic and Organic Chemistry)
Course Code- RUSCHE102
Academic Year 2019-20
Credits: 2

Learning objectives :

The basic objective of the first unit of this paper is to recapitulate earlier theories pertaining to atomic structure, the Concept of quantum numbers, Shapes of orbitals etc.
The student should learn the periodic development of construction of periodic table and its classification. The various types of bonds, and the reactivity of compounds is discussed n the second unit which increases the curiosity of the student learn about the structural aspects of the compounds of ABn type.

The very important IUPAC name of mono and bi-functional aliphatic compounds including their cyclic analogues are expected to learn by student.The fundamental concepts which govern the structure, bonding, hybridization, bond angles and shapes of molecules.

Electronic effects and their applications with respect to stability of reactive intermediates and determination of relative strengths of acids and bases. Types of organic reactions.

Learning Outcome : The student will be able to understand the

- Earlier theories pertaining to atomic structure.
- Concept of quantum numbers.
- Difference between orbit and orbitals.
- Shapes of orbitals

Also, after studying this chapter students should be able to understand

- Concept of atomic weight and atomic number for the construction of periodic table
- Classification of elements depending on entry of valence electrons viz. s, p, d and f block elements.
- Different types of elements viz main group, transition, and inner transition elements.
- Trends in following properties Atomic and ionic size; electron gain enthalpy; ionization enthalpy, effective atomic number

The student will be able to:

- Write IUPAC name of mono and bi-functional aliphatic compounds including their cyclic analogues.
- Understand the fundamental concepts which govern the structure, bonding, hybridization, bond angles and shapes of molecules.
- Know Electronic effects and their applications with respect to stability of reactive intermediates and determination of relative strengths of acids and bases. Types of organic reactions.

Unit I	**1 Atomic Structure and Periodic Table and Periodicity of Properties**. **1.1 Atomic Structure** **1.1.1** Rutherford's Atomic Model; Bohr's Theory and its limitations, Somerfield extension to Bohr's theory Zeeman effect ; their relationship with quantum number; orbit and orbital **1.1.2** Quantum Numbers of last electron; Hund's rule, Aufbau principle; Pauli exclusion Principle **1.1.3** Wave function, Schrodinger wave equation (Mathematical expression not to be discussed), Radial and Angular forms of the wave function; Relationship between Radial function and probability; plots of probability for different orbitals; shapes of orbitals : s,p,d,f. **1.2 Periodic Table and Periodicity of Properties**. **1.2.1** Long form of the Periodic Table; Classification of elements as main group, transition, and inner transition elements; **1.2.2** Periodicity in the following properties: Atomic and ionic size; electron gain enthalpy; ionization enthalpy, effective nuclear charge (Slater rule); Electronegativity: Pauling and Mulliken (Numerical problems expected, wherever applicable). **1.3 Chemistry of s- block elements** 1.3.1. Chemical properties, Uses of alkali and alkaline earth metals, Diagonal relationship of Li and Mg. 1.3.2 **Role of Na and K in biological systems**	**(15 L)**
Unit II	**2.1 Chemical Bond and Reactivity** **2.1.1** Types of chemical bonds; comparison between ionic and covalent bonds **;** polarizability and its effect on a bond, (Fajan's Rules). **2.1.2** Shapes of simple molecules: Lewis dot structures; Sedgwick-Powell theory; Basic VSEPR Theory for AB_n type of molecules (neutral or charged species), with and without lone pair of electrons.	**(15 L)**

	2.1.3 Isoelectronic species; applications and limitations of VSEPR Theory.	
Unit III	**3.1 Nomenclature of Organic Compounds:** 3.1.1 IUPAC nomenclature of mono functional aliphatic compounds. 3.1.2 IUPAC nomenclature of bi-functional aliphatic compounds and their cyclic analogues. **3.2 Bonding and Structure of organic compounds:** Concept of Hybridization (sp3, sp^2 and sp hybridization) Hybridization: sp^3, sp^2 and sp hybridization of carbon and nitrogen; sp^3 and sp^2 hybridizations of oxygen in organic compounds and their geometry with suitable examples. **3.3 Basic concepts involved in organic reaction mechanism:** **3.3.1 Electronic Effects:** Inductive, electromeric, resonance effects, hyperconjugation. **3.3.2 Carbocations, Carbanions and Free radicals:** Homolytic and heterolytic fission, examples of the same. Formation of carbocations, carbanions and free radicals. (primary, secondary, tertiary, allyl, benzyl), their relative stability. **3.4** Organic acids and bases; their relative strengths.	**(5L)** **(5L)** **(3L)** **(2L)**

Semester-I
Chemistry Practicals
Credits: 2

Course Code	Experiments
RUSCHEP101	**Paper I:** .**Preparation of a solution of a primary standard for acid base titrations :** **1** Determination of the strength of the supplied sodium hydroxide solution, using solution of a primary standard for acid base titration. **Preparation of a solution of a primary standard for oxidation reduction titrations:** **2** Determination of the strength of the supplied sodium thiosulphate solution. **Use of the secondary standard:** **3** Determination of the strength of the supplied iodine solution using the sodium thiosulphate solution of known strength. [determined in experiment **- 2]** **4** To determine the rate constant of the acid catalyzed hydrolysis of methyl acetate. **5** To determine relative viscosity of a given polymer solution using Ostwald's viscometer. **Paper II:** 1. Commercial analysis of (ANY ONE) a) Mineral acid b) Acetic acid in vinegar 2. Analysis of solution containing Na_2CO_3 and $NaHCO_3$ using two indicators 3. Gravimetric analysis a) To determine the percentage composition of a mixture of $BaSO_4$ and NH_4Cl. b) To determine the percentage composition of a mixture of ZnO and $ZnCO_3$. **Methods of Purification:** **1.** Purification of a given organic compound by crystallization,

SEMESTER-II
Course Code- RUSCHE201
Paper-I (Organic Chemistry)
Academic Year 2019-20
Credits: 2

Learning Objectives:

In order to facilitate the student to understand, the basic concepts of Organic Chemistry, the coherence of the topics were observed and the topics are included in the current syllabi. The topics such as Stereochemistry, Chemistry of Aliphatic Hydrocarbons and Aromatic Hydrocarbons form the basis of Organic Chemistry, and it is essential for students, who are pursuing higher studies in Chemistry, to have profound knowledge of these topics.

Learning Outcome :

After studying these topics, the students will be able to know

- Isomerism and its types
- CIP Rules and E-Z notations
- Types of cycloalkanes and their relative stability with energy
- Electrophilic aromatic substitutions.
- Directing effects of the groups in electrophilic aromatic substitutions.

Unit I	**1.1 Stereochemistry:** 1.1.1 Optical Isomerism: optical activity, specific rotation, chirality, enantiomers, molecules with two similar and dissimilar chiral-centres, distereoisomers, meso structures,racemic mixture. 1.1.2 Flying-wedge, Fischer, Newman and Sawhorse projection formulae (erythro, threo isomers) and their interconversion. 1.1.3 Relative and absolute configuration: D/L and R/S designations. 1.1.4 Geometrical isomerism in alkenes and cycloalkanes: cis–trans isomerism and E/Z notations with C.I.P rules. 1.1.5 Conformation analysis of alkanes (ethane, propane and n-butane) and their relative stability on the basis of energy diagrams. **1.2 Cycloalkanes and Conformational Analysis:** Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of cyclohexane: Chair, boat, half chair, and twist boat forms and their relative stability with energy	**(15L)**

Unit II	**2.1 Chemistry of Aliphatic Hydrocarbons:** **2.1.1 Carbon-Carbon sigma bond:** **Chemistry of alkanes:** Methods of Preparation of alkanes, Wurtz reaction, Wurtz-Fittig reaction, reactions of alkanes,free radical substitutions: Halogenation - relative reactivity and selectivity. **2.1.2 Carbon-Carbon pi bonds:** alkenes and alkynes**,** methods of preparation of alkenes and alkynes by elimination reactions: mechanism of E_1 and E_2. Saytzeff and Hofmann eliminations. **2.1.3 Reactions of alkenes:** electrophilic addition and mechanism (Markownikoff/ Anti Markownikoff addition). mechanism of ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2 and 1, 4-addition reactions in conjugated dienes, Diels-Alder reaction; Allylic and benzylic bromination using N-bromosuccinimide and its mechanism. **2.1.4 Methods of Preparation and reactions of alkynes:** Acidity, ectrophilic and nucleophilic additions. hydration to form carbonyl compounds, alkylation of terminal alkynes.	**(15L)**
Unit III	**3.1Aromatic Hydrocarbons:** **3.1.1** Aromaticity: Benzene, Kekule's formulation of benzene structure (historical background), Hückel's rule, anti-aromaticity, aromatic character of arenes. **3.1.2** Aromaticity: cyclic carbocations/carbanions and heterocyclic compounds with suitable examples, aromaticity and acidity, relative stabilities. **3.1.3** Electrophilic aromatic substitution: sulphonation and Friedel-Craft alkylation/acylation and mechanisms for the same, mechanism of halogenation, nitration of benzene: **3.1.4** Directing effects of the substituent groups on electrophilic aromatic substitution, reactions of mono substituted benzene derivatives ($-CH_3$, $-NH_2$, $-OH$, NO_2, ^-X) **3.1.5** Nucleophilic aromatic substitution of Aryl halides (replacement by –OH group and effect of nitro substituent).	**(15L)**

SEMESTER-II
Course Code- RUSCHE202
Paper-II(Inorganic and Physical Chemistry)
Credits: 2

Learning Objectives:

Taking into consideration, the relevance of topics and the convenience of understanding, the topics are framed accordingly. The students are required to know chemistry of main group elements and their important properties. Also , the synthesis, properties and uses of inorganic compounds of commercial importance viz. Plaster of Paris and bleaching powder etc. must be known by them. The concept of Chemical Thermodynamics is of utmost importance in order to study spontaneity of any chemical reaction. Hence, it is included in the syllabi.

Learning Outcome :

The Students will be to :

- Do the comparison of the properties of main group elements in the respective groups.
- Understand Concept of metallic and non metallic character with respect to electropositivity.
- Know The methods of preparation of the compounds which are commercially available along with their properties and uses.
- Understand different types of oxides and oxyacids of sulphur , nitrogen - their sources and reactions
- Identify health hazards their environmental implications remedial measures
- Understand basic terms used in thermodynamics.
- Understand different laws of thermodynamics and their applications
- Learn different processes in thermodynamics and its effect and various thermodynamic properties.
- Learn first law of thermodynamics and its expression in terms of relationship between Heat (q), work (w) and internal energy (U).
- Understand second law of thermodynamics and its implications.

Unit I	**1.0 Concept of Qualitative Analysis** 1.1.1 Macro, Semi-Micro, Micro, Ultra Micro, Trace Analysis **1.1.2** Reactions involving liberation of gases, Use of Papers impregnated with Reagents in qualitative analysis (With reference to papers impregnated with starch-iodide, potassium dichromate, lead acetate, dimethyl glyoxime, and oxine reagents) (balanced Chemical Reactions expected). **1.1.3** Precipitation equilibria: Factors affecting the solubility of an ionic compound viz. common ions, uncommon ions, temperature, nature of the solvent, pH, complexing agents (Balanced Chemical Equations and Numerical Problems Expected) **1.2 Acid-Base Theories** **1.2.1** Arrhenius; Lowry-Bronsted concept ; Classification of solvents, auto dissociation of amphi protic solvents, Lewis concept ; Usanovich concept **1.2.2** Hard and Soft Acids and Bases-HSAB (with respect to occurrence and feasibility of chemical reaction);.	**(9L)** **(6L)**
Unit II	2.1 **Oxidation Reduction Chemistry** **2.1.1** Oxidation state, oxidation number, oxidation- reduction in terms of oxidation number **2.1.2** Balancing redox equations by i) oxidation number method and ii) ion-electron method **2.1.3** Calculation of equivalent weight on the basis of chemical nature. **2.2 Study of, oxides of carbon, sulfur and nitrogen with respect to their Environmental impact.**	**(9L)** **(6L)**
Unit III	**3.1 Chemical Thermodynamics:** **3.1.1Recapitualation:** Introduction, terms involved: System, surrounding, open closed and isolated systems, intensive and extensive properties of system, state of a system, state function and path function. Different processes in thermodynamics. **3.1.2**: Heat (q), work (w) and internal energy (U) and their sign conventions. **3.1.3** Statement of first law, work done in isothermal and adiabatic reversible processes, work done in irreversible process, internal energy change for isothermal and adiabatic processes. Numerical problems based on **3.1.3** **3.1.4** Enthalpy and enthalpy change in a constant volume and constant pressure process, enthalpy change in a reversible process.	**(15L)**

	Numerical problems based on **3.1.4** **3.1.5** limitations of first law, need for the direction of the energy **c**hange**,** conversion of heat into other energy forms, heat engines, mechanical efficiency of a heat engine, Carnot's cycle, Carnot's theorem, Introduction to entropy, second law of thermodynamics, different statements of second law, entropy changes in a reversible and an irreversible process, combined statement of first and second law ,entropy changes for different physical processes. Numerical problems based on **3.1.5** **3.1.6** Spontaneous processes**,** need for prediction of a spontaneous process**,** Free energy, Gibbs free energy and Helmholtz free energy, changes in Gibbs and Helmholtz's free energy and inter relation between them, criteria for spontaneity of a process.	

Semester-II
Chemistry Practicals
Credits: 2

Course Code	Experiments
RUSCHEP201	**Paper I** 1. **Characterization of organic compound containing C, H, (O), N, S and X** (Minimum of 6 compounds) **Chemical synthesis (one step)** a) Preparation of Iodoform derivative of methyl ketone. b) Preparation of acetyl derivative of primary amine. c) Preparation of 2,4-DNP derivative of carbonyl compound. **Paper II:** 1. **Qualitative analysis:** (at least 5 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+}, Mn^{2+}, Mg^{2+}, Al^{3+}, Cr^{3+}, K^{+},NH_4^{+} Anions (From amongst): CO_3^{2-}, NO_2^{-}, NO_3^{-}, Cl^{-}, Br^{-}, I^{-}, SO_4^{2-}, (The Qualitative analysis should not involve use of H_2S in any form) 2. To determine the valence factor of $KMnO_4$ by titrating with oxalic acid. 3. To determine the acid-neutralising power of commercially available antacid formulation.

Reference Books

Organic Chemistry

1. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education)
2. Stereochemistry, P. S. Kalsi, New Age International Publishers.
3. Paula Y. Bruice, Organic Chemistry, Pearson Education.
4. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition.
5. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education
6. Organic reactions and their mechanism, P.S. Kalsi, New Age International Publishers.
7. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall.

Physical Chemistry

1. The Elements of Physical Chemistry, P.W. Atkins, Oxford University Press, Oxford.
2. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
3. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001).
4. The Elements of Physical Chemistry, P.W. Atkins, Oxford University Press, Oxford.
5. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication.
6. Physical Chemistry, G.M. Barrow, Tata McGraw Hill Publishing Co.Ltd. New Delhi.
7. An Introduction to the Liquid State by P.A. Egelstaff, Publisher OUP Oxford

Inorganic Chemistry

1. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
2. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
3. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970

Modality of Assessment FYBSc:

Theory Examination Pattern:

A) Internal Assessment - 40%:

(40 marks)

Sr No	Evaluation type	Marks
1	One Assignment	15
2	One class Test (multiple choice questions / objective)	20
3	Active participation in class (seminars/presentation)	05

B) External examination - 60 %

Semester End Theory Assessment - 60% **60 marks**

i. Duration - These examinations shall be of **two hours** duration.

ii. Theory question paper pattern :-

1. There shall be **three** questions each of **20** marks. On each unit there will be one question.
2. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1)A)	Any 4 out of 6	16	Unit I
Q.1)B)	Any 4 out of 6	04	
Q.2)A)	Any 4 out of 6	16	Unit II
Q.2)B)	Any 4 out of 6	04	
Q.3)A)	Any 4 out of 6	16	Unit III
Q.3)B)	Any 4 out of 6	04	

Practical Examination Pattern:

(A)Internal Examination:-

Heading	Paper I	Paper II
Journal	05	05
Test	10	10
Participation	05	05
Total	20	20

(B) External (Semester end practical examination) :- 50 Marks Per Section

Sr.No.	Particulars	Marks	Total
1.	**Laboratory work (Paper I + Paper-II)**	**25 + 25 =**	**50**
2.	**Viva**	**05 + 05 =**	**10**

PRACTICAL BOOK/JOURNAL

Semester I& II:

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department ; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

Semester I

Course	101			102			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

Semester II

Course	201			202			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100