Resolution Number: AC/I(21-22).2(II).RUS5

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore • Experience • Excel

Syllabus for Semester I & II

Program: F.Y.B.Sc

Program Code: RUSCHE

(Credit Based Semester and Grading System for academic year 2022–2023)

SEMESTER I

Course Code: RUSCHE101

Unit	Content	No of Lectures
1	**Chemical Calculations:** 1.1 Mole concept, relation with molar mass, conversion of amount into mole and vice versa, relation with the number of particles present. 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 millimoles and milliequivalents. 1.3 Problem solving based on various concentration units 1.4 Stoichiometry and calculations based on it, concept of limiting reactant and yield for a chemical reaction. 1.5 Calculations based on stoichiometry. 1.6 Primary standards, properties of primary standards, primary standards for different types of titrations, secondary standards, standardization, standard solutions.	15
2	**Atomic Structure and Periodic Table and Periodicity of Properties.** 2.1 Atomic Structure 2.1.1 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. 2.1.2 Quantum Numbers of last electron; Hund's rule, Aufbau principle; Pauli exclusion Principle. 2.1.3 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. . 2.2 Periodic Table and Periodicity of Properties. 2.2.1 Long form of the Periodic Table; Classification of elements as main group, transition, and inner transition elements;	15

	2.2.2 Periodicity in the following properties: Atomic and ionic size; electron gain enthalpy; ionization enthalpy, effective nuclear charge (Slater rule); Electronegativity: Pauling and Mulliken rules (Numerical problems expected, wherever applicable). **2.3 Chemistry of s- block elements** **2.3.1.** Chemical properties, Uses of alkali and alkaline earth metals, Diagonal relationship of Li and Mg. **2.3.2 Role of Na and K in biological systems.**	
3	**Fundamentals of Organic Chemistry** 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, sp2and sp hybridization) Hybridization: sp3, sp2and sp hybridization of carbon and nitrogen; sp3 and sp2 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. 3.3.4 Organic acids and bases; their relative strengths.	15

Course Code: RUSCHE102

Unit	Content	No of Lectures
1	**1. Gaseous Sate** 1.1.1 Postulates of kinetic theory of gases and Gas Laws. 1.1.2 Ideal and real gases, deviations from the gas laws, reasons for the deviations, compressibility factor, Boyle temperature. 1.1.3 Volume correction and pressure correction, van der Waals equation of state, use of the equation to explain the deviations from the gas laws. 1.1.4 Joule-Thomson effect, Joule-Thomson coefficient, inversion temperature, Linde's process of liquefaction of gases. 1.1.5 Maxwell - Boltzmann's distribution of velocities, the graphical presentation and its interpretation, average velocity, most probable velocity and R.M.S. velocity. **2. Liquid State** 1.2.1 Introduction to liquid state, characteristics of liquid state, physical properties of the liquids. 1.2.2 Determination of surface tension by drop number method using stalagmometer. 1.2.3 Surface active solutes and surface tension, applications of surface tension measurement. 1.2.4 Viscosity: Introduction, coefficient of viscosity. 1.2.5 Determination of coefficient of viscosity by Ostwald viscometer. 1.2.6 Applications of viscosity measurement.	15
2	**Oxidation Reduction Chemistry and Environmental impact of oxides of carbon, sulphur and nitrogen.** 2.1 Oxidation state, oxidation number, oxidation- reduction in terms of oxidation number 2.2 Balancing redox equations by i) oxidation number method and ii) ion- electron method. 2.3 Calculation of equivalent weight on the basis of chemical nature. 2.4 Study of oxides of carbon, sulphur and nitrogen with respect to their	15

	(a) Sources (b) Health Hazards (c) Environmental Impact (d) Control Techniques	
3	**Stereochemistry** 3.1.1 Optical Isomerism: optical activity, specific rotation, chirality, enantiomers, molecules with two similar and dissimilar chiral-centres, distereoisomers, mesostructures, racemic mixture. 3.1.2 Flying-wedge, Fischer, Newman and Sawhorse projection formulae (erythro, threo isomers) and their interconversion. 3.1.3 Relative and absolute configuration: D/L and R/S designations. 3.1.4 Geometrical isomerism in alkenes and cycloalkanes: cis–trans isomerism and E/Z notations with C.I.P rules. 3.1.5 Conformational analysis of alkanes (ethane, propane and n-butane) and their relative stability on the basis of energy diagrams.	15

Course Code: RUSCHEP101

	Experiments to Be Covered	
	i) Determination of the strength of the supplied sodium hydroxide solution, using solution of a primary standard for acid base titration. ii) Determination of the strength of the supplied sodium thiosulphate solution. iii) To determine value of ideal gas constant R in different units by eudiometer method. iv) To determine relative viscosity of a given polymer solution using Ostwald's viscometer. v) To determine the percentage composition of a mixture gravimetrically ($BaSO_4$ + NH_4Cl) vi) Semi-Micro Qualitative analysis of a binary mixture containing two cations and two anions (Only non-interfering radicals) vii) Purification of a given organic compound by crystallization with solvent/solvent-free. (Minimum three). ix) Characterization of solid organic compounds (Minimum three Compounds) x) To determine the individual strength of Sodium Carbonate and Sodium Bicarbonate in a mixture of the two using two indicators. xi) To Determine the Strength of commercially available sample of HCl.	

SEMESTER II

Course Code: RUSCHE201

Unit	Content	No of Lectures
1	**Chemical Thermodynamics-I** 1.1 Fundamental concepts in Thermodynamics: The macroscopic variables basic definitions needed to describe thermodynamic systems, equations of state and the ideal gas law. 1.2 First Law of Thermodynamics : Work, heat, and internal energy, Operational definitions, the molecular interpretation of heat, work and internal energy, the formulation of the First Law, state functions, and path functions 1.3 Work: The general expression for work, Expansion against constant pressure, Reversible expansion, Comparing Work for Reversible and Irreversible Processes 1.4 Heat transactions: Heat capacity, the definition of enthalpy, Enthalpy change and heat transfer, the variation of enthalpy with temperature. Heat capacity at constant pressure and volume, the relation between heat capacities. 1.5 Thermochemistry: Standard enthalpy changes, Hess's law, The temperature dependence of reaction enthalpies. Using Kirchhoff's law, application in biochemistry and materials science, experimental techniques i) Differential scanning calorimetry ii) Isothermal titration calorimetry	15
2	**Concept of Qualitative Analysis and Acid Base Theories:** 2.1.1 Macro, Semi-Micro, Micro, Ultra Micro, Trace Analysis 2.1.2 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). 2.1.3 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) 2.2 Acid-Base Theories	15

	2.2.1 Arrhenius; Lowry-Bronsted concept ; Classification of solvents, auto dissociation of amphiprotic solvents, Lewis concept ; Usanovich concept 2.2.2 Hard and Soft Acids and Bases-HSAB (with respect to occurrence and feasibility of chemical reaction);.	
3	**Chemistry of Aliphatic Hydrocarbons:** 3.1.1 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. 3.1.2 Carbon-Carbon pi bonds: alkenes and alkynes, methods of preparation of alkenes and alkynes by elimination reactions: mechanism of E1 andE2. Saytzeff and Hofmann eliminations. 3.1.3 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 benzylicbromination using N-bromosuccinimide and its mechanism. 3.1.4 Methods of Preparation and reactions of alkynes: Acidity, electrophilic and nucleophilic additions. Hydration to form carbonyl compounds, alkylation of terminal alkynes.	15

Course Code: RUSCHE202

Unit	Content	No of Lectures
1	**1. Chemical Kinetics – I and Photochemistry** 1.1.1 Rate of a reaction, rate constant and measurement of reaction rates. 1.1.2 Order and molecularity of reaction. 1.1.3 Integrated rate equation for zero, first and second order reactions (with equal and unequal initial concentration of the reactants). 1.1.4 Kinetic characteristics of zero, first and second order reactions. 1.1.5 Numerical problems based on zero, first and second order reactions, Applications of kinetic study 1.1.6 Methods for the determination of the order of a reaction **2. Photochemistry** 1.2.1 Electromagnetic radiation, photochemical reactions, first and second law of photochemistry, photochemical and thermal reactions. 1.2.2 Quantum yield, measurement of quantum yield, actinometers.	15
2	**Chemical Bond and Reactivity** 2.1.1Types 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; Sidgwick-Powell theory; Basic VSEPR Theory for ABn type of molecules (neutral or charged species), with and without lone pair of electrons. 2.1.3 Isoelectronic species; applications and limitations of VSEPR Theory.	15
3	**Chemistry of Aromatic Hydrocarbons** **3**.1.1 Aromaticity: Benzene, Kekule's formulation of benzene structure (historical background), Hückel's rule, anti-aromaticity, aromatic character of arenes.	15

	3.1.2Aromaticity: 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 substituents/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).	

Course Code: RUSCHEP201

	Experiments to Be Covered	
	i) To determine the rate constant of the acid catalyzed hydrolysis of methyl acetate. ii) Determination of the strength of the supplied iodine solution using the sodium thiosulphate solution of known strength. iii) To study thermodynamic parameters of a simple chemical reactions. iv) To determine the valence factor of KMnO4 by titrating with oxalic acid. v) To determine the percentage composition of a mixture gravimetrically (ZnO + $ZnCO_3$) vi) Semi-Micro Qualitative analysis of a binary mixture containing two cations and two anions (Should also include interfering radicals) (Minimum three mixtures) vii) 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 viii) To determine the acid neutralising capacity of commercially available sample of antacid. ix) Characterisation of Liquid Organic Compounds containing C, H, (O), N, X elements. (Minimum three compounds)	

Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment - 40% (40 Marks)

Sr No	Evaluation Type	Marks
1	Assignment	15
2	Class Test (MCQ / Objectives)	20
3	Active Participation in Class (Seminars/Presentations)	05
	Total	**40**

B) External Examination : 60 % (60 marks)
Semester End Theory Examination :

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 based on
Q.1)	**Any 5 out of 7**	**20**	**Unit I**
Q.2)	**Any 5 out of 7**	**20**	**Unit II**
Q.3)	**Any 5 out of 7**	**20**	**Unit III**
	Total	**60**	

Practical Examination Pattern:

(A) Internal Examination:- 40 % (20 Marks)

Particulars	Paper I	Paper II
Journal	05	05
Experimental Work	10	10
Participation	05	05
Total	**20**	**20**

B) External Examination : 60 % (30 Marks)

Semester End Practical Examination:

Particulars	Paper I	Paper II
Laboratory Work	25	25
Viva	05	05
Total	**30**	**30**

PRACTICAL BOOK/JOURNAL

- 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 / In-charge of the department ; failing which the student will not be allowed to appear for the practical examination.**

Overall Examination and Marks Distribution Pattern:

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

(Total Marks : 300)