CHEMISTRY

COURSE STRUCTURE
Class – First Year PUC - Theory

One Paper **Time : 3 Hours** **Max. Marks : 80 marks**

Units	Title	Marks
I	Some Basic concepts of Chemistry	3
II	Structure of Atom	6
III	Classification of Elements and Periodicity in Properties	4
IV	Chemical Bonding and molecular Structure	5
V	States of Matter: Gases and Liquids	4
VI	Thermodynamics	6
VII	Equilibrium	6
VIII	Redox Reactions	3
IX	Hydrogen	3
X	s-Block Elements	5
XI	Some p-Block Elements	7
XII	Organic Chemistry: some basic Principles and Techniques	7
XIII	Hydrocarbons	8
XIV	Environmental Chemistry	3
XV	Practical Oriented Questions	10
	Total	**80**

CHEMISTRY

Class - First year PUC - Theory

Unit : Some Basic Concepts of Chemistry

General Introduction: Importance and scope of chemistry.
Historical approach to particulate nature of matter, laws of chemical combination.
Dalton's atomic theory: concept of elements, atoms and molecules.
Atomic and molecular masses. Mole concept and molar mass: percentage composition, empirical and molecular formula: chemical reactions, stoichiometry and calculations based on stoichiometry.

Unit II : Structure of Atom

Discovery of electron, proton and neutron: atomic number, isotopes and isobars. Rutherford's model and its limitations. Bohr's model and its limitations, concept of shells subshells, dual nature of matter and light, De Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s,p, and d orbitals, rules for filling electrons in orbitals- Aufbau principle, Pauli exclusion principle and Hund's rule, electronic configuration of atoms, stability of half filled and completely filled orbitals.

Unit III : Classification of Elements and Periodicity in Properties

Significance of classification, brief history of the development of periodic table, modern periodic law and the present form of periodic table, periodic trends in properties of elements-atomic radii, ionic radii, ionization enthalpy, electron gain enthalpy, electro negativity, valence, Nomenclature of elements with atomic number greater than 100.

Unit IV: Chemical Bonding and Molecular Structure

Valence electrons, ionic bond, bond parameters, covalent bond: Born Haber Cycle. Lewis structure, polar character of covalent bond, covalent character of ionic bond, valance bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s,p and d orbitals and shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules and hydrogen bond.

Unit V : States of Matter: Gases and Liquids

Three states of matter, Intermolecular interactions, types of bonding, melting, melting and boiling points. Role of gas laws in elucidating the concept of the molecule, Boyle's law. Charle's law, Gay Lussac's law, Avogadro's law. Ideal behavior, empirical derivation of gas equation, Avogadro's number. Ideal gas equation. Derivation from ideal behavior, liquefaction of gases, critical temperature, kinetic energy and molecular speeds (elementary idea)

Liquid State- Vapour pressure, viscosity and surface tension (qualitative idea only, no mathematical derivations).

Unit VI : Chemical Thermodynamics

Concepts of system, types of systems, surroundings. Work, heat, energy, extensive and intensive properties, state functions.
First law of thermodynamics-internal energy change (U)and enthalpy change (H)Hess's law of constant heat summation, enthalpy of: bond dissociation, combustion, formation, atomization, sublimation. Phase transformation, ionization, and solution.
Introduction of entropy as a state function, Gibbs energy change for spontaneous and nonspontaneous processes, criteria for equilibrium. Second and third laws of thermodynamics.

Unit VII : Equlibrium

Equlibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium –Le Chatelier's principle: ionic equilibrium – ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of polybasic acids, acid strength, concept of pH Henderson Equation. Hydrolysis of salts (elementary idea). Buffer solutions, solubility product, common ion effect (with illustrative examples).

Unit VII : Redox Reactions
Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions in terms of loss and gain of electrons and change in oxidation number.

Unit IX : Hydrogen

Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen, hydrides-ionic, Covalent and interstitial: physical and chemical properties of water, heavy water, hydrogen peroxide-preparation, properties, structure and use: hydrogen as a fuel.

Unit X : S-Block Elements (Alkali and Alkaline earth metals)
Group 1 and Group 2 elements:

General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii) trends in chemical reactivity with oxygen, water, hydrogen and halogens: uses.

Preparation and properties of some important compounds:

Sodium carbonate, sodium hydroxide and sodium hydrogen carbonate, biological importance of sodium and potassium.
CaO, $CaCO_3$ and industrial use of lime and limestone, biological importance of Mg and Ca.

Unit XI : Some p-Block Elements

General Introduction of p-Block Elements

Group 13 elements: General introduction, electronic configurations, occurrence. Variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group, Boron-physical and chemical properties, some important compounds, borax, boric acid, boron hydrides, Aluminium reactions with acids and alkalies and uses.

Group 14 elements: General introduction, electronic configurations, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behavior of first element, Carbon-cantenation, allotropic forms, physical and chemical properties: uses of some important compounds: oxides.
Important compounds of silicon and a few uses: silicon tetrachloride, silicones, silicates and Zeolites, their uses and structure of sillicates.

Unit XII : Organic Chemistry – Some Basic Principles and Techniques

General introduction, methods of qualitative and quantitative analysis, classification and IUPAC nomenclature of organic Compounds.
Electronic displacements in a covalent bond: inductive effect, electomeric effect, resonance and hyper conjugation.
Homolytic and heterolytic fission of a covalent bond, free radicals, carbocations, carbanions, electrophiles and nucleophiles, types of organic reactions.

Unit XIII : Hydrocarbons
Classification of hydrocarbons

Alkanes-Nomenclature, isomerism, conformations (ethane only), physical properties, chemical reactions including halogenation, free radical mechanism, combustion and pyrolysis.
Alkenes – Nomenclature, structure of double bond (ethane) geometrical isomerism,
Physical properties, methods of preparation, chemical reactions, addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.
Alkynes-Nomenclature, structure of triple bond (ethyne), physical properties.
Methods of preparation, chemical reactions: acidic character of alkynes, addition reaction of –hydrogen, halogens, hydrogen halides and water.

Aromatic hydrocarbons: Introduction, IUPAC nomenclature: Benzene: resonance aromaticity: chemical properties: mechanism of electrophilic substitution.-nitration sulphonation, halogenation, Friedel Craft's alkylation and acylation carcinogencity and toxicity.

Unit XIV : Environmental Chemistry

Environmental pollution- air, water and soil pollution, chemical reactions in atmosphere, smog, major atmospheric pollutants: acid rain, ozone and its reactions, effects of depletion of ozone layer, greenhouse effect and global warming-pollution due to industrial wastes: green chemistry as an alternative tool for reducing pollution, strategy for control of environmental pollution.

Practicals

PRACTICALS SYLLABUS

A. Basic Laboratory Techniques

1. Cutting glass tube and glass rod
2. Bending a glass tube
3. Drawing out a glass jet
4. Boring a cork

B. Characterization and purification of chemical substances

1. Determination of melting point of an organic compound
2. Determination of boiling point of an organic compound
3. Crystallization of impure sample of anyone of the following: Alum, Copper sulphate, Benzoic acid.

C. Experiments related to pH change

(a). Anyone of the following experiments:

- Determination of pH of some solutions obtained from fruit juices, varied concentrations of acids, bases and salts using pH paper or universal indicator.
- Comparing the pH of solutions of strong and weak acid of same concentration.
- Study the pH change in the titration of a strong base using universal indicator.

(b). Study of pH change by common-ion effect in case of weak acids and weak bases.

D. Chemical equilibrium

One of the following experiments:

(a). Study the shift in equilibrium between ferric ions and thiocyanate ions by increasing/decreasing the concentration of either ions.

(b). Study the shift in equilibrium between $[Co(H_2O)_6]_{2+}$ and chloride ions by changing the concentration of either of the ions.

E. Quantitative estimation

- Using a chemical balance.
- Preparation of standard solution of oxalic acid
- Determination of strength of a given solution of sodium hydroxide by titrating it against standard solution of oxalic acid.
- Preparation of standard solution of sodium carbonate.
- Determination of strength of a given solution of hydrochloric acid by titrating it against standard sodium carbonate solution.

F. Qualitative analysis

Determination of one anion and one cation in a given salt.

Cations- Pb^{2+}, Cu^{2+}, As^{3+}, Al^{3+}, Fe^{3+}, Mn^{2+}, Ni^{2+}, Zn^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, NH_4^{+}

Anions- CO_3^{2-}, S^{2-}, SO_3^{2-}, SO_4^{2-}, NO_2^{-}, NO_3^{-}, CL^{-}, Br^{-}, I^{-}, PO_43^{-}, $C_2O_4^{2-}$, CH_3COO^{-}

(Note: Insoluble salts excluded)

G. Detection of nitrogen, sulphur, chlorine

CHEMISTRY

Class - Second Year PUC - Theory
(Theory)

One Paper **Time: 3 Hours** **Max. Marks: 80 marks**

Units	Titles	Marks
I	Solid State	4
II	Solutions	5
III	Electrochemistry	5
IV	Chemical kinetics	5
V	Surface chemistry	4
VI	General Principles and processes of Isolation of Elements	3
VII	p-Block Elements	8
VIII	d-Block Elements	5
IX	Coordination Compounds	3
X	Haloalkanes and Haloarenes	4
XI	Alcohols, Phenols and Ethers	4
XII	Aldehydes, Ketones and Carboxylic acids	6
XIII	Organic Compounds containing Nitrogen	4
XIV	Biomolecules	4
XV	Polymers	3
XVI	Chemistry in Everyday life	3
XVII	Practical Oriented questions	10
	Total	**80**

Unit I: Solid State

Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea). Unit cell in two dimensional and three dimensional lattices, packing efficiency. Calculation of density of unit cell, packing in solids, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties. Band theory of metals, conductors, semiconductors and insulators and n & p type semiconductors.

Unit II: Solutions

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties-relative lowering of vapour pressure, Raoult's law, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, van't Hoff factor and calculations involving it.

Unit III: Electrochemistry

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity variations with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells, lead accumulator, EMF of a cell, standard electrode potential. Nernst equation and its application to chemical cells, Relation between Gibbs energy change and emf of a cell, fuel cells, corrosion.

Unit IV: Chemical Kinetics

Rate of a reaction (average and instantaneous), factors affecting rates of reaction: concentration, temperature, catalyst, order and molecularity of a reaction: rate law and specific rate constant, integrated rate equations and half-life (only for zero and first order reactions), concept of collision theory (elementary idea, no mathematical treatment) Activation energy, Arrhenius equation.

Unit V: Surface Chemistry

Adsorption-physisorption and chemisorption, factors affecting adsorption of gases on solids, catalysis, homogenous and heterogeneous, activity and selectivity, enzyme catalysis, colloidal state, distinction between true solutions, colloids and suspensions, lyophilic, lyophobic, multimolecular and macromolecular colloids, properties of colloids, Tyndall effect, Brownian movement, electrophoresis, coagulation, emulsion-types of emulsions, Elementary idea of nanomatereials.

Unit VI: General Principles and Processes of Isolation of Elements

Principles and methods of extraction-concentration, oxidation, reduction electrolytic method and refining, occurrence and principles of extraction of aluminum, copper, zinc and iron.

Unit VII: p-Block Elements

Group 15 elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties, nitrogen-preparation , properties and uses, compounds of nitrogen, preparation and properties of ammonia and nitric acid, oxides of nitrogen (structure only) , Phosphorus-allotropic forms, compounds of phosphorus, preparation and properties of phosphine, halides (PCl_3, PCl_5) and oxo acid's (elementary idea only)

Group 16 elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, di oxygen, preparation, properties and uses, classification of oxides, Ozone, sulphur-allotropic forms, compounds of sulphur, preparation, properties and uses of sulphur dioxide, sulphuric acid, industrial process of manufacture, properties and uses, other oxides and oxoacids of sulphur (structures only)

Group 17 elements: General introduction, electronic configuration, oxidation states, occurrence, trends In physical and chemical properties; compounds of halogens: preparation, properties and uses of chlorine and hydrochloric acid, interhalogen compounds, oxoacids of halogens (structures only).

Group 18 elements: General introduction, electronic configuration. Occurrence, trends in physical and chemical properties uses.

Unit VIII: d and f Block Elements

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals-metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation. Preparation and properties of K2 Cr2 O7 and KMnO4.

Lanthanoids-electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequences.

Actinoids- Electronic configuaration, oxidation states and comparison with lanthanoids.

Unit IX: Co-ordination compounds

Co-ordination compounds-Introduction, ligands, co-ordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear

co-ordination compounds. Bonding (Werner's theory, VBT and CFT); structural and stereo isomerism importance of co-ordination compounds (in qualitative inclusion of analysis, extraction of metals and biological systems).

Unit X: Haloalkanes and Haloarenes.

Haloalkanes:
Nomenclature nature of C-X bond physical and chemical properties, mechanism of substitution reactions. Stability of carbocations, R-S and d-I configurations
Haloarenes:
Nature of C-X bond substitution reactions (directive influence of halogen for monosubstituted compounds only, stability of carbocations R-S and d-I configurations) Uses and environmental effects of-dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

Unit XI: Alcohols, Phenols and Ethers

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only); identification of primary, secondary and tertiary alcohols; mechanism of dehydration, uses of methanol and ethanol.

Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenol.

Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

Unit XII: Aldehydes and Ketones and Carboxylic Acids:

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; uses.

Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

Unit XIII: Organic compounds containing Nitrogen

Nitro compounds: General methods of preparation and chemical reactions.

Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Cyanides and Isocyanides-will be mentioned at relevant places in context.

Diazonium salts: Preparation chemical reactions and importance in synthetic organic chemistry.

Unit XIV: Biomolecules

Carbohydrates- Classification (aldoses and ketoses) monosaccharides (glucose and fructose). D-L configuration, oligosaccharides (sucrose, lactose, maltose) polysaccharides (starch, cellulose, glycogen), importance.

Proteins- Elementary idea of α-amino acids, peptide bond, polypeptides, proteins, primary structure, secondary structure, tertiary structure and quaternary structure (qualitative idea only). Denaturation of proteins; enzymes.
Lipids and hormones, their classification and functions.
Vitamins-Classification and functions.

Nucleic Acids: DNA & RNA

Unit XV: Polymers
Classification-natural and synthetic methods of polymerization (addition and condensation), copolymerization. Some important polymers: natural and synthetic like polythene, nylon, polyesters, bakelite, rubber. Biodegradable and non-biodegradable polymers.

Unit XVI: Chemistry in Everyday life:

1. Chemicals in medicines – analgesics, tranqilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines, antioxidants.
2. Chemicals in food – preservatives, artificial sweetening agents.
3. Cleansing agents – soaps and detergent, cleansing action.

Practicals Syllabus

A. Surface Chemistry.

(a) Preparation of one lyophilic and one lyophobic sol
Lyophilic sol – starch, egg albumin and gum
Lyophobic sol – aluminium hydroxide, ferric hydroxide, arsenious sulphide.
(b) Study of the role of emulsifying agents in stabilizing the emulsions of different oils.

B. Chemical Kinetics

(a) Effect of concentration and temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.
(b) Study of reaction rates of any one of the following:

(i) Reaction of iodide ion with hydrogen peroxide at room temperature using different concentrations of iodide ions.

(ii) Reaction between potassium iodate, KlO3 and sodium sulphite: (Na2SO3) using starch solution as indicator (clock reaction).

(c) Thermochemistry

Any one of the following experiments

i) Enthalpy of dissolution of copper sulphate or potassium nitrate.

ii) Enthalpy of neutralization of strong acid (HCl) and strong base (NaOH)

iii) Determination of enthalpy change during interaction (Hydrogen bond formation) between acetone and chloroform)

(d) Electrochemistry

Variation of cell potential in Zn/Zn2+/CU with change in concentration of electrolytes (CuSO4 or ZnSO4) at room temperature.

(e) **Chromatography**

i) Separation of pigment from extracts of leaves and f lowers by paper chromatography and determination of Rf values.

ii) Separation of constituents present in an inorganic mixture containing two cations only (constituents having large difference in Rf values to be provided).

(f) Preparation of Inorganic Compounds

i) Preparation of double salt of ferrous ammonium sulphate or potash alum.

ii) Preparation of potassium ferric oxalate.

(g) Preparation of Organic Compounds

Preparation of any two of the following compounds

i) Acetanilide

ii) Di-benzal acetone

iii) P-Nitroacetanilide

iv) Aniline yellow or 2- Napthol aniline dye

v) Iodoform

(h) Tests for the functional groups present in organic compounds:

Unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (primary) groups.

(i) Characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in given food stuffs.

(j) Determination of concentration/molarity of KMnO4 solution by titrating it against a standard solution of:

i) Oxalic acid

ii) Ferrous ammonium sulphate

(students will be required to prepare standard solutions by weighing themselves).

K. Qualitative analysis

Determination of one cation and one anion in a given salt.

Cations – Pb, Cu, As, Al, Fe, Mn , Ni , Zn , Co , Ca , Sr , Ba , Mg , Na .

Anions – Co , S , So , So , No , No , Cl, Br , Po , C o , CH COO

(Note: Insoluble salts excluded)

Project work – Wherever feasible may included

i) Model Preparation

ii) Investigatory Project

iii) Science Exhibits

iv) Participation in Science fairs

v) Testing of purity of food articles like butter, pulses and milk, etc.