WEST BENGAL COUNCIL OF HIGHER SECONDARY EDUCATION

SYLLABUS FOR CLASSES XI AND XII

SUBJECT : CHEMISTRY (CHEM)

CLASS - XI

SEMESTER – I

SUBJECT : CHEMISTRY (CHEM)

FULL MARKS : 35 **CONTACT HOURS : 70 Hours**

COURSE CODE : THEORY

Sub-topics

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit - 1	**Some Basic Concepts of Chemistry:** Laws of chemical combination. 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. Different concentration terms of solutions and related calculations.	**07**	**03**
Unit - 2	**Structure of Atom:** Bohr's model and its limitations, concept of shell and sub-shells, the dual nature of matter and light, de Broglie's relationship. Heisenberg uncertainty principle, Schrödinger wave equation (elementary idea only). 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, exchange energy, electronic configuration of atom, stability of half-filled, completely filled orbitals.	**12**	**06**
Unit - 3	**Classification of Elements and Periodicity in Properties:** Modern periodic law and the present form of the periodic table, periodic trends in properties of elements – atomic radii, ionic radii, van der Waals' radii, ionization enthalpy, electron gain enthalpy, electronegativity, valency. Nomenclature of elements with atomic number greater than 100.	**07**	**04**
Unit - 4	**Chemical Bonding and Molecular Structure:** Valence electrons, ionic bond, bond parameters, covalent bond, Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridisation, involving *s, p* and *d* orbitals and shapes of some simple molecules, intermolecular interactions, Hydrogen bonding, Molecular orbital theory of homonuclear diatomic molecules (H_2, He_2, O_2, N_2, F_2 – qualitative idea only)	**13**	**06**

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit - 5	**States of Matter — Solids and Gases:** Classification of solids (elementary idea): 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. Kinetic theory of gas, molecular speeds, Dalton's law of partial pressure, Graham's law, deviation of ideal behaviour and van der Waals' equation, Liquefaction of gases, critical temperature.	**09**	**04**
Unit - 6	***s*-Block Elements (Group 1 and Group 2 elements):** Electronic configuration, occurrence, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens, hydrides (ionic, covalent and interstitial), hydrogen peroxide (preparation, properties, structure & use.), hydrogen as a fuel. Biological importance of Na, K, Mg, Ca.	**10**	**05**
Unit - 7	***p*-Block Elements (Group 13 and Group 14 elements):** General introduction to *p*-block elements, electronic configuration, occurrence, variation in properties, oxidation states, and trends in chemical reactivity of group 13 and 14 elements. **Group 13**: Boron: physical and chemical properties of compounds of Boron: Boron oxides, boric acid, borates and B_2H_6 Aluminium: Reactions of Al with acid and alkali, uses of Al, Preparation and uses of $LiAlH_4$ and Al_2O_3. **Group 14:** Carbon: catenation, allotropic forms, nano carbon, graphene, physical and chemical properties of two oxides of carbon- CO and CO_2, Silicon: some compounds of silicon and their important uses – Silicon tetrachloride (Structure, preparation, hydrolysis and reduction reaction only), silicates [structure of open chain silicates constructing of $(SiO_3)_n^{2n-}$ ions], use of zeolites,	**12**	**07**

CLASS - XI

SEMESTER – II

SUBJECT : CHEMISTRY (CHEM)

FULL MARKS : 35 **CONTACT HOURS : 60 HOURS**

COURSE CODE : THEORY

Sub-topics

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit - 1	**Thermodynamics:** Concepts of system (including types of system), surroundings. Work, heat, energy, extensive and intensive properties, state function, Zeroth law of thermodynamics and definition of temperature. The first law of thermodynamics – internal energy change (ΔU) and enthalpy change (ΔH), Enthalpy of bond dissociation, combustion, formation, atomization, ionization, solution and sublimation. Transformation of state. Hess's law of constant heat summation, Born Haber Cycle and its application. 2^{nd} law of thermodynamics, the introduction of entropy as a state function, Gibbs energy change for spontaneous and non-spontaneous processes, criteria for equilibrium.	**12**	**07**
Unit - 2	**Equilibrium:** Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass reaction, equilibrium constant, factors affecting equilibrium – Le Chatelier's principle; ionic equilibrium, ionization of acids and bases, strong and weak electrolytes, degree of 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).	**10**	**06**
Unit - 3	**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, applications of redox reactions in permanganometry and dichromatometry	**05**	**03**
Unit - 4	**Organic Chemistry: Some basic principles:** General introduction, classification and IUPAC nomenclature of organic compounds. Electronic displacements in a covalent bond: inductive effect, resonance and hyperconjugation. Homolytic and Heterolytic fission of a covalent bond: free radicals, carbocations, carbanions electrophiles and nucleophiles, types of organic reactions. Elementary idea of addition, elimination and substitution reactions.	**12**	**07**

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit - 5	**Hydrocarbons: Classification of hydrocarbons** Alkanes – Nomenclature, isomerism, conformations (ethane only), physical properties (up to 6 carbons) and chemical reactions including halogenations, free radical mechanism, combustion and pyrolysis. Alkenes – Nomenclature, structure of double bond (ethene), geometrical isomerism, physical properties (up to 3 carbons) 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 (up to 3 carbons) 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, halogenations, Friedel-Crafts alkylation and acylation, carcinogenicity and toxicity.	**14**	**08**
Unit - 6	**Environmental Chemistry:** Environmental pollution – air, water and soil pollution (cause and effects), Primary and secondary pollutants (solid and liquid), chemical reactions in the atmosphere, smog, pollution due to industrial wastes; solid waste management (elementary idea only), SPM, RSPM, green chemistry as an alternative tool for reducing pollution. Water preservation and protection, Strategy for control of environmental pollution.	**07**	**04**

CLASS - XII

SUBJECT : CHEMISTRY (CHEM)

SEMESTER – III

FULL MARKS : 35 **CONTACT HOURS : 70 HOURS**

COURSE CODE : THEORY

Sub-topics

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit - 1	**Liquid State** Introduction, Solubility of gases in liquids, solid solutions, Vapour pressure and Raoult's law. Colligative properties; relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure. Determination of molecular mass using colligative properties. Abnormal molecular mass, van't Hoff factor and calculations involving it. Colloidal solution, the difference between true solutions, colloids and suspensions; lyophilic, lyophobic, multi-molecular colloids; properties of colloids; Tyndal effect, Brownian movement, electrophoresis, coagulation, emulsions and types of emulsions.	**16**	**08**
Unit - 2	***p*-Block Elements (Groups 15, 16, 17 and 18)** **Group 15 elements:** general introduction, electronic configuration, occurrence, oxidation states, Structure and reaction of NH_3, HNO_3, NCl_3, oxides of nitrogen (structure only); Phosphorus – allotropic forms(White and Red), preparation and properties of phosphine, phosphorus halides (PCl_3, PCl_5) and oxoacids (elementary idea only) **Group 16 elements:** General introduction, electronic configuration, occurrence, oxidation states; Oxygen: classification of oxides. Preparation and properties of Ozone. Sulphur: allotropic forms (rhombic and monoclinic). Properties and uses of oxides, oxoacids and peracids of sulphur. **Group 17 elements:** General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; Compounds of halogen; preparation, structure and uses of oxides, oxoacids of halogens, interhalogen compounds. Elementary idea of pseudohalogens and polyhalides. **Group 18 elements :** General introduction, electronic configuration, occurrence, uses of noble gases. Preparation, structure and chemical reactions of XeO_2, XeO_3, XeF_2, XeF_4, XeF_6, $XeOF_2$.	**18**	**08**

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit - 3	**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/L* configurations Uses and environmental effects of – dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, **Haloarenes:** Nature of C-X bond, substitution reaction (directive influence of halogen for monosubstituted compounds only), stability of carbocations, *R/S* and *D/L* configurations. Uses and environmental effects of DDT.	**10**	**05**
Unit - 4	**Alcohols, Phenols and Ethers** **Alcohols:** Nomenclature, methods of preparation, physical and chemical properties (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 reaction, uses of phenol. **Ethers:** Nomenclature, methods of preparation, physical and chemical properties, uses.	**10**	**05**
Unit - 5	**Biomolecules :** **Carbohydrates** Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D/L configuration, oligosaccharides (sucrose), polysaccharides (starch, cellulose) **Proteins** Elementary idea of α-amino acids, peptide bonds, polypeptides, structure of proteins (primary structure only), denaturation of proteins; enzymes. **Nucleic Acids:** DNA & RNA (introduction and basic concept)	**08**	**05**
Unit - 6	**Polymers:** Classification- (natural and synthetic), methods of polymerization (addition and condensation), copolymerization. Some important polymers; like polythene, nylon, polyesters, bakelite, and rubber. Biodegradable and non-biodegradable polymers	**08**	**04**

CLASS - XII

SUBJECT : CHEMISTRY (CHEM)

SEMESTER – IV

FULL MARKS : 35 **CONTACT HOURS : 60 HOURS**

COURSE CODE : THEORY

Sub-topics

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit - 1	**Electrochemistry** Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variation of conductivity with concentration, Kohlrausch's law, electrolysis and laws of electrolysis (elementary idea), dry cell – electrolytic cells and Galvanic cells, 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, Li-ion battery.	**08**	**05**
Unit - 2	**Chemical Kinetics** Rate of a reaction (average and instantaneous), factors affecting rate of reactions- concentration, temperature and 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); the concept of collision theory (elementary idea, no mathematical treatment) activation energy, Arrhenius equation Catalysis, homogeneous and heterogeneous catalysis, enzyme catalysis.	**10**	**07**
Unit - 3	***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 – ionic radii, ionization enthalpy, oxidation states, colour, catalytic property, magnetic property. Preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$. **Lanthanoids** Electronic configuration, oxidation states, chemical reactivity, lanthanoid contraction and its consequences, uses. **Actinoids** Electronic configuration, oxidation states, comparison with lanthanoids, uses.	**10**	**06**
Unit - 4	**Coordination compounds** Introduction, ligands, classification of ligands based on denticity and field intensity, coordination number, colour, magnetic properties and shape, IUPAC nomenclature of mononuclear coordination compounds, EAN rule, Bonding (Werner's theory, VBT and CFT), CFSE, structural-isomerism and stereo-isomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems)	**08**	**05**

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit - 5	**Aldehydes, 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	**10**	**05**
Unit - 6	**Organic compounds containing Nitrogen** **Nitro compounds:** General methods of preparation and reduction reactions. **Amines:** Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines. **Cyanides and Isocyanides –** Nomenclature, structure, methods of preparation, chemical reactions (hydrolysis and reduction reactions only). **Diazonium salts:** Preparations, chemical reactions and importance in synthetic organic chemistry	**14**	**07**

PRACTICAL FOR CLASSES XI AND XII

SUBJECT : CHEMISTRY (CHEM)

CLASS – XI

COURSE CODE : PRACTICAL

FULL MARKS : 30

Evaluation Scheme for Examination	**Marks**
Volumetric analysis	10
Environment-related experiments	08
Characterization and purification of chemical substances	06
Class Record, Project and Viva	06
Total	**30**

Practical Syllabus

A. Basic Laboratory Techniques

i. Cutting glass tube and glass rod
ii. Bending a glass tube
iii. Drawing out a glass jet
iv. Boring a cork

B. Characterization and purification of chemical substances

i. Determination of the melting point of an organic compound
ii. Determination of the boiling point of an organic compound
iii. Crystallization of impure sample of any of the following: Alum, Copper, Sulphate, Benzoic acid.

C. Environment-related experiments

i. Calculation of pH of soil sample.
ii. Determination of turbidity for a given sample of water
iii. Determination of dissolved oxygen in a given sample of water
iv. Determination of TDS of water sample

D. Quantitative estimation (Use of digital balance (precession up to 3 decimal points)**) (Volumetric analysis)**

i. Determination of strength of a given sodium hydroxide solution by titrating it against a standard oxalic acid solution.
ii. Determination of strength of a given hydrochloric acid solution by titrating it against standard sodium carbonate solution.
iii. Standardisation of $KMnO_4$ solution by using standard Oxalic acid solution.
iv. Estimation of Fe in Mohr's salt solution using standard $KMnO_4$ solution or standard $K_2Cr_2O_7$ solution.

Project Work

a) Preparation of standard solutions:

i) Preparation of (N/10) Oxalic acid solution.
ii) Preparation of (N/10) Mohr's salt solution.
iii) Preparation of (N/10) Sodium carbonate solution.
iv) Preparation of (N/10) Hydrochloric acid solution.
v) Preparation of (N/10) Sodium hydroxide solution.

b) Preparation of inorganic compounds:

i) Preparation of potash alum.

ii) Preparation of potassium ferric oxalate.

c) Study of acidity of-

i) Different samples of tea leaves.

ii) Fruit and vegetable juices.

CLASS – XII

COURSE CODE : PRACTICAL

FULL MARKS : 30

Evaluation Scheme for Examination	**MARKS**
Potentiometric Analysis	06
Salt Analysis	08
Detection of functional groups in Organic compounds	04
Content-Based Experiment (Chemical Kinetics/Thermochemistry/ Preparation of Organic Compounds)	06
Class record, Viva and Project work	06
Total	**30**

Practical Syllabus

A. Chemical kinetics

(i) Study of the rate of reaction of iodide ions with hydrogen peroxide at room temperature using different concentrations of iodide ions. (with Excel plot)

(ii) Study of the reaction rate of hydrolysis of ester in an acidic medium (with Excel plot)

B. 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.

C. Electrochemistry

(i) Potentiometric titration of Fe^{3+}/Fe^{2+} system with Potassium dichromate and Potassium permanganate solutions.

(ii) Potentiometric determination of concentration of $AgNO_3$ solution (N/100 or N/200) using standard KCl solution (N/10).

D. Tests for the functional groups present in organic compounds:

Unsaturation, alcoholic -OH (1°), phenolic -OH, aldehyde, ketone, carboxylic acid and primary aromatic amine groups.

E. Preparation of Organic compounds:

Preparation of any two of the following compounds :

(i) Benzilic acid (From Benzil)

(ii) Aniline yellow or 2-Naphthol aniline dye.

(iii) Iodoform.

F. Characteristic test of carbohydrates, fats and proteins in pure samples and their detection in given foodstuffs.

G. Qualitative analysis

Determination of one cation and anion in a given salt.

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

Anions – $CO_3^{2-}, S^{2-}, SO_4^{2-}, S_2O_3^{2-}, NO_2^-, NO_3^-, , Cl^-, Br^-, I^-, PO_4^{3-}$

(Note: Insoluble salts excluded)

Project work – where feasible may include

(i) Model preparation

(ii) Investigatory project

(iii) Science exhibits

(iv) Participation in science fairs

(v) Testing purity of food articles like butter, pulse, milk etc.