

**St. Aloysius (Autonomous) College, Jabalpur**

Department of Chemistry

According to the Department of Higher Education, Govt. of M.P.

Under Graduate Yearly Syllabus as recommended by

Central Board of Studies and Approved by the Governor of M.P.

**Chemistry Major Syllabus Session 2021-22**

***Class B.Sc. (I) Year Paper – I***

***Maximum Marks: 70***

**Course outcome-**

By the end of this course student will learn the following aspect of chemistry-

- Ancient Indian Chemical technique
- Various theories and Principle applied to reveal atomic structure.
- Significance of quantum number
- Concepts of periodic properties of elements.
- Theories related to chemical bonding
- Acid-Base concept , pH buffer
- Factor responsible for reactivity of organic molecules.
- Basics and Mechanism of Chemical Kinetics.

**UNIT – I**

(a) Chemical Techniques in ancient India: general Introduction

(b) Contribution of ancient Indian Scientists in chemistry e.g., metallurgy, yes, pigments, cosmetics, Ayurveda, Charak Sanhita.

**Atomic Structure:**

Review of Bohr's theory and its limitations. Atomic spectrum of Hydrogen. Dual nature of particles and waves, de Broglie's equation, Heisenberg's Uncertainty Principle and its significance. Quantum number and their significance. Rules for filling electrons in various orbitals, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau Principle and its limitations, Variation of orbital energy with atomic number.

Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

**Keywords/Tags: Metallurgy, Dyes, Cosmetics, Charak Sanhita Hydrogen Spectrum, Hund's Rule,**

**UNIT - II**

Elementary idea of the following properties of the elements with reference to s & p-block elements in periodic table.

Effective nuclear number (EAN), Shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. Atomic radii (vander Waals), Ionic and crystal radii, Covalent radii (octahedral and tetrahedral) Detailed discussion of the following properties of elements, with reference to s & p-blocks.

Ionization energy – Successive ionization energy and factors affecting ionization energy. Applications of Ionization energy. Electronegativity-Pauling's/Mulliken's electronegativity scales. Variation of electro negativity with bond order, partial charge, hybridization

**Keywords/Tags: EAN, Atomic radii, Ionic radii, Crystal radii**

### **UNIT - III**

#### **Ionic Bonding: General Characteristics of Ionic Bonding.**

Ionic Bonding and energy: lattice and salvation energies and their importance in the context of stability and solubility of ionic compounds.Statement of Born-Lande equation for calculation of lattice energy, Madelung constant, Born-Haber cycle and its applications. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules.

Covalent bonding: Lewis structure, Valence bond theory(Heitler-London Approach).Hybridization-Concept, types ( $SP$ ,  $SP^2$ ,  $SP^3$ ,  $dSP^2$ ,  $d^2SP^3$ ) with suitable example of inorganic and organic molecules.Ionic character in covalent compounds-dipole moment and percentage ionic character.

Valence Shel Electron pair Repulsion (VSEPR) Theory: Assumption, need of theory, application of theory to explain geometries or shapes of some inorganic molecules and ions on the basis if VSEPR and hybridaization with suitable examples of linear trigonal planar, square planar, tetrahedral, trigonal bipyramidl and octahedral arrangements such as: $NH_3$ ,  $H_2O$ ,  $SF_4$ ,  $ClF_3$ ,  $PCl_5$ ,  $SF_6$ ,  $ClF_5$ ,  $XeF_4$ .

#### **Molecular orbital (MO) concept of bonding**

The approximations of the theory, Linear combination of Atomic Orbitals(LCAO) (elementary pictorial approach).Rules for the LCAO method, bonding and antibonding MOs.Characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals. Molecular orbital Diagram of homonuclear diatomic molecules: $H_2$ ,  $Li_2$ ,  $Be_2$ ,  $B_2$ ,  $C_2$ ,  $N_2$ ,  $O_2$ ,  $F_2$  and their ions.Molecular orbitals of heteronuclear diatomic molecules:  $CO$ ,  $NO$ ,  $CN$ ,  $HF$ .

#### **Bond parameters:**

Definition and factors affecting- bond orders, bond lengths, bond angles.

**Keywords/Tags: Ionic Bonding, Covalent Bonding, hybridaization, VSEPR Theory, LCAO, MO diagram, Bond Parameters**

### **UNIT – IV**

Arrhenius concept, Bronsted-Lowry's concept, conjugate acids and bases, relative strength of acids, Lewis concept. pH, buffer solutions. Acid-base neutralisation curves, Henderson equation.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values

Indicator, choice of indicators.

**Keywords/Tags:** Acid-base concept, Bronsted-Lowry's concept, Conjugate Acids and Bases, pH, Buffer Solution, Indicator.

### UNIT – V

#### **(a) Fundamentals of Organic Chemistry**

Structure, shape and reactivity of organic molecules: Physical Effects, Electronic Displacement: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of bonds: Homolysis and Heterolysis. Reactive Intermediates: Carbocations, Carbanions and free radicals. Nucleophiles and Electrophiles.

#### **(b) Stereochemistry of Organic Compounds:**

Concept of isomerism- **Geometrical isomerism:**

Determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

**Optical isomerism:** Elements of symmetry, molecular chirality, enantiomers & their properties, stereogenic centre, optical activity of enantiomers. Concept of chirality ( up to two carbon atoms ) : chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythroisomers, mesoisomer, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

#### **Conformations and Conformational analysis**

Conformations of ethane, butane and cyclohexane. Interconversion of wedge Formula, Newman, Sawhorse and Fischer representations.

**Keywords/Tags:** Electronic Displacements, Nucleophiles, Electrophiles, Isomerism, Molecular Chirality, Enantiomers, Sequence Rules, Conformation

### UNIT-VI

#### **Chemical Kinetics:**

Rate of reaction, Definition and difference of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation of half-life period. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

#### **Ionic Equilibria:**

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Common ion effect. Salt hydrolysis-

calculation of hydrolysis constant, degree of hydrolysis and pH for difficult salts. Solubility and solubility product of sparingly soluble salts-applications of solubility product.

**Keywords/Tags:** Order Of Reaction, Molecularity Of Reaction, Arrhenius Equation, Activation Equation, Activation Energy, Electrolytes, Salt Hydrolysis, Solubility Product.

**St. Aloysius (Autonomous) College, Jabalpur**  
**Department of Chemistry**

According to the Department of Higher Education, Govt. of M.P.  
Under Graduate Yearly Syllabus as recommended by  
Central Board of Studies and Approved by the Governor of M.P.

**Chemistry Major Syllabus Session 2021-22**

***Class B.Sc. (I) Year Paper – II***

***Maximum Marks: 70***

**Course outcome-** By the end of this course student will learn the following aspect of chemistry-

- **Basic concept of mathematics for chemist**
- **Fundamental of analytical chemistry and steps involve in analysis.**
- **Basic Knowledge of computer for chemists**
- **Basic concepts of Chemical equilibrium**
- **Principle of chromatography and chromatography techniques**
- **Various techniques of spectroscopic Analysis.**

**UNIT – I**

**1. Mathematics for Chemists:**

straight line equation Logarithmic relations, curves sketching, linear graphs and calculation of slopes, Differentiation of functions like  $k_x$ ,  $e^x$ ,  $x^n$ ,  $\sin x$ ,  $\log x$ ; maxima and minima, partial differentiation. Integration of some useful/relevant functions.

Keywords/Tags: Linear graphs, Logarithmic relations, differentiation, Integration.

**UNIT - II**

**Basic Analytical chemistry:** Introduction to analytical Chemistry and its interdisciplinary nature. Concept of Sampling, Importance of accuracy. Precision and source of error in analytical measurements. Significant figures. Statistical term: mean .mean deviation, median, standard deviation, Numerical problems.

**Calculation used in Analytical Chemistry**

**Some important unit of measurements-** SI units, Distinction between mass and weight, mole, milli mole and Numerical problems.

**Solution and their Concentrations-** Concept of molarity, molality and normality. Expressing the concentration in parts per million (ppm), parts per billion(ppb), Numerical problems.

**Chemical Stoichiometry-** empirical and molecular formulas, stoichiometric calculation, Numerical problems.

**Keywords/Tags:** Accuracy, Precision, SI Units, unit of concentration, Chemical Stoichiometry.

**UNIT - III**

**Unit-3 Computer for Chemists**

Introduction to computer, Introduction to operating systems like-DOS, windows , Linus and Ubuntu.

### **Use of Computer Programs**

Running of standard programs and packages such as MS-word, MS-Excel, Power –point, Execution of linear regression x-y point . Use of softwares for drawing structures and Molecular formulae

Keywords/Tags: Operating system, MS-word, MS-excel, Power-point.

### **UNIT - IV**

#### **Chemical Equilibrium:**

Equilibrium constant and free energy , concept of chemical potential . thermodynamic derivation of law of chemical equilibrium . Temperature dependence of equilibrium constant : Vant Hoff reaction isochore. van't reaction isotherm . Le Chatelier's principal and its applications.

Key/Tags: Chemical Equilibrium, Equilibrium constant, Free energy, Chemical potential.

### **UNIT - V**

Chromatography Introduction .Principial and classification Mechanism of separation: adsorption. Partition and ion-exchange.

Development of chromatograms: frontal elution and displacement methods.

Paper Chromatography (ascending descending and circular), thin layer chromatography (TLC) and Column Chromatography ( C C ) and High Pressure Liquids Chromatography (HPLC) , types of column and column selection , applications, limitation

**Principle and Applications of: Flash – Chromatography, Ion-Exchange chromatography and Chiral chromatography.**

Keywords/ tags Chromatogram, ion exchange, Column Selection, Adsorption.

### **UNIT - VI**

#### **Spectral techniques of analysis**

Basics of absorption spectroscopy: Electromagnetic radiation Spectral range. Absorbance. Absorptive, Molar Absorptive.

Fundamental Laws of absorption. Lambert-Beer Law and its limitation.

Constitution and working of photometer , spectrometer, colorimeter.

#### **Ultraviolet (UV) absorption spectroscopy**

Presentation and analysis of UV spectra. Types of electronic transition Effect of conjugation. Concept of chromophore and auxochrome, Bathochromic, hypsochromic. Hyperchromic and hypochromic shift. UV spectra of conjugated polyenes and enones.

#### **Infra-red (IR) absorption spectroscopy**

Molecular vibration. Hook's law, selection rules. Intensity and position of IR bands. Measurement of IR-spectrum. Finger print region, Characteristics absorption of various functional group and interpretation of IR spectra of simple organic compounds.

Keywords/Tags: Hypsochromic Hypochromic, absorption, spectrum.

**St. Aloysius (Autonomous) College, Jabalpur**  
**Department of Chemistry**

According to the Department of Higher Education, Govt. of M.P.  
Under Graduate Yearly Syllabus as recommended by  
Central Board of Studies and Approved by the Governor of M.P.

**Chemistry Minor Syllabus Session 2021-22**

**Class B.Sc. (I) Year**

**Maximum Marks: 70**

**Course outcome-** By the end of this course student will learn the following aspect of chemistry-

- Basic concept of mathematics for chemist
- Fundamental of analytical chemistry and steps involve in analysis.
- Basic Knowledge of computer for chemists
- Basic concepts of Chemical equilibrium
- Principle of chromatography and chromatography techniques
- Various techniques of spectroscopic Analysis.

**UNIT – I**

**2. Mathematics for Chemists:**

straight line equation Logarithmic relations, curves sketching, linear graphs and calculation of slopes, Differentiation of functions like  $k_x$ ,  $e^x$ ,  $x^n$ ,  $\sin x$ ,  $\log x$ ; maxima and minima, partial differentiation. Integration of some useful/relevant functions.

Keywords/Tags: Linear graphs, Logarithmic relations, differentiation, Integration.

**UNIT - II**

**Basic Analytical chemistry:** Introduction to analytical Chemistry and its interdisciplinary nature. Concept of Sampling, Importance of accuracy. Precision and source of error in analytical measurements. Significant figures. Statistical term: mean .mean deviation, median, standard deviation, Numerical problems.

**Calculation used in Analytical Chemistry**

**Some important unit of measurements-** SI units, Distinction between mass and weight, mole, milli mole and Numerical problems.

**Solution and their Concentrations-** Concept of molarity, molality and normality. Expressing the concentration in parts per million(ppm), parts per billion(ppb), Numerical problems.

**Chemical Stoichiometry-**empirical and molecular formulas, stoichiometric calculation, Numerical problems.

**Keywords/Tags:** Accuracy, Precision, SI Units, unit of concentration, Chemical Stoichiometry.

**UNIT - III**

**Unit-3 Computer for Chemists**



Introduction to computer, Introduction to operating systems like-DOS, windows , Linus and Ubuntu.

### **Use of Computer Programs**

Running of standard programs and packages such as MS-word, MS-Excel, Power –point , Execution of linear regression x-y point . Use of softwares for drawing structures and Molecular formulae

Keywords/Tags: Operating system, MS-word, MS-excel, Power-point.

### **UNIT - IV**

#### **Chemical Equilibrium:**

Equilibrium constant and free energy , concept of chemical potential . thermodynamic derivation of law of chemical equilibrium . Temperature dependence of equilibrium constant : Vant Hoff reaction isochore . van't reaction isotherm . Le Chatelier's principal and its applications.

Key/Tags: Chemical Equilibrium Equilibrium constant, Free energy, Chemical potential.

### **UNIT - V**

Chromatography Introduction .Principial and classification Mechanism of separation: adsorption. Partition and ion-exchange.

Development of chromatograms: frontal elution and displacement methods.

Paper Chromatography (ascending descending and circular), thin layer chromatography (TLC) and Column Chromatography ( C C ) and High Pressure Liquids Chromatography (HPLC) , types of column and column selection , applications, limitation

**Principle and Applications of: Flash – Chromatography, Ion-Exchange chromatography and Chiral chromatography.**

Keywords/ tags Chromatogram, ion exchange, Column Selection, Adsorption.

### **UNIT - VI**

#### **Spectral techniques of analysis**

Basics of absorption spectroscopy: Electromagnetic radiation Spectral range. Absorbance. Absorptivity, Molar Absorptivity.

Fundamental Laws of absorption. Lambert-Beer Law and its limitation.

Constitution and working of photometer , spectrometer, colorimeter.

#### **Ultraviolet(UV) absorption spectroscopy**

Presentation and analysis of UV spectra. Types of electronic transition Effect of conjugation. Concept of chromophore and auxochrome, Bathochromic, hypsochromic. Hyperchromic and hypochromic shift. UV spectra of conjugated polyenes and enones.

#### **Infra-red (IR) absorption spectroscopy**

Molecular vibration. Hook's law, selection rules. Intensity and position of IR bands. Measurement of IR-spectrum. Finger print region, Characteristics absorption of various functional group and interpretation of IR spectra of simple organic compounds.

Keywords/Tags: Hypsochromic Hypochromic, absorption, spectrum.