

# **ORDINANCE, REGULATION & SYLLABUS**

## **For B.Sc. [CHEMISTRY]**



*Offered by*

**NEHRU GRAM BHARATI**

**(DEEMED TO BE UNIVERSITY),  
KOTWA-JAMUNIPUR-DUBAWAL  
PRAYAGRAJ-221505  
UTTAR PRADESH**

**Session:**

**From 2019 – 2020**

## **ORDINANCE AND REGULATIONS FOR B.Sc. DEGREE PROGRAMME**

### **A. ORDINANCE**

#### **1. The Degree of Bachelor of Science (B.Sc.)**

The Nehru Gram Bharati (Deemed to University) may confer the Degree of Bachelor's Programme in Science on Such candidates who, being eligible for admission to the Bachelor's Degree Programme, have received regular instruction in the prescribed course of study, passed successfully relevant examinations and being otherwise suitable by virtue of their character, have fulfilled such other condition as may be laid down from time to time by the appropriate authorities.

#### **2. Requirement for Admission**

##### **A. Registration:**

(i) Candidates of Bachelor Degree shall first be admitted to the first semester upon the reopening of the University after summer vacation every year.

(ii) Subsequent Registration

A candidate, who fails to clear a regular course of study during any of the second, third, fourth, fifth and sixth semesters may be registered in the appropriate term of any subsequent year to the semester concerned but within such time as enables him, to complete the study of all semester comprising Bachelor Degree Programme within a maximum period of five years from the date of his/her registration for the first semester.

##### **B. Minimum Qualification For Admission**

(i) Admission to the Bachelor's Degree Programme of study shall be open to those candidates who have passed the 10+2/intermediate exam from any Board (U.P Board/CBCS board/ICSC/or any other Govt. recognized board). Admission shall be made according to merit subject to the fulfillment of eligibility requirement as determined by the University and availability of seats in the Bachelor courses.

##### **C. Conditions of Admission:**

(i) No application for registration to the First Semester shall be entertained unless it is accompanied by:

(a) Original Transfer certificate of a candidate who has been a regular student in any Institution at any time prior to making application for registration in the Faculty.

(ii) Candidate shall give also a written undertaking to the effect that:

(a) He/She shall exclusively devote his/her time to the study of courses prescribed for Bachelor's Degree and in particular he/she shall not offer any other course leading to a degree of any description whatsoever, not shall he/she undertake any remunerative work, though with the prior permission of the Faculty, he/she may join certificate of or diploma courses in any foreign language.

(b) He/She shall abide by the provision of NGB (DU) Act, Statutes, Ordinances, Regulations and Rules that are framed or may be framed there under and the orders of Officers and authorities of the University and the concerned Faculty from time to time.

#### **3. Fees**

The students pursuing Bachelor's Degree Program of study shall have to pay fee as may be prescribed by the University from time to time.

4. The course of study, scheme of examination, result and promotion are covered in the regulation, and are given below.

### **REGULATIONS**

1. The syllabus for B. Sc. based on semester with credit based pattern comprises of six semesters. The examination shall be of Minimum 18 (eighteen) and Maximum 20 (twenty) theory papers and 6 practical. From semester I to IV, each theory and practical will be of 50 marks.
2. During semester V & VI, the marks for theory will be 75 or 50 and the marks of practical will be 75 or 100. The theory papers and practical in semesters I to IV will be of 2 credits, while in V and VI semester, theory will be of 3 or 2 credits and practical will be of 3 or 4 credits respectively. Thus total number of credits from I to IV will be 32 credits while in V and VI semester the number of total credits will be 24 credits. Thus the grand total of credits in B.Sc. will be 56 for each subject.
3. The semester I to IV has 8 credits (2X3=6 theory and 2×1=2 practical, Total=08 credit) and V to VI has 12 credits (3X3=9 theory and 3×1=3 practical, Total 12 credits or 2×4=8 theory and 4×1=4 practical, Total=12 credits). There shall be six practical and one seminar/project in complete course. The Examination in each theory paper shall be of three hours duration. The structure of syllabus for B.Sc. (Semester with credit based pattern) is given in the following table.
4. Each semester shall have minimum 90 teaching days, exclusion of holidays, admission and examinations.

### **SCHEME OF EXAMINATION**

1. The evaluation scheme of examination consists of two parts: Internal Assessment (IA) and End Semester Examination (ESE). Internal assessment includes Assignments/Seminars/ Unit test/Group activities/Discussion, etc. The internal assessment will contribute 20% and the end semester examination will contribute 80% to the total marks.
2. There shall be continuous assessment of the student in each course. The course instructor shall hold a maximum of three and minimum of one internal test /assignment /presentation, etc.
3. In case of semester examination, there shall be no binding on the number of external paper setters/examiners, generally the course instructor shall be the paper setter and examiner. The duration of the End Semester Examination (ESE) of each course will be 3 Hours.

**Note: The ratio of internal assessment and end semester examination will be the same as determined by the University.**

# **B.Sc. – CHEMISTRY**

## **(Six Semester Credit System)**

The syllabus for B. Sc. Chemistry based on semester with credit based pattern comprises of six semesters. The examination shall be of 18 (eighteen) theory papers and 6 practical each of 50 marks from Semester I to IV. During Sem V & VI, the marks for theory and practical will be 75. The theory papers as well as practical in semesters I to IV have 2 credits, while in V and VI semester, theory and practical will be 3 credits in each. Thus total number of credits from I to IV will be 32 credits while in V and VI Sem, the number of total credits will be 24 credits. Thus the grand total of credits in B.Sc. Chemistry will be 56. The semester I to IV per paper has 8 credits (2X3=6 theory and 2 practical=08 ) and V to VI per paper has 12 credits (3X3=9 theory, 3 practical=12). There shall be six practical in complete course and only one seminar in VI Semester. The Examination in each theory paper shall be of three hours duration. The structure of syllabus for B.Sc. Chemistry (Semester with credit based pattern) is given in the following table.

**B.Sc. Chemistry**  
**(Six Semester Credit System)**

Sr. No.	Code	Paper	Title	IA	ESE	Total Marks	Credits
<b>Semester I</b>							
1.	BOC 101	Paper I	Inorganic Chemistry	10	40	50	2
2.	BOC 102	Paper II	Organic Chemistry	10	40	50	2
3.	BOC 103	Paper III	Physical Chemistry	10	40	50	2
4.	BOC 104	Practical		10	40	50	2
			Total Credits			200	8
<b>Semester II</b>							
5.	BOC 201	Paper I	Inorganic Chemistry	10	40	50	2
6.	BOC 202	Paper II	Organic Chemistry	10	40	50	2
7.	BOC 203	Paper III	Physical Chemistry	10	40	50	2
8.	BOC 204	Practical		10	40	50	2
						200	8
<b>Semester III</b>							
9.	BOC 301	Paper I	Inorganic Chemistry	10	40	50	2
10.	BOC 302	Paper II	Organic Chemistry	10	40	50	2
11.	BOC 303	Paper III	Physical Chemistry	10	40	50	2
12.	BOC 304	Practical		10	40	50	2
						200	8
<b>Semester IV</b>							
13.	BOC 401	Paper I	Inorganic Chemistry	10	40	50	2
14.	BOC 402	Paper II	Organic Chemistry	10	40	50	2
15.	BOC 403	Paper III	Physical Chemistry	10	40	50	2
16.	BOC 404	Practical		10	40	50	2
						200	8
<b>Semester V</b>							
17.	BOC 501	Paper I	Inorganic Chemistry	15	60	75	3
18.	BOC 502	Paper II	Organic Chemistry	15	60	75	3
19.	BOC 503	Paper III	Physical Chemistry	15	60	75	3
20.	BOC 504	Practical		15	60	75	3
						300	12
<b>Semester VI</b>							
21.	BOC 601	Paper I	Inorganic Chemistry	15	60	75	3
22.	BOC 602	Paper II	Organic Chemistry	15	60	75	3
23.	BOC 603	Paper III	Physical Chemistry	15	60	75	3
24.	BOC 604	Practical		15	60	75	3
						300	12

## SEM-I

### Paper -I (BOC-101)

#### Inorganic Chemistry

##### Unit -I

##### Atomic Structure:

Bohr's and Sommerfield's atomic models, de-Broglie equation, Heisenberg uncertainty principle, Schrodinger wave equation, Significance of wave function, Radial and angular wave functions, quantum numbers, shapes of s p d and f orbital, Aufbau's principle and electronic configuration of atoms, Paul's exclusion principle and Hund's rule of maximum multiplicity. Periodic classification of elements, long form of the periodic table including transuranic elements.

##### Unit II

##### Periodic Properties of the elements:

Atomic, covalent and Ionic radii, Ionization potential, electron affinity, Electronegativity including trends in periodic table and applications in predicting and explaining the chemical behaviour, Lattice energy and hydration energy and their relation to solubility of ionic compounds.

##### Unit III

##### Electrode Potential:

Electrode potential and electro-chemical series, Electrode potential diagram and its application.

##### Unit IV

##### Chemistry of Zero Group and S-block elements:

- Isolation and separation of inert gases from air and compounds of inert gases.
- Cooperative study, diagonal relationships. Organometallic compounds of Li, Na, K, Be and Mg. Polymer complexes (Crown ether complexes) of alkali metals.

##### Unit V

##### Principle involved in Qualitative:

- Chemical reactions in qualitative analysis of inorganic mixture.
- Application of Coordination compounds in qualitative analysis.
- General principles of Volumetric analysis, Redox reactions, Equivalent weight, normality, molarity, and molality,
- Solubility product, Common ion effect, Co-precipitation post-precipitation

### Paper -II (BOC-102)

#### Organic Chemistry

##### Unit-I

##### Structure of Bonding:

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Resonance, hyper conjugation, aromaticity, inductive effect, electromeric effect, mesomeric effect, hydrogen bonding.

##### Unit -II

##### Stereochemistry of Organic Compound:

Concept of isomerism and types of isomerism.

**Optical isomerism-** elements of symmetry, Molecular Chirality, enantiomers, stereogenic centre, optical activity, Properties of enantiomers, chiral and achiral molecules with stereogenic centers, diastereomers, threo and erythro Diastereomers, Meso compounds, resolution of Enantiomers Retention racemization and Inversion.

### **Unit-III**

#### **Alkanes and cycloalkanes:**

IUPAC nomenclature, Methods of preparation (with special reference to Wurtz reaction, Kolbe Reaction, Corey-house Reaction and decarboxylation of carboxylic acid) physical and chemical properties of alkanes.

Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

**Cycloalkanes-** Nomenclature, Methods of preparation, chemical properties, Baeyer's strain theory and its limitation, Ring, Strain in small rings, (cyclopropane), theory of stainless rings The case of cyclopropane ring: banana bonds.

### **UNIT-IV**

#### **Arenes and Aromaticity:**

Structure of Benzene : Resonance structure, MO picture Nomenclature of benzene derivatives, the aryl group, Aromatic Nucleus and side chain, structure of benzene, Resonance structure and MO picture.

### **Unit-V**

**Aromaticity:** The Huckel rule, aromatic ions, Aromatic electrophilic substitution- general pattern of the mechanism, role of and  $\pi$ -complexes, mechanism of nitration, halogenation, sulphonation mercuration and Friedel-Crafts reaction.

## **Paper -III (BOC-103)**

### **Physical Chemistry**

#### **Unit I**

##### **Gases:**

Postulates of Kinetic theory of gases and gas laws, specific heat ratio  $C_p/C_v$ , deviation from ideal gas behaviour, Maxwell Law of Distribution of velocity (Qualitative treatment).

#### **Unit-II**

##### **The First Law of Thermodynamics:**

Thermodynamics terms and statement of the first law, thermodynamic reversibility and maximum work, enthalpy of a system, heat capacity at constant volume and at constant pressure. Extensive and intensive properties, state functions and exact differentials, cyclic rule, integration factor. Variation of internal energy with temperature and volume, enthalpy as a function of temperature and pressure. Relation between  $C_p$  and  $C_v$ .

#### **Unit III**

##### **Thermo chemistry:**

Heat of reaction and formation, solvation, dilution and hydration.

#### **Unit IV**

##### **Chemical Kinetics:**

Reaction rate, order and molecularity of reaction, zero, first, second and third order reactions. Methods for determining the order of reaction.

## **Unit V**

### **Electrochemistry:**

Electrolytic conductance: equivalent conductance, molar conductance, variation of conductance with concentration, Kohlrausch's law of independent migration of ions, conductance ratio, effect of other factors on conductance. Ionic mobilities, transport number, determination of transport number (Hittorf and moving boundary method).

## **Chemistry Practical (BOC-104)**

**Time : 6 Hours (one day) M.M.- 50 Marks**

1. Analysis of inorganic mixture (semi-micro) for five radicals including insoluble and interfering radicals. - **10 Marks**

2. Volumetric Analysis:

Determination of Iron using  $K_2Cr_2O_7$  - **07 Marks**

3. Detection of elements and functional groups in organic compounds. - **07 Marks**

4. Record and Viva-Voce.- **6+10 Marks**

5. Internal Assessment- **10 Marks**

### **Reference:**

## **SEM-II**

### **Paper -I (BOC-201)**

#### **Inorganic Chemistry**

##### **Unit -I**

##### **Chemical Bonding:**

Ionic, Covalent (polar and non-polar) Coordinate bond, Sigma and pi-bonds, odd electron bonds, hydrogen bond, Vander Walls Forces and metallic bond. Covalent character in ionic bonds, partial ionic character of covalent bond.

##### **Unit -II**

##### **Coordination Chemistry:**

Double salts and coordination compounds, Werner's theory, Chelates Sedgwick's concept of effective atomic number, IUPAC system of nomenclature of coordination compounds.

##### **Unit -III**

##### **Extraction of Elements:**

General principle of extraction and purification of metals. Occurrence and isolation of the elements. Extraction and isolation of Li, Be and Ra from their minerals.

##### **Unit -IV**

##### **Preparation, Properties and Uses of:**

(a) Heavy water, Lithium tetra hydro aluminate, Lithium separate, Basic beryllium acetate.

(b) Structure and Bonding of:  $H_2O_2$ , Basic beryllium acetate,  $Be(BH_4)_2$ ,  $Be(Me)_2$ , Anhydrous beryllium chloride, Polymeric Calcium compounds.

##### **Unit -V**



**Principle involved in Volumetric analysis:**

- (a) General principles of Volumetric analysis, Redox reactions, Equivalent weight, normality, molarity, and molality,  
(b) Solubility product, Common ion effect, Co-precipitation post-precipitation

**Paper -II (BOC-202)****Organic Chemistry****Unit-I**

**Mechanism of Organic Reactions:** Curves arrow rotation, drawing electron movements with arrows, half headed and double headed arrows, Homolytic and heterolytic bond fission. Types of reagents electrophiles and nucleophiles, Types of organic reactions.

**Reactive intermediates:** carbocations, carbanions, Free radicals, arynes, Carbenes and nitrenes (with examples)

**Unit -II****Stereochemistry of Organic Compound:**

Relative and absolute configuration, sequence rules. D & L and R & S system of Nomenclature.

**Geometrical isomerism :** Elementary idea of geometrical isomerism, determination of configuration of geometric isomers. E & Z system of Nomenclature geometric isomerism in oximes and alicyclic compounds. Difference between configuration and confirmation.

dehydration of alcohols and dehydrohalogenation of alkyl halides, The Saytzeff rule, Hofmann, elimination, chemical properties and relative stabilities of alkenes. Mechanism involved in by hydrogenation, Markownikoff's rule Industrial application of ethylene and propene.

Nomenclature and classification of dienes : Isolated, conjugated and cumulated dienes. Method of preparation, polymerization. Chemical reaction-1,2 and 1,4 addition, Diels-alder reaction.

**Unit-III**

**Alkynes :** Nomenclature, structure and bonding in alkynes. Method of formation, chemical properties and Acidity of Alkynes.

**Unit-IV****Alkyl and Arylhalides:**

Nomenclature and class of alkyl halides, Methods of formation, chemical reactions, mechanisms of nucleophilic substitution reaction of Alkyl halides SN1 and SN2 reaction with energy profile diagrams.

**Unit-V**

**Polyhalogen compound:** Chloroform and Carbon tetrachlorides. Method of formation of arylhalides, nuclear and side chain reaction. The addition-elimination and the elimination-addition mechanism of nucleophilic aromatic substitution reaction.

Reactive reactivities of alkyl halides Vs alkyl, Vinyl and aryl halides Synthesis and uses of DDT and BHC.

**Paper -III (BOC-203)**

## **Physical Chemistry**

### **Unit I**

#### **Gases:**

vander Waals equation of state, critical constants and their determination. Reference to some other equations of state e.g. Bertheot and Dieterici. Law of corresponding states.

### **Unit-II**

#### **The First Law of Thermodynamics:**

**Joule-Thomson effect:** Joule and Joule-Thomson effect, Joule- Thomson coefficient. Inversion temperature. Van der Waals equation and J-T effect.

Important thermodynamic quantities (W, Q, E and H) in an isothermal expansion of an ideal gas and adiabatic expansion of an ideal gas. Calculations of various thermodynamic quantities for Vander Waals gases undergoing various operations under different conditions.

### **Unit III**

#### **Thermo Chemistry:**

### **Unit IV**

Heat of Combustion and neutralisation. Hess's law and its application, Bond energy and resonance energy.

### **Unit IV**

#### **Chemical Kinetics:**

Complex reactions, opposing reactions, consecutive reactions and side reactions with reference to first order reactions. Effect of temperature on reaction velocity. Energy of activation and to experimental determination. collision theory of bi-molecular gaseous reactions

### **Unit -V**

#### **Electrochemistry:**

Qualitative treatment of the Debye -Huckel theory of strong electrolytes. Some applications of conductance measurements. Hydrolysis of salts. Bronsted and Lewis acids and bases. pH and pKa, acid-base concept in non-aqueous media, Buffer solutions. Theory of acid-base indicators.

Applications of Conductivity, measurements, determination of degree of dissociation, determination of Ka of acids. Determination of solubility Product of a sparingly soluble salt, conductometric titrations.

## **Chemistry Practical (BOC-204)**

### **Time : 6 Hours (one day) M.M.- 50 Marks**

1. Analysis of inorganic mixture (semi-micro) for five radicals including insoluble and interfering radicals. – **10 Marks**

2. Volumetric Analysis: - **07Marks**

Iodometry and Iodimetry (determination of Copper, dichromate and arsenious oxide)

3. Detection of elements and functional groups in organic compounds. – **07 Marks**

4. Record and Viva-Voce- **6+10 Marks**

5. Internal Assessment- **10 Marks**

### **Reference:**

## SEM-III

### Paper -I (BOC-301)

#### Inorganic Chemistry

##### Unit - I

##### **Chemical Bonding and Shapes of Molecules:**

Covalent bond, Hybridization of orbitals and directional nature of covalent bond, Sidgwick- Powell theory, VSEPR theory, Shapes of Molecules (inorganic):  $\text{BeCl}_2$ ,  $\text{BF}_3$ ,  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{OF}_2$ ,  $\text{Cl}_2\text{O}$ ,  $\text{ClO}_2$ ,  $\text{PCl}_3$ ,  $\text{SF}_4$ ,  $\text{ICl}_3$ ,  $\text{BrF}_5$ ,

##### Unit - II

##### **P-Block Elements:**

Chemical reactivity and group trend of elements, hydrides and halides (synthesis, properties and structure), Application of redox potential diagrams with reference to N, P, S, Cl, Br and I. Oxy acids of N, P, S and halogens, Interhalogens, Pseudohalogens and polyhalides.

##### Unit - III

##### **Extraction of elements:**

Extraction of isolation of the following elements B, Ge, Cr.

##### Unit - IV

##### **Inorganic Compounds-Preparation, Properties and uses of:**

Boric acid, Borides, Diborane, Ferric Alumina, Zirconia, Silanes, Ultraviolet Si and Ge.

##### **Inorganic Compounds- Structure and bonding of :**

Diborane, Borazine, Phosphazine, Dimeric aluminium chloride ( $\text{Al}_2\text{Cl}_6$ )

##### Unit - V

##### **Gravimetry :**

Principles of gravimetric analysis, Co precipitation, post precipitation and super saturation.

### Paper -II (BOC-302)

#### Organic Chemistry

##### Unit-I

##### **Electromagnetic Spectrum : Absorption Spectra -**

Ultraviolet (UV) absorption spectroscopy-absorption laws (Beer-Lambert Law); molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated dienes and enones.

##### Unit - II

**Alcohols-** Methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols.

Dihydric alcohols-Methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [ $\text{Pb}(\text{OAc})_4$  and  $(\text{HIO}_4)$ ] and pinacol- pinacolone rearrangement.

Trihydric alcohols-Methods of formation, chemical reactions of glycerol.

### **UNIT-III**

#### **Ethers and Epoxides :**

Ethers- Williamson's synthesis, Reaction with HX Synthesis of epoxides, Acid and base- catalyzed ring opening of epoxides, orientation of epoxide ring opening, reaction of Grignard and organolithium reagents with epoxides.

### **UNIT-IV**

#### **Carboxylic Acids :**

Acidity of carboxylic acids. Effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation.

Methods of formation and chemical reactions of halo acids and hydroxy acids.

### **UNIT-V**

#### **Organic Compounds of Nitrogen :**

Preparation of nitro alkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media.

Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Amine salts as phase-transfer catalysts.

## **Paper -III (BOC-303)**

### **Physical Chemistry**

#### **Unit - I**

##### **Thermodynamics**

**Second Law of thermodynamics:** need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

#### **Unit II**

##### **Chemical Equilibrium:**

Law of mass action and its application to homogeneous and heterogeneous equilibria, Le-Chatelier principle and its application to chemical equilibrium. Degree of dissociation and abnormal molecular weights.

#### **Unit III**

##### **Phase Equilibrium:**

**Statement and meaning of the terms-** Phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibrium of one component system-water, S system.

**Nernst distribution law-**Thermodynamic derivation of the distribution law and limitations.

#### **Unit IV**

##### **Electrochemistry**

**Types of reversible electrodes-** Gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst

equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes-standard electrode potential, sign conventions, electrochemical series and its significance.

**Corrosion**-types, theories and methods of combating it.

#### **Unit V**

**Colloids** : Preparation of colloids, theories of stability of colloids, Determination of size of colloidal particles, Electrokinetic potential (Zeta potential). Donnan membrane theory and its applications.

### **Chemistry Practical (BOC-304)**

**Time : 6 Hours (one day) M.M.- 50 Marks**

1. **Gravimetric Analysis: - 08 Marks**

i. Barium as  $\text{BaSO}_4$

ii. Iron as  $\text{Fe}_2\text{O}_3$

2. **Organic preparation (one step) and crystallization: - 08 Marks**

i. Acetylation

ii. Osazone formation

3. **Physical Chemistry experiments: - 08 Marks**

i. Experiments of surface tension (using stalagmometer)

ii. Partition coefficient determination.

4. **Records and Viva-Voce- 6+10 Marks**

5. Internal Assessment- **10 Marks**

**Reference:**

### **SEM-IV**

#### **Paper -I (BOC-401)**

##### **Inorganic Chemistry**

###### **Unit - I**

###### **Chemical Bonding and Shapes of Molecules :**

Valece shell electron pair repulsion (VSERR) theory, Shapes of Molecules (inorganic) :  $\text{PCl}_5$ ,  $\text{SF}_4$ ,  $\text{ClF}_3$ ,  $\text{IF}_7$ ,  $\text{XeF}_2$ ,  $\text{XeF}_4$ ,  $\text{ClO}_4^-$ ,  $\text{I}^{3-}$ , MO theory homonuclear and heteronuclear (CO and NO) diatomic molecules.

###### **Unit - II**

###### **d- Block Elements :**

Transition elements, General Characteristics, Variable oxidation states, Complex formation, colour, magnetic properties and catalytic properties. Comparative account of 3d, 4d and 5d transition metals with respect to their atomic and ionic sizes, stability of oxidation states and magnetic properties.

###### **Coordination Chemistry:**

Isomerism in coordination compounds, stereo chemistry of complexes involving coordination number 4 and 6.

###### **Unit III**

###### **Extraction of elements :**

Extraction of isolation of the following elements : F, Ni.

#### **Unit - IV**

##### **Inorganic Compounds-Preparation, Properties and uses of :**

Hydrozine, hydroxylamine, hydrozoic acid, hyponitrous acid, potassium hexacyano ferrate (i) and ferrite (iii) sodium hexanitrite cobaltate(iii)

##### **Inorganic Compounds- Structure and bending of :**

$\text{Al}(\text{BH}_4)_3$ , hyponitrous acid, Hydrazoic acid, Nickel carbonyl.

#### **Unit - V**

##### **Gravimetry :**

Principles of gravimetric analysis, Co precipitation, post precipitation and super saturation.

## **Paper -II (BOC-402)**

### **Organic Chemistry**

#### **Unit-I**

##### **Electromagnetic Spectrum : Absorption Spectra -**

Infrared (IR) absorption spectroscopy- molecular vibrations. Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum fingerprint region; characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

#### **Unit-II**

##### **Phenols:**

Preparation of phenols, acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitution, acylation and carbonylation. Mechanisms of Fries rearrangement" Claisen rearrangement, Gatterman Synthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

#### **UNIT-III**

##### **Aldehydes and Ketones:**

Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1, 3-dithianes, synthesis of ketones from nitriles and from carboxylic acid.

Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction.

Use of acetals as protecting group. Oxidation of aldehydes, Bayer-Villiger oxidation of ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner,  $\text{LiAlH}_4$ ; and  $\text{NaBH}_4$ , reductions.

Halogenation of enolizable ketones.

#### **UNIT-IV**

##### **Carboxylic Acid Derivatives:**

Relative stability of acyl derivatives. Interconversion of acid derivatives by nucleophilic acyl substitution.

Preparation of carboxylic acid derivatives, chemical reactions. Mechanism of esterification and hydrolysis (acidic and basic).

#### **UNIT-V**

#### **Organic Compounds of Nitrogen :**

Preparation of alkyl and aryl amines.

(reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds Gabriel-phthalimide reaction, Hofmann bromamide reaction.

Reaction of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

### **Paper -III (BOC-403)**

#### **Physical Chemistry**

##### **Unit - I**

##### **Thermodynamics**

**Second Law of thermodynamics:** need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

##### **Unit II**

##### **Chemical Equilibrium**

**Equilibrium constant and free energy** - Thermodynamic derivation of law of mass action.

**Reaction isotherm and reaction isochore-** Clausius-Clapeyron equation and Clapeyron equation and its applications.

##### **Unit III**

##### **Phase Equilibrium:**

Phase equilibrium of two component system- solid-liquid equilibrium, simple eutectic-Bi-Cd, Pb-Ag systems, desilverisation of lead.

**Nernst distribution law-** Applications of the nernst distribution law.

##### **Unit IV**

##### **Electrochemistry**

**Electrolytic and Galvanic cells** - Reversible and irreversible cells, conventional representation of electrochemical cells. e.m.f. of cell and its measurements. Computation of cell. e.m.f. of calculation of thermodynamic quantities of cell reactions ( $\Delta G$ ,  $\Delta H$  and  $\Delta K$ ) polarization, over potential and hydrogen over-voltage.

Definition of pH and pKa determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods.

**Buffers-**mechanism of buffer action, Henderson-Hazel equation; Hydrolysis of salts.

##### **Unit V**

**Surface Phenomenon :** Physical and chemical adsorption Freundlich adsorption isotherm, Gibb's adsorption isotherm, Langmuir's theory of monomolecular adsorption. B.E.T. theory.

### **Chemistry Practical (BOC-404)**

**Time : 6 Hours (one day) M.M.- 50 Marks**

1. Gravimetric Analysis:- **08 Marks**

i. Zinc as ZnO

ii. Copper as CuO

2. Organic preparation (one step) and crystallization:- **08 Marks**

i. Picrate formation

ii. Azo-dye formation

3. Physical Chemistry experiments:- **08 Marks**

i. Experiments on viscosity (using viscometer)

ii. Molecular weight determination of a volatile substance (by Victor Meyers method)

4. Records and Viva-Voce - **06+10Marks**

5. Internal Assessment- **10 Marks**

**Reference:**

## **SEM-V**

### **Paper -I (BOC-501)**

#### **Inorganic Chemistry**

##### **Unit - I**

##### **Theories of Covalent bond:**

Valence bond theory-Heitler-London and Pauling Slater theories and resonance, Molecular orbital theory-LCAO method, bonding, non-bonding and anti-bonding molecular orbitals, Molecular orbital energy level diagrams for homonuclear and heteronuclear di-atomic molecules, electronic structure, bond order, bond length, and bond energy.

##### **Unit - II**

##### **Metals and Metallurgy:**

Comparative study of the chemistry of d block elements and their important compounds. Metallurgical extraction of V and Re.

##### **Unit - III**

##### **4 f block elements:**

**Characteristics**-Electronic structure, lanthanide contraction its consequences, oxidation states, complex formation, magnetic properties, their differences from transition metals. Separation of lanthanides

##### **Unit - IV**

##### **Structures and Characteristics of Solids:**

Metallic, Ionic, and molecular crystals. structures of ionic solid-radius ratio rules.

##### **Unit - V**

**Environmental Pollution:** Water pollutions and green house effects.

##### **Bioinorganic chemistry :**

Essential and trace elements. Chemistry of chlorophyll, Haemoglobin, Myoglobin and Cyanocobalamin.

### **Paper -II (BOC-502)**

#### **Organic Chemistry**

##### **Unit I**



## 1. Spectroscopy -

Nuclear magnetic resonance (N. M. R.) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, area of signals.

### Unit- II

#### **Organometallic Compounds :**

**Organolithium compounds :** formation and chemical reactions.

#### **Organosulphur Compounds:**

Methods of formation and chemical reactions of thiols, thio-ethers, sulphonic acids, sulphonamides and sulphaguanidine.

### Unit III

#### **Heterocyclic compounds:**

**Introduction:** Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitutions. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

### Unit IV

**Carbohydrates** Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters, Determination of ring size of monosaccharides. Cyclic structure of D (+) - glucose, Mechanism of mutarotation.

Disaccharides-maltose, sucrose and lactose, structure determination.

### Unit V

#### **Amino Acids, Peptides and Proteins:**

Amino acids, acid-base behaviour, isoelectric point and electrophoresis, Preparation and reactions of  $\alpha$ -aminoacids. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Solid-phase peptide synthesis.

## Paper -III (BOC-503)

### Physical Chemistry

#### Unit -I

**Third Law of thermodynamics :** Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs functions (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

#### Unit -II

**Chemical Kinetics and Catalysis:** Steady state approximation Lindemann's theory of unimolecular reaction. Quantitative treatment of transition state theory of reaction rates. Primary salt effect in ionic reactions.

#### Unit -III

#### **Photochemistry:**

Absorption of light, Chain reaction, free radical chains (Rice-Heertzfeld mechanism for the decomposition of ethane). Lamberts and Beer's law, Grothaus-Draper law.

#### **Unit IV**

**E.M.F. :** Concentration cells with and without transference, liquid junction potential, fuel cells, chemical cells without transference.

#### **Unit -V**

**Nuclear Chemistry:** Radioactive decay and equilibrium, nuclear reactions, Q value, cross sections, type of reactions, Chemical effects of nuclear transformations. Natural and artificial radioactivity, theory of nuclear disintegration; disintegration and displacement laws; radioactive series.

### **Chemistry Practical (BOC-504)**

**Time : 6 Hours (one day) M.M.- 50 Marks**

#### **1. Inorganic: - 08 Marks**

- i. Paper chromatographic separation of metal ions (binary mixture only)
- ii. Colorimetric determination of metal ions.
- iii. Determination of hardness of water by EDTA.

#### **2. Organic: - 08 Marks**

- i. Determination of iodine value of a vegetable oil.
- ii. Determination of saponification value of vegetable oil.

#### **3. Physical - 08 Marks**

- i. Hydrolysis of methyl acetate catalyses by an acid.
- ii. Hydrolysis of Ethyle acetate.
- iii. Acetone iodine reaction Catalysed by  $H^+$

#### **4. Records and Viva-Voce 06+10 Marks**

#### **5. Internal Assessment- 10 Mark**

**Reference:**

## **SEM-VI**

### **Paper -I (BOC-601)**

#### **Inorganic Chemistry**

##### **Unit - I**

##### **Theories of coordination bond-**

Valence bond theory and its limitations, crystal field theory-d orbital splitting in octahedral and tetrahedral crystal fields , Ligand field splitting (  $10Dq$ ) and factors affecting its magnitude, spectrochemical series. Crystal field stabilization energies (CFSE) for  $d1$  to  $d10$  systems in octahedral and tetrahedral fields.

##### **Unit - II**

##### **Metals and Metallurgy:**

Application of reduction potential diagram. Metallurgical extraction of Ti, No and W.

##### **Unit - III**

##### **Silicones and Phosphazenes:**

Silicones and phosphazenes as example of inorganic polymers, nature of bonding in triphosphazenes.

#### **Unit - IV**

##### **Structures and Characteristics of Solids:**

Structure of metals-close-packed structures, characteristics of unit cells.

#### **Unit - V**

**Environmental Pollution:** Air pollutions and Acid rain.

##### **Bioinorganic Chemistry**

Biological role of alkali and alkaline earth metal ions. Nitrogen fixation.

## **Paper -II (BOC-602)**

### **Organic Chemistry**

#### **Unit I**

##### **Spectroscopy -**

Interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethyl acetate, toluene and acetophenone.

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

#### **Unit- II**

##### **Organometallic Compounds :**

**Organomagnesium compounds:** The Grignard reagents-formation, structure and chemical reactions.

**Organozinc compounds :** formation and chemical reactions.

#### **Unit III**

##### **Heterocyclic compounds:**

**Introduction:** Introduction to condensed five and six-membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napleralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

#### **Unit IV**

##### **Organic Synthesis via Enolates :**

Acidity of hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate : the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3-dithianes, Alkylation and acylation of enamines.

#### **Unit V**

##### **Synthetic Polymers :**

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers.

Condensation or step growth polymerization. Polyesters, Polyamides. Phenol formaldehyde resins, urea-formaldehyde resins and polyurethanes.

Natural and synthetic rubbers.

## **Paper -III (BOC-603)**

### **Physical Chemistry**

#### **Unit -I**

1. **Third Law of thermodynamics** : Thermodynamics derivation of the law of mass action, reaction isotherm and Van't Hoff equation (influence of temperature on equilibrium constant). Thermodynamics derivation of phase rule. Partial molar quantities. Chemical potential, Gibbs-Duhem equation, Chemical potential and other thermodynamic functions. Effect of temperature on chemical potential. Effect of pressure on chemical potential. Chemical potential of real gases and fugacity of real gases. Colligative properties (thermodynamic treatment): Lowering of vapour pressure, osmotic pressure, elevation of boiling point and depression of freezing point.

#### **Unit -II**

**Chemical Kinetics and Catalysis:** Kinetics of homogeneous, acid-base and enzyme catalysis, heterogeneous catalysis, negative catalysis and inhibition. Effect of pH and temperature on enzyme catalysis. Effect of temperature on surface reaction. Promoters and poisons.

#### **Unit -III**

##### **Photochemistry:**

Einstein's law of photochemical equivalence, quantum efficiency, reasons for low and high quantum yields. Kinetics of some typical photochemical reactions (Decomposition of acetaldehyde, dimerisation of anthracene). Photo electric cell. Photosensitization.

#### **Unit IV**

**Atomic structure:** Bohr's theory, Sommerfield's model, dual nature of electron, de-Broglie's equation. Experimental verification of the wave nature of electron (Davisson and Germer's experiment). Heisenberg's uncertainty principle. Derivation of Schrodinger's wave equation, Applications of Schrodinger's wave equation, two particle in a one dimensional and three dimensional box and physical significance of the wave function.

#### **Unit -V**

**Nuclear Chemistry:** Nuclear bindings energy ; nuclear reaction; fission and fusion products and fission yields, radioactive isotopes and their uses. Radioactive techniques; tracer technique, neutron activation analysis, counting technique such as G.M. ionization and preoperational counter.

## **Chemistry Practical (BOC-604)**

**Time : 6 Hours (one day) M.M.- 50 Marks**

### **1. Inorganic: - 08 Marks**

- i. Solvent extraction separation and estimation of Mg (ii) and Fe(ii)
- ii. Ion exchange Method- Separation and estimation of Mg (ii) and Zn(ii)
- iii. EDTA titrations of  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Zn}^{2+}$  and  $\text{Cu}^{+2}$

### **2. Organic: - 08 Marks**

- i Paper chromatographic separation of amino acids and sugars (only binary mixtures)
- ii. Determination of acid value of a vegetable oil.

### **3. Physical - 08 Marks**

- i. Heat of neutralization of NaOH an HCl
- ii. Molecular weight determination of a volatile substance by Duma's method

iii. To study the effects of acid strength on the hydrolysis of an ester. Acid strength on the hydrolysis of an ester.

4. **Records and Viva-Voce- 06+ 10 Marks**

5. Internal Assessment- **10 Marks**

**Reference:**