B.Sc. with Chemistry (First and Second Semester)

1. There shall be six Semesters in all with two Semesters in one Year in B.Sc. with Chemistry, a 3-year UG Programme. A Semester comprise of One Theory Course divided into three independent units and One Practical Course each with a specific Course Code Number, Course Title and a total of 06 Credits (04 Theory + 02 Practicals). Each Theory Course is of 60 Periods of one hour each and assigned 04 credits. Each Practical Course is of 30 periods of two hours each and assigned 02 credits.
   Degree of the three year UG Programme will be awarded to candidates who satisfy the minimum credit requirement as per university policy.

2. The maximum marks for each Semester Examination will be 150 [Theory -100 marks (70 external assessment and 30 internal assessment) + Practicals - 50 marks]. Theory Examination at the End of each Semester will be of three hours duration and of 70 marks and Practical Examination will be of four hours duration and of 50 marks. There shall ber Internal Assessment of 30 marks in each Theory Course on continuous assessment basis at the Department/ College level and External Assessment of 70 marks in the End of each Semester at the University level. The candidate will have to pass both in Internal Assessment and External Assessment separately in each Theory Course. In Practical course there is External Assessment only in the end of Each Semester. It will be necessary for a candidate to pass in theory and practical examination separately. Criteria for pass percentage and grade system to be followed will be as per university policy.
3. Internal Assessment of 30 marks is distributed as follows:

One Written Test	20 marks
One Assignment including creative skill	05 marks
Attendance	05 marks (for 75% attendance - 3 marks; upto 90% attendance -04 marks and from 91 to 100% attendance - 05 marks)

Each theory course is assigned three periods of one hour each of teaching per week and each Practical Course is assigned two continuous periods of one hour each. The scheme of Examination of Practical Examination of 50 marks is given at the end of the Practical Course.

Scheme of examination for end of semester examination applicable to all undergraduate courses (Pass Course) for Theory Examination of 70 marks is as follows:

The question paper of semester Examination for the Disciplinary Centric Core Course (DCCC), Discipline specific elective (DSE), Ability Enhancement Course (AEC), Value Added Course (VAC) and Skill Enhancement Course (SEC) will be of 70 marks and it will be divided in two parts i.e. Part A and Part-B.

Part-A will consist of 10 compulsory questions. There will be at least three questions from each unit and answer to each question shall be limited upto 50 words. Each question will carry two marks. **Total 20 Marks.**

Part-B will consist of 10 questions. At least three questions from each unit be set and student will have to answer five questions, selecting at least one question from each unit. The answer to each question shall be limited to 400 words. Each question carries10 Marks. **Total 50 Marks.**

Semester I

CHEMISTRY-CHE 5.5 01T-CO: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & HYDROCARBONS

(Credits: Theory-04; Practicals - 02) Theory:60 Lectures

Course Objectives: This course aims at giving students theoretical understanding about the basic constituents of matter – atoms, ions and molecules in terms of their electronic structure and reactivity. Structure and bonding in/of these are to be dealt with basic quantum chemistry treatment. Reactivity of chemical species based on their electron transfer affinity is introduced. Understand the concepts of Organic reactions and techniques of writing the movement of electrons, bond breaking, bond forming 6. Learn the Concept of aromaticity, resonance, hyper conjugation, etc. Understanding the mechanism of nucleophilic, electrophilic reaction Understand the preparation of alkanes, alkenes and alkynes, their reactions, etc. Accompanying laboratory course is designed for students to have hands-on experience of basic quantitative analytical techniques related to volumetric titrations.

Learning Outcome: On successful completion, students would have clear understanding of the concepts related to atomic and molecular structure, chemical bonding, aliphatic and aromatic hydrocarbons. Students will also have hands-on experience of calibration of glasswares, qualitative analysis of inorganic ions, standard solution preparation in different concentration units and learn volumetric estimation through acid-base.

UNIT-I

Atomic Structure: Review of Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2. Significance of quantum numbers, radial and angular wave functions and probability distribution curves. Shapes of s, p and d atomic orbitals, nodal planes. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Electronic configuration of the elements (s-block, p-block, and first series of d-block elements). Stability of half-filled and completely filled orbitals. Effective nuclear charge. (12 Lectures)

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches. (8 Lectures)

UNIT-II

Fundamentals of Organic Chemistry: Classification of Organic Compounds and Nomenclature, Hybridization, Shapes of molecules; Influence of hybridization on bond properties. Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Structure, shape and reactivity of organic molecules; Homolytic and

Heterolytic fission with suitable examples; Curved arrow notations; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and their relative stability of reactive intermediates: Carbocations, Carbanions, Free radicals, and Carbenes; Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values; Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions; Methods for determination of organic reaction mechanisms; Calculation of Formal charges on intermediate and other ionic species (12 Lectures)

Stereochemistry of Organic Compounds: Concept of isomerism, types of isomerism, Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomers and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). Resolution of enantiomers, inversion, retention and racemization. (8 Lectures)

UNIT-III

Hydrocarbons: Alkanes (Upto 5 Carbons)- Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent Reactions: Free radical Substitution: Halogenation. **Alkenes (Upto 5 Carbons)-** Preparation: Elimination reactions, Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule), cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction); Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markovnikov's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation. **Alkynes (Upto 5 Carbons)-** Preparation: Acetylene from CaC_2 and conversion into higher alkynes, by dehalogenation of tetrahalides and dehydrohalogenation of vicinal-dihalides Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$. (12 Lectures)

Aromatic Compounds: Nomenclature of benzene derivatives, Aryl group, Aromatic nucleus and side chain, Structure of Benzene: Molecular Formula and Kekule Structure, stability and carbon-carbon bond length of Benzene, Molecular orbital structure of Benzene. Aromaticity-Hückel's rule, aromatic character of arenes, cyclic carbocations, carbanions and heterocyclic compounds with suitable examples. (8 Lectures)

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd edWiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014). McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
6. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education,2000. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.

7. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

CHEMISTRY LAB- CHE 5.5 01 P-CO: QUALITATIVE INORGANIC ANALYSIS, ELEMENTAL ANALYSIS OF ORGANIC COMPOUNDS, LABORATORY TECHNIQUES

(Credits: Practicals-02) **30 Periods of two hours each**

A. Major Exercise **(15 marks)**

1.Qualitative inorganic analysis Analysis of simple salt containing two anions and two cations from the following Anions: Carbonate, sulfate, chloride, bromide, acetate, nitrate, borate, phosphate. cations: Lead, copper, iron, aluminum, zinc, manganese, nickel, calcium, strontium, barium, potassium and ammonium (including interfering radicals).

B. Minor Exercise **(10 marks)**

1.Determination of Melting point of given Organic compound.

2.Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)

C. Minor Exercise **(10 marks)**

1. Calibration of pipette, burette, and thermometer.

2. Purification of organic compounds by crystallization.

Reference Books:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

Scheme of Practical Examination & Distribution of marks

Max. Marks: 50 **Time: 4 hours.**

1. Major Exercise (one) - 15 marks
2. Minor Exercise (B) - 10 marks
3. Minor Exercise (C) - 10 marks
4. Record - 5 marks
5. Viva-voce - 10 marks

Semester II

CHEMISTRY-CHE 5.5 02T-CE: CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY

(Credits: Theory-04, Practicals-02) **Theory: 60 Lectures**

Course Objectives: The objective of this paper is to develop basic understanding of the chemical energetics, laws of thermodynamics, chemical and ionic equilibrium. It provides basic understanding of the behaviour of electrolytes and their solutions. It acquaints the students with the functional group approach to study organic chemistry. To establish applications of this concept structure, methods of preparation and reactions for the following classes of compounds: Aromatic hydrocarbons, alkyl and aryl halides, alcohols, phenols and ethers, aldehydes and ketones are described. This course helps the students to relate the structure of an organic compound to its physical and chemical properties.

Learning Outcome: By the end of this course, students will be able to: Understand the laws of thermodynamics, thermochemistry and equilibria. Understand the concept of pH and its effect on the various physical and chemical properties of the compounds. Use the concepts learnt to predict feasibility of chemical reactions and to study the behaviour of reactions in equilibrium. Understand the fundamentals of functional group chemistry through the study of methods of preparation, properties and chemical reactions with underlying mechanisms. Use concepts learnt to understand stereochemistry of a reaction and predict the reaction outcome. Design newer synthetic routes for various organic compounds. Accompanying laboratory course is designed for students to have hands-on experience of basic quantitative analytical techniques related to volumetric titrations.

UNIT-I

Chemical Energetics: Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. (8 Lectures)

Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gasses.

Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. (12 Lectures)

UNIT-II

Aromatic hydrocarbons: Industrial preparation of benzene from coal tar, Preparation of benzene from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions of benzene: Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Crafts reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain

oxidation of alkyl benzenes (upto 4 carbons on benzene) with their mechanism; Energy profile diagram; Activating and deactivating substituents; Orientation and ortho/para ratio (8 Lectures)

Alkyl and Aryl Halides: Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN^1, SN^2 and SN^i) reactions. Preparation: from alkenes and alcohols; Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution. **Aryl Halides** Preparation: (Chloro, bromo and iodo-benzene): from phenol, Sandmeyer & Gattermann reactions; Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$); Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides. (12 Lectures)

UNIT-III

Alcohols, Phenols and Ethers (Upto 5 Carbons) & Carbonyl compounds: Alcohols- Preparation: Preparation of 1°, 2° and 3° alcohols using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters; Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppenauer oxidation. **Diols: (Upto 6 Carbons)** oxidation of diols, Pinacol-Pinacolone rearrangement. (8 Lectures)

Phenols: Preparation- Cumene hydroperoxide method, from diazonium salts; Reactions: Electrophilic substitution, Nitration, halogenation and sulphonation. Reimer Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction. **Ethers (aliphatic and aromatic):** Preparation, Cleavage and autooxidation.
Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde) Preparation- from acid chlorides and from nitriles; Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives; Iodoform test, Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction, Meerwein-Pondorff Verley reduction. (12 Lectures)

Reference Books:

1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007). Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
2. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
3. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
4. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985). Learning India Pvt. Ltd., New Delhi (2009). Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998). Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
6. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
7. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988). Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
8. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
9. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

CHEMISTRY LAB- CHE 5.5 02 P-CE : CHEMICAL ENERGETICS, EQUILIBRIA&FUNCTIONALORGANICCHEMISTRY

(Credits: Practicals-02) **30 Periods of two hours each**

A. Major Exercise (15 marks)

1. To determine the percentage composition of a given mixture (non interacting systems) by viscosity method.
2. To determine the percentage composition of a given binary mixture by surface tension method.
3. To determine specific reaction rate of hydrolysis of methyl acetate/ethyl acetate catalysed by hydrogen ion at room temperature.

B. Minor Exercise (10 marks)

1. To study the distribution of Iodine between water and carbon tetrachloride.
2. To study the distribution of Benzoic acid between benzene and water

C. Minor Exercise (10 marks)

1. Determination of mixed melting point of urea and cinnamic acid in various compositions (1:4, 1:1,4:1)

2.Sublimation of Naphthalene, Camphor, Phathalic acid and Succinic acid

Reference Books:

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011)

Scheme of Practical Examination & Distribution of marks

Max. Marks: 50 **Time: 4 hours.**

1.One Major Exercise (A)	**-**	**15 marks**
2.One Minor Exercise (B)	**-**	**10 marks**
3.One Minor Exercise (C)	**-**	**10 marks**
4.Record	**-**	**5 marks**
5.Viva-voce	**-**	**10 marks**

11.8.2025 F

MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER

SYLLABUS

पाठ्यक्रम

SCHEME OF EXAMINATION AND COURSES OF STUDY
FACULTY OF SCIENCE
FOUR YEAR B.Sc. HONS. (CHEMISTRY)
B.Sc. HONS. CHEMISTRY SEMESTER I & II Examination
(w.e.f. 2024-25)
B.Sc. HONS. CHEMISTRY SEMESTER III & IV Examination
(w.e.f. 2025-26)
B.Sc. HONS. CHEMISTRY SEMESTER V & VI Examination
(w.e.f. 2026-27)
B.Sc. HONS. CHEMISTRY SEMESTER VII & VIII Examination
(w.e.f. 2027-28)

2025

महर्षि दयानंद सरस्वती विश्विद्यालय अजमेर

MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER

30/7/2025

(Dr. Saurabh Singh)

(Dr. RK Gunsaria)

(Dr. Ashok K. Kalla)

(MANOJ KUMAR BATRA)

[DR. KAILASH CHAND SILOLIA]

Four Years B.Sc. Hons. Chemistry

Semester Scheme of Examination as per NEP 2020

1. There shall be Eight Semesters in all with two Semesters in one Year in B.Sc. Hons. Chemistry. Each Semester comprises of One Theory Course divided into three independent units and One Practical Course with a specific Course Code Number, Course Title, Total of 06 Credits (04 Theory + 02 Practicals). Each Theory Course is of 60 hours and assigned 04 credits. Each Practical Course is of 30 hours and assigned 02 credits.In Semester III and Semester IV there will one SEC each of 30 hours and 2 credits (maximum 50 marks) in Sem V and Sem VI there will be one SEC of 45 hours each of 3 credits (maximum 75 marks).

   Students of 4 year UG programme in Chemistry (Hons.) will be awarded B.Sc. Hons. Degree in Chemistry after successful completion of four years, securing 160 credits and satisfying the credit requirement as per university policy.

2. The maximum marks for each Semester Examination will be 150 - 6 credits (Theory 100 marks + 50 Practicals) and 30 marks for Internal Assessment. Theory Examination at the End of each Semester will be of three hours duration and of 100 marks and Practical Examination will be of four hours duration and of 50 marks. There shall be 30% Internal Assessment in each Theory Course on continuous assessment basis at the Department/College level in addition to 70% External Assessment in the End of each Semester at the University level. The candidate will have to pass both in Internal Assessment and End of Semester Exams (EOSE) separately in each Theory Course. In practical course there is External Assessment only at the end of Each Semester. It will be necessary for a candidate to pass in theory and practical examination also separately. Criteria for pass percentage and grade system to be followed will be as per university policy.
3. Internal Assessment of 30% marks is distributed as follows:

One Written Test	20 marks
One Assignment including creative skill	05 marks
Attendance	05marks(upto 75%-3marks: Upto 90%-04 marks and Upto 100%-05 marks)

4. Each theory course is assigned two periods of one hour each of teaching per week and SEC is assigned one period of one hour and each Practical Course is assigned two continuous periods of one hour each.

5. Each Theory Course is divided into three independent units. The Question Paper will be divided into two parts – Part A and Part B.
   Part A (of 20 marks) is compulsory and contain 10 (ten) Questions each to be answered in 50 marks and to be answered in 50 words.

Part B (of 50 marks) is compulsory and contain 05 (five) questions with internal choice with minimum one question from each unit. Each question is to be answered in 400 words.

6. The maximum marks of 50 of Practical Examination are distributed as follows:

One Major Exercise	=15 (fifteen) marks
Two Minor Exercise	=02x10=20 marks
Viva-Voce	=10 (ten) marks
Record	=05 (five) marks

FOUR YEAR B.SC. HONS CHEMISTRY

SEMESTER –I

S.NO.	TYPE OF COURSE	COURSE CODE	TITLE OF THE COURSE	CREDITS	MAXIMUM MARKS		
					INTERNAL ASSESSMENT	EXTERNAL ASSESSMENT	TOTAL
1.	DSC	CHE 8.0 01T CO	GENERAL CHEMISTRY-I	04	30	70	100
2.	DSC	CHE 8.0 01P CO	PRACTICALS OF GENERAL CHEMISTRY	02	-	50	50

SEMESTER –II

S.NO.	TYPE OF COURSE	COURSE CODE	TITLE OF THE COURSE	CREDITS	MAXIMUM MARKS		
					INTERNAL ASSESSMENT	EXTERNAL ASSESSMENT	TOTAL
1.	DSC	CHE 8.0 02T CO	GENERAL CHEMISTRY-II	04	30	70	100
2.	DSC	CHE 8.0 02P CO	PRACTICALS OF GENERAL CHEMISTRY	02	-	50	50

SEMESTER –III

S.NO.	TYPE OF COURSE	COURSE CODE	TITLE OF THE COURSE	CREDITS	MAXIMUM MARKS		
					INTERNAL ASSESSMENT	EXTERNAL ASSESSMENT	TOTAL
1.	DSC	CHE 8.0 03T1 CO	GENERAL CHEMISTRY-III	04	30	70	100
2.	DSC	CHE 8.0 03P1 CO	PRACTICALS OF GENERAL CHEMISTRY-III	02	-	50	50
3.	DSC	CHE 8.0 03T2 CO	GENERAL CHEMISTRY-IV	04	30	70	100
4.	DSC	CHE 8.0 03P2 CO	PRACTICALS OF GENERAL CHEMISTRY-IV	02	-	50	50
5.	SEC	CHE 8.0 03T SEC CO	SOIL & WATER ANALYSIS	02	15	35	50

SEMESTER –IV

S.NO.	TYPE OF COURSE	COURSE CODE	TITLE OF THE COURSE	CREDITS	MAXIMUM MARKS		
					INTERNAL ASSESSMENT	EXTERNAL ASSESSMENT	TOTAL
1.	DSC	CHE 8.0 04T1 CO	GENERAL CHEMISTRY-V	04	30	70	100
2.	DSC	CHE 8.0 04P1 CO	PRACTICALS OF GENERAL CHEMISTRY-V	02	-	50	50
2.	DSC	CHE 8.0 04T2 CO	GENERAL CHEMISTRY-VI	04	30	70	100
4.	DSC	CHE 8.0 04P2 CO	PRACTICALS OF GENERAL CHEMISTRY-VI	02	-	50	50
5.	SEC	CHE 8.0 04T SEC CO	FOOD ANALYSIS	02	15	35	50

SEMESTER –V

S.NO.	TYPE OF COURSE	COURSE CODE	TITLE OF THE COURSE	CREDITS	MAXIMUM MARKS		
					INTERNAL ASSESSMENT	EXTERNAL ASSESSMENT	TOTAL
1.	DSC	CHE 8.0 05T CO	GENERAL CHEMISTRY-VII	04	30	70	100
2.	DSC	CHE 8.0 05P CO	PRACTICALS OF GENERAL CHEMISTRY-VII	02	-	50	50
3.	DSE	CHE 8.0 05T E(A)	BIO INORGANIC CHEMISTRY	04	30	70	100
4.	DSE	CHE 8.0 05P E(A)	PRACTICALS OF BIO INORGANIC CHEMISTRY	02	-	50	50
5.	DSE	CHE 8.0 05T E(B)	PHYSICAL ORGANIC CHEMISTRY	04	30	70	100
6.	DSE	CHE 8.0 05P E(B)	PRACTICALS OF PHYSICAL ORGANIC CHEMISTRY	02	-	50	50
7.	SEC	CHE 8.0 05T SEC CO	RESEARCH METHODOLOGY	03	22	53	75

SEMESTER –VI

S.NO.	TYPE OF COURSE	COURSE CODE	TITLE OF THE COURSE	CREDITS	MAXIMUM MARKS		
					INTERNAL ASSESSMENT	EXTERNAL ASSESSMENT	TOTAL
1.	DSC	CHE 8.0 06T CO	GENERAL CHEMISTRY-VIII	04	30	70	100
2.	DSC	CHE 8.0 06P CO	PRACTICALS OF GENERAL CHEMISTRY-VIII	02	-	50	50
3.	DSE	CHE 8.0 06T E(A)	ADVANCE PHYSICAL CHEMISTRY	04	30	70	100
4.	DSE	CHE 8.0 06P E(A)	PRACTICALS OF ADVANCE PHYSICAL CHEMISTRY	02	-	50	50
5.	DSE	CHE 8.0 06T E(B)	ANALYTICAL METHODS IN CHEMISTRY	04	30	70	100
6.	DSE	CHE 8.0 06P E(B)	PRACTICALS OF ANALYTICAL METHOD IN CHEMISTRY	02	-	50	50
7.	SEC	CHE 8.0 06 T SEC CO	FOOD ADULTERATION AND WASTE WATER TREATMENT	03	22	53	75

SEMESTER –VII

S.NO.	TYPE OF COURSE	COURSE CODE	TITLE OF THE COURSE	CREDITS	MAXIMUM MARKS		
					INTERNAL ASSESSMENT	EXTERNAL ASSESSMENT	TOTAL
1.	DSC	CHE 8.0 07T1 CO	GENERAL CHEMISTRY-IX	04	30	70	100
2.	DSC	CHE 8.0 07P1 CO	PRACTICALS OF GENERAL CHEMISTRY-IX	02	-	50	50
3.	DSC	CHE 8.0 07T2 CO	GENERAL CHEMISTRY-X	04	30	70	100
4.	DSC	CHE 8.0 07P2 CO	PRACTICALS OF GENERAL CHEMISTRY-X	02	-	50	50
5.	DSE	CHE 8.0 07T E(A)	POLYMER CHEMISTRY	04	30	70	100
6.	DSE	CHE 8.0 07T E(B)	INDUSTRIAL CHEMISTRY	04	30	70	100

7.	DSE	CHE 8.0 07T E(C)	INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS	04	30	70	100
8.	DSE	CHE 8.0 07T E(D)	INORGANIC MATERIAL OF INDUSTRIAL IMPORTANCE	04	30	70	100

SEMESTER –VIII

S.NO.	TYPE OF COURSE	COURSE CODE	TITLE OF THE COURSE	CREDITS	MAXIMUM MARKS		
					INTERNAL ASSESSMENT	EXTERNAL ASSESSMENT	TOTAL
1.	DSE	CHE 8.0 08T E(A)	PHARMA CHEMISTRY	04	30	70	100
2.	DSE	CHE 8.0 08T E(B)	SPECTROSCOPY	04	30	70	100
3.	DSE	CHE 8.0 08T E(C)	RESEARCH METHODOLOGY FOR CHEMISTRY	04	30	70	100
4.	DSE	CHE 8.0 08T E(D)	RESEARCH DESIGN & IPR	04	30	70	100
5.	DSE	CHE 8.0 08T CO	SUPRA MOLECULAR CHEMISTRY	04	30	70	100
6.	DSE	CHE 8.0 08T CO	IMP. BIOMOLECULER	04	30	70	100
7.	DSE	CHE 8.0 08T3 CO	SPECTROSCOPY & STRUCTURE DETERMINATION OF ORGANIC COMPOUNDS	04	30	70	100

SEMESTER-III

B.Sc. (Hons.) CHEMISTRYSEM-III

COURSE TITLE: GENERAL CHEMISTRY-III

COURSE CODE: CHE 8.0 03T1 CO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks:30** **End of Semester Exam: Max marks:70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions:

Part-Awillconsistof10 compulsory questions.The answer to each question should be limited to a maximum of 50 words. Each question in Part A will carry two marks. **20 Marks**

Part B will consist of 10 questions, at least three questions from each unit. Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part B will carry ten marks. ***50Marks***

Course Objective-The course aims to teach students about periodic properties, s-block elements, p-block elements, and boron hydrides, as well as the chemistry of elements in the First, Second, and Third Transition Series. It covers UV and IR spectroscopy techniques for organic compound study, and covers thermodynamics, entropy, free energy, heat capacity, Joule's law, and thermodynamic laws.

Learning Outcome-After the completion of the course, the students will be able to:understand alkanes and cycloalkanes, Baeyer's strain theory, key periodic properties, s-block elements, p-block elements, and boron hydrides. It also explores the limitations and application of these theories in ring stability, atomic and ionic size, ionization enthalpy, and reactivity.To understand various chemical elements and their compounds, including borazine, fullerenes, carbides, fluorocarbons, silicates, interhalogen compounds, polyhalide ions, d-block elements, thermodynamics, energy change in heat capacities, Joule's law, and the derivation of $\Delta G=\Delta H -T\Delta S$.

Unit – I

Periodic Properties: Atomic and ionic radii, ionization energy, electron affinity and electronegativity-definition, methods of determination or evaluation, trends in the periodic table, and application in explaining the chemical behaviour.

S-Block Elements: Comparative study, diagonal relationship, salient features of Hydrides, solvation and complexation tendencies, including their function in biosystems.

P-Block Elements: Comparative study (including diagonal relationship) of group elements compounds like hydrides, oxides, oxyacids, and halides of group 13-17.

Hydrides of Boron-diborane and higher boranes, borazine, borazoles, fullerenes, carbides, fluorocarbons, silicates, tetra sulphur tetra nitride, basic properties of halogens, interhalogens and polyhalides.

Chemistry of Elements of First Transition Series :

Characteristic properties of d-block elements.

Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states,coordination number and geometry.

Chemistry of Elements of Second and Third Transition Series :

General characteristics comparative treatment with their 3D-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties, and stereochemistry.

(20 Lectures)

Unit – II

Alkanes and Cycloalkanes: IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes, Isomerism in alkanes, sources, methods of formation (with special reference of Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes. Mechanism of free–radical halogenation of alkanes: orientation, reactivity and selectivity. Cycloalkanes- nomenclature, methods of formation, chemical reactions. Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), Theory of strainless rings. The case of cyclopropane ring-banana bonds.

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

Infrared (IR) spectroscopy – Molecular vibrations. Hook's law, selection rules, intensity and position of IR bands, measurement IR spectrum, fingerprint region, characteristics absorption of various functional groups and interpretation of IR spectra of organic compounds.

(20 Lectures)

Unit – III

Thermodynamics – I

Definition of thermodynamic terms: system, surroundings etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

First Law of Thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure, and their relationship. Joule's law – Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU&dH for the expansion of ideal gases under isothermal and adiabatic conditions for a reversible process.

Thermodynamics – II

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

Concept of entropy : entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Thermodynamics – III

Third law of thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz function; Gibbs function (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.

(20 Lectures)

Reference Books:

1. Cotton & Wilkinson – Advanced Inorganic Chemistry, John Wiley & Sons, New Jersey, **USA**
2. Shriver & Atkins – Inorganic Chemistry,Oxford University Press, Oxford, **UK**
3. Greenwood, N.N., & Earnshaw, A. (1984). Chemistry of the elements.,Pergamon Press,Oxford, **UK**
4. Huheey, Keiter & Keiter – *Inorganic Chemistry: Principles of Structure and Reactivity,Pearson Education, Boston, Massachusetts, **USA***
5. Gurtu&Gurtu; Advance Physical Chemistry Experiments, Pragati Prakashan, Meerut
6. P.S. Kalsi – "Spectroscopy of Organic Compounds", New Age International Publishers,New Delhi, **India**
7. Y.R. Sharma – "Elementary Organic Spectroscopy",S. Chand & Company Ltd.,New Delhi, **India**
8. C.N. Banwell & Elaine McCash – "Fundamentals of Molecular Spectroscopy",McGraw Hill Education,New York, **USA**
9. Donald L. Pavia, Gary M. Lampman & George S. Kriz – "Introduction to Spectroscopy"
10. "Organic Spectroscopy" – William Kemp,Palgrave Macmillan,London, **UK**
11. L.G. Wade – "Organic Chemistry",Pearson Education,Boston, Massachusetts, **USA**

B.Sc. (Hons.) CHEMISTRY SEM-III

COURSE TITLE: PRACTICALS OF GENERAL CHEMISTRY-III
COURSE CODE: CHE 8.0 03 P1 CO

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**Total lecture-30** **(Two hours each)**

Course Objective-This program aims to equip students with practical experience in experimental physical chemistry, develop laboratory skills in chemical solutions preparation and handling, and evaluate oil and water samples quality.

Learning Outcome-After completing this course, students will be able to: understand transition temperature of hydrated salts, examining how solutes influence the critical solution temperature of partially miscible liquids, and calculating the heat of neutralization for robust and weak acid-base reactions. Understand the enthalpy of solution for calcium chloride using the Born–Haber cycle, establishing the rate constant for acid-catalyzed hydrolysis, creating primary standard solutions, and appreciating their significance in volumetric analysis.

I. Major Exercise – Quantitative analysis **- 15 Marks**

1. To determine the transition temperature of the given substance (e.g. $MnCl_2 \cdot 4H_2O$, $SrBr_2 \cdot 2H_2O$)
2. To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.
3. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
4. To determine the enthalpy of neutralisation of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.
5. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle.
6. To determine the rate constant for hydrolysis inversion of sugar using a polarimeter.

II. Minor Exercise **- 10 Marks**

1. Preparation of Primary Standard solution
   Oxalic Acid, Copper Sulphate and Magnesium Chloride.
2. Preparation of Secondary standard solution
   Sodium Hydroxide and Sodium Thiosulphate

3. Preparation of Standard Solution of liquids
HCl, NH_3, CH_3COOH, $CH_3COOC_2H_5$, H_2SO_4

III. **Minor Exercise** **- 10 Marks**

Quantitative analysis

1. To determine of iodine value of oil sample
2. To determine of saponification Value oil sample
3. To determine of Chemical Oxygen Demand of water sample
4. To determine of Dissolved Oxygen sample

- 10 Marks

IV. **Viva-Voce** **- 05 Marks**

V. **Record**

Reference Books: -

1. P.C. Kamboj; University Practical Chemistry,Vishal Publishing Co., Punjab
2. Dr.Gurumeet C Wadhawa, Dr.Vitthal S. Shivankar, Dr.Supriya P. Babar, Dr.MarayappaSonawale; Chemistry Practical for Undergraduate and Postgraduate Students, IIP, Karnatak
3. K.N. Rastogi; Chemistry Practicals, ABD Publishers, Jaipur (Rajasthan)
4. J N Gurtu and R Kapoor; Advanced Experimental Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
5. Prof. B. C. Joshi, Dr. V. K. Goyal, and Dr R. L. Pitaliya; Practical Chemistry, CBH, Jaipur
6. Jagdamba Singh, R.K.P. Singh, Jaya Singh etc.; Advance Practical Chemistry, Pragati Prakashan, Meerut
7. Gurtu&Gurtu; Advance Physical Chemistry Experiments, Pragati Prakashan, Meerut
8. N. K. Vishnoi; Advancede Practical Organic Chemistry, Vikas Publishing House Pvt Ltd., New Delhi
9. S.S. Dara; Text Book on Experiments and Calculations- Engineering Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
10. Anil Kumar et.al.; Practical Chemistry (B.Sc.-I, II and III), Shree Publishers & Distributer, Delhi

B.Sc. (Hons.) CHEMISTRY SEM-III

COURSE TITLE: PAPER-II (GENERAL CHEMISTRY-IV)

COURSE CODE: CHE 8.0 03T2 CO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks: 30** **End of Semester Exam : Max marks: 70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part A will consist of 10 compulsory questions.The answer to each question should be limited to a maximum of 50 words. Each question in Part A will carry two marks. **20Marks**

Part B willconsistof10questions, at least three questions from each unit.Students must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part B will carry ten marks. ***50Marks***

Course Objectives-To study about acids and bases through different theories, such as Arrhenius and Lewis. It emphasizes the role of non-aqueous solvents in chemical reactions where water isn't ideal. It examines properties of solvents like liquid ammonia and liquid sulfur dioxide. Additionally, it covers oxidation and reduction concepts, focusing on electron transfer and redox potential analysis. To introduce coordination compounds, discussing ligands and coordination numbers.To study types of ligands and bonding theories in coordination chemistry, geometry, and isomerism. It also covers the preparation and reactions of aldehydes and ketones, as well as the properties of carboxylic acids and their derivatives. To discuss solutions, colligative properties, and the behaviour of solid and liquid mixtures, including miscible and immiscible systems.

Learning Outcomes- After the completion of the course, the students will be able to:discuss the differences between acid-base theories and how to identify acids, bases, and their pairs. It covers auto-ionization and acid-base behaviour in non-aqueous solvents using solvent-system theory, as well as chemical reactions in these solvents, including precipitation and redox reactions. It highlights various redox types combination, decomposition, displacement, disproportionation,and how to assess their feasibility with standard electrode potentials. Additionally, it explains bonding in coordination complexes, predicting geometry, and isomerism. To compare preparation methods for aldehydes and ketones and describe important reactions like aldol condensation and Clemmensen reduction, focusing on the reactivity and mechanisms of carboxylic acids and their derivatives.To explain important reactions like Hell–Volhard–Zelinsky halogenation, Hofmann degradation, and Kolbe's electrolysis. To understand dilute solutions and calculate colligative properties, including vapor pressure lowering, boiling point elevation, freezing point depression, and osmotic pressure. To describe the thermodynamics of solid solution formation as well as the classification of liquid–liquid mixtures into miscible, partially miscible, or immiscible systems. To interpret the phase behaviour of binary liquid systems using temperature–composition phase diagrams.

Unit – I

Acids and Bases :
Arrhenius, Bronsted-Lowry, the Lux-Flood, Solvent System, and Lewis concepts of Acids and Bases.

Non-aqueous Solvents
Physical properties of a solvent, types of solvents and their general characteristics, Reaction in liquid NH_3 and Liquid SO_2.

Oxidation and Reduction
Use of redox potential data analysis of redox cycle, redox stability in water frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.

Coordination Compounds
Werner's coordination theory and its experimental verification, Effective atomic number concept, Chelates, Nomenclature of coordination compounds, Isomerism in coordination compounds, valence bond theory of transition metal complexes.

Some conformational effects of chelate ring conformational contributions to circular dichromate spectra geometrical isomerism in triethyltetramine complexes ring conformational effects in triethyltetramine complex.

(20 Lectures)

Unit – II

Aldehydes and Ketones
Structure of the carbonyl group, Synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1.3-dithianes, synthesis of ketones from nitries and from carboxylic acid and Physical properties.

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. MPV (Meervein – Pondrof – Verley). Clemmensen. Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones. Use of acetals and 1.3-dithianes as protecting group.

Carboxylic Acids
Structure and bonding, physical properties, acidity of carboxylic acids, effects of substance on acid strength. Preparation of carboxylic acids. reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. reduction of carboxylic acids, mechanism of decaroxylation.

Methods of preparation and chemical reaction of halo acids,Hydroxy acids-malic, tartaric acid, citric acid.

Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

Carboxylic Acid Derivatives

Structure, nomenclature, and synthesis of acid chlorides, esters, amides and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

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

(20 Lectures)

Unit – III

Solutions, Dilute Solutions, and Colligative Properties

Ideal and non-ideal solutions methods of expressing the concentration of solutions, activity, and activity coefficient.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination, Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression ofthe freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, degree of dissociation and association of solutes.

Solid solution: compound formation with congruent melting point (Mg Zn) and incongruent melting point, ($NaCl$-H_2O) and ($CuSO_4$ H_2O) system. Freezing mixtures, acetone-dry ice.

Liquid- liquid mixtures- ideal liquid mixtures. Raoult's and Henry's law Non-ideal system-azeotropes – HCl-H_2O and ethanol – water, systems.

Partially miscible liquids – Phenol-water, trimethylamine-water, nicotine-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature.

Immiscible liquids, steam distillation.

Nernst distribution law-thermodynamic derivation, applications.

(20 Lectures)

References Books:

1. Hand, Clifford W. & H. L. Blewitt – *Acid-base Chemistry* (1986),Collier Macmillan (Macmillan USA)New York & London, United States / United Kingdom
2. *A Textbook of Physical Chemistry* (Vol. I & II) by K. L. Kapoor, Macmillan Publishers India Ltd. Gurgaon (Gurugram), Haryana, India
3. *Physical Chemistry* by Ira N. Levine, McGraw-Hill (Higher Education, often listed as McGraw-Hill, New York or McGraw-Hill – U.S. edition), New York, United States

4. *Ligand Field Theory and Its Applications* (Brian N. Figgis & Michael A. Hitchman), Wiley-VCH (John Wiley & Sons), New York, USA, Weinheim, Germany
5. *Principles of Inorganic Chemistry* — Puri, Sharma & Kalia, Milestone Publishers & Distributors, New Delhi, India
6. *Concise Inorganic Chemistry* by J. D. Lee:, Wiley-Blackwell, New York, United States
7. *Principles and Applications of Electrochemistry* — D. R. Crow, published by Chapman & Hall, based in London, UK.
8. *Inorganic Chemistry* – Huheey, Keiter & Keiter, Addison Wesley / Harper & Row, Reading, MA / London, USA / UK
9. *A Textbook of Organic Chemistry* – Arun Bahl & B. S. Bahl, S. Chand & Company Ltd, New Delhi, India
10. *Organic Chemistry* – Morrison, Boyd & Mukherjee, Pearson Education India, Noida, India
11. *Organic Chemistry Vol. 2* – I. L. Finar, Pearson Education / Longman. London, UK
12. *Physical Chemistry* – Atkins & de Paula, Oxford University Press, Oxford, UK

B.Sc. (Hons.) CHEMISTRY SEM-III

COURSE TITLE: PRACTICALS OF GENERAL CHEMISTRY-IV
COURSE CODE: CHE 8.0 03 P2 CO

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**TOTAL LECTURE-30** **(Two Hours each)**

Course Objective-This course aims to give students practical experience and understanding of important experimental methods in physical chemistry, including electrochemical, optical, colligative, and spectroscopic techniques. To study Methyl Orange and milk composition, learning flame photometry for measuring sodium, lithium, and potassium concentrations, understand urea-formaldehyde resin formation, and using paper chromatography and thin-layer chromatography to separate organic compounds and biologically important compounds like amino acids.

Learning Outcomes: After the completion of the course, the students will be able to:determine the solubility and solubility product (K_{sp}) of a sparingly soluble salt using conductometric methods, the kinetics of saponification of ethyl acetate using conductometry, the ionization constant (Ka) of a weak acid through conductometric titration, the specific rotation of an optically active compound using a polarimeter.To determine the molecular weight of a non-volatile solute by the Rast method, the Beer–Lambert Law using UV-Visible spectrophotometry for compounds like $KMnO_4$ and $K_2Cr_2O_7$, and determine the concentration of unknown solutions, synthesize Methyl Orange through diazotization and

coupling reactions, the biochemical composition of milk, particularly the role of proteins like casein, the principle and working of a flame photometer.

I. Major Exercise – **- 15 Marks**

1. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
2. To study the saponification of ethyl acetate conductometrically.
3. To determine the ionisation constant of a weak acid conductometrically.
4. To verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer.
5. To determine the specific rotation of a given optically active compound.
6. Determination of molecular weight of a non-volatile solute by Rast method freezing point method.
7. Determination of the apparent degree of dissociation of an electrolyte (e.g. NaCl) in aqueous solution at different concentrations by ebullioscopy.
8. To verify the Beer-Lambert law for $KMnO_4$ and $K_2Cr_2O_7$ and determine the concentration of the given solution of the substance.

- 10 Marks

II. Minor Exercises

1. To prepare Methyl Orange from Sulphanilic acid,
2. Isolation of Casein from Milk
3. Analysis of Na, Li, and K using flame photometry.
4. To prepare of urea-formaldehyde resin
5. To prepare of phenol-formaldehyde resin

- 10 Marks

III Minor Exercise

1. Separation of two organic compounds by paper Chromatography
2. Separation of two dyes by TLC/paper Chromatography
3. Separation of two amino acids by paper chromatography

- 10 Marks

IV. Viva-voce **-05 Marks**

V. Record

Reference Books:-

1. P.C. Kamboj; University Practical Chemistry,Vishal Publishing Co., Punjab
2. Dr.Gurumeet C Wadhawa, Dr.Vitthal S. Shivankar, Dr.Supriya P. Babar, Dr.MarayappaSonawale; Chemistry Practical for Undergraduate and Postgraduate Students, IIP, Karnatak

3. K.N. Rastogi; Chemistry Practicals, ABD Publishers, Jaipur (Rajasthan)
4. J N Gurtu and R Kapoor; Advanced Experimental Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
5. Prof. B. C. Joshi, Dr. V. K. Goyal, and Dr R. L. Pitaliya; Practical Chemistry, CBH, Jaipur
6. Jagdamba Singh, R.K.P. Singh, Jaya Singh etc.; Advance Practical Chemistry, PragatiPrakashan, Meerut
7. Gurtu&Gurtu; Advance Physical Chemistry Experiments, PragatiPrakashan, Meerut
8. N. K. Vishnoi; Advanced Practical Organic Chemistry, Vikas Publishing House Pvt Ltd., New Delhi
9. S.S. Dara; Text Book on Experiments and Calculations- Engineering Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
10. Anil Kumar et.al.; Practical Chemistry (B.Sc.-I, II and III), Shree Publishers & Distributer, Delhi

B.Sc. (Hons.) CHEMISTRY SEM-III

COURSE TITLE: SOIL AND WATER ANALYSIS
COURSE CODE: CHE 8.0 03T SEC CO

SEC (SKILL ENHANCEMENT COURSE)

CREDITS -02 (Max. Marks -50) **Internal Assessment: Max. marks : 15** **End of Semester Exam : Max marks : 35**	**TOTAL LECTURES -30** **(One Hour each)**

Instructions: Part A willconsistof10compulsoryquestions. The answer to each question should be limited to a maximum of 50 words. Each question in Part A will carry one mark. **10 Marks**

Part-B will consist of 10 questions, at least three questions from each unit.Students must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry five marks.

25 Marks

Course Objective-It aims to teach fundamental concepts such as soil composition, classification, and their roles in agriculture and the environment. Students will learn to analyze key soil parameters, including pH, texture, moisture content, and nutrients, among others, additionally, the course focuses on understanding water quality, assessment methods, and its effects on human health and ecosystems, practical skills in assessing water suitability for various uses like drinking, agriculture, and industry, the course will also highlight the important link between water quality and human health.

Learning Outcomes- After the completion of the course, the students will be able to:understand the composition and classification of soil, including its physical, chemical, and biological components.To understand the chemical and physical properties of water, its sources and pollution, important water quality parameters, and methods for their determination. To understand the significance of various water quality parameters like pH, conductivity, alkalinity, hardness, chloride, calcium, iron, magnesium, total solids, dissolved oxygen (DO), and Chemical Oxygen Demand (COD), and how to determine their concentrations using appropriate laboratory techniques.

Unit-I

Analysis of soil: Introduction to Soil, Importance of Soil analysis, Physical Properties of Soil-Soil Texture and Structure, soil moisture and its measurement, soil color, and its Significance. Chemical composition of soil, soil exchange, concept of pH and pH measurement, fertility of soil, physical parameters of soil and soil health indicators.

(10 Lectures)

Unit-II

Water Quality Fundamentals - Chemistry of water, Physical and chemical properties, Water recourses, water pollution, Important water Quality parameters and methods for their determination - turbidity, color, taste, pH, acidity, alkalinity, chemical constituents, hardness, dissolved oxygen etc., water sampling, standards for drinking water as per BIS specifications, household water treatment and safe storage.

(10 Lectures)

Unit-III

Water analysis - Laboratory tests for water quality monitoring, Determination of pH and conductivity, Test for acidity and alkalinity, Test for total hardness, Test for chloride, calcium, iron etc., calculation of magnesium content and total solids, Dissolved Gases in water (DO) and Chemical Oxygen Demand (COD).

(10 Lectures)

Reference Books:

1. Willard, H. H. Instrumental Methods of Analysis, CBS Publishers.
2. Skoog & Lerry. Instrumental Methods of Analysis, Saunders College Publications, New York.
3. Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992).
4. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.
5. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
7. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.
8. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
9. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).
10. Vickers, A. 2001. Handbook of Water Use and Conservation. Water Plow Press.

SEMESTER-IV

B.Sc. (Hons.) CHEMISTRY SEM-IV

COURSE TITLE: GENERAL CHEMISTRY-V

COURSE CODE: CHE 8.0 04T1 CO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks: 30** **End of Semester Exam: Max marks: 70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part A will carry two marks. **20 Marks**

Part B will consist of 10 questions, at least three questions from each unit. Students must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part B will carry ten marks. ***50Marks***

Course Objective-To develop an in-depth understanding of solid-state structures, weak interactions, bioinorganic processes, organonitrogen compounds, and electrochemistry. The course emphasizes theoretical knowledge, reaction mechanisms, and analytical techniques critical for interpreting chemical properties, biological relevance, and electrochemical behaviour.

Learning Outcome-After the completion of the course, the students will be able to: explain ionic structures, coordination numbers, radius ratio of 4 and 6, lattice energies, and defects in ionic solids. Describe hydrogen bonding, van der Waals forces, and metallic bonding in chemical systems. Understand the basic fundamentals of bioinorganic chemistry, inorganic polymers and nuclear chemistry. Understanding the preparation, properties, and applications of nitrogen-containing compounds. Such as Nitroalkanes, Nitroarenes, Amines, and Aryl amines. Correlate the basic nature of amines with their structure. The understanding of Laws of Electrochemistry, Kohlrausch law, Ostwald dilution law and their limitations, Debye-Huckel Onsager equation. Types of reversible electrodes, Reference electrodes, electrode potential, Electrolytic and Galvanic cells, EMF, and Calculation of Thermodynamic Quantities and their Applications.

Unit – I

Ionic Solids-Ionic Structures: Radius ratio and coordination number of 4 and 6 limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber Cycle solvation energy and solubility of ionic solids, polarizing power and polarizbility. Fajan's rule. Metallic bond.

Weak Interactions: Hydrogen bonding, Vander Waals forces

Bioinorganic Chemistry:
Essential and trace elements to biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin,biological role of alkali and alkaline earth metalions with special reference to Ca^{2+}, nitrogen fixation.

Inorganic Polymers:
Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

Nuclear Chemistry:
Sub atomic particle natural radioactivity, artificial transmutations of element, artificial radioactivity nuclear fission and atomic bomb, atomic reactions, nuclear fusion, transuranic series, Neptunium series using LSO/OPS.

(20 Lectures)

Unit – II

Organic Compounds of Nitrogen
Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitutions in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid.

Amines: Structure, nomenclature and preparation of alkyl, and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Physical properties, stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines, Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts. Gabrielphthalimide reaction and Hoffmann bromamide reaction with mechanism.
Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid,diazotisation and mechanism,synthetic transformation of aryl diazonium salts, azocoupling and its applications.

(20 Lectures)

Unit – III

Electrochemistry-I
Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitations,Deby-Huckel-Onsager's equation for strong electrolytes (elementary

treatment only), Transport number, definition and determination by Hittorf method and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, determination of K_a of acids, determination of solubility product of sparingly soluble salts, conductometric titrations.

Electrochemistry-II

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(SHE) reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolytic and Galvanic cells- reversible and irreversible cells, conventional representation of electrochemical cells.

EMF of a cell and its measurements. Computation of cell EMF, Calculation of thermodynamic quantities of cell reaction ($\Delta G, \Delta H$ and ΔK) polarization.

(20 Lectures)

Reference Books:

1. *Principles of Bioinorganic Chemistry* – Lippard & Berg, University Science Books, Sausalito, CA, USA*Principles of Nuclear Chemistry* – H. J. Arnikar, New Age International, New Delhi, India
2. Inorganic Polymers, V. K. Ahluwalia & A. Mishra, Ane Books Pvt. Ltd., New Delhi, India
3. Inorganic Polymers, R. N. Mukherjee, Macmillan India Ltd., New Delhi, India
4. *Inorganic Chemistry* – Huheey, Keiter & Keiter, Addison Wesley / Harper & Row, Reading, MA / London, USA / UK
5. *Solid State Chemistry: An Introduction* – Smart & Moore, CRC Press (Taylor & Francis), Boca Raton, FL, USA
6. *A Textbook of Organic Chemistry* – Arun Bahl & B. S. Bahl, S. Chand & Company Ltd, New Delhi, India
7. *Organic Chemistry* – Morrison, Boyd & Mukherjee, Pearson Education India, Noida, India
8. *Organic Chemistry* – Clayden, Greeves, Warren &Wothers, Oxford University Press, Oxford, UK
9. *Organic Chemistry Vol. 2* – I. L. Finar, Pearson Education / Longman. London, UK
10. *Advanced Organic Chemistry* – Jagdamba Singh & L. D. S. Yadav, Narosa Publishing House, New Delhi, India
11. *Physical Chemistry* – Atkins & de Paula, Oxford University Press, Oxford, UK
12. *Principles of Physical Chemistry* – Puri, Sharma & Pathania, Shoban Lal Nagin Chand & Co., Jalandhar, India

13. *A Textbook of Physical Chemistry* – A. S. Negi & S. C. Anand, Kedar Nath Ram Nath, Meerut, India
14. *Modern Electrochemistry Vol. 1 & 2* – Bockris& Reddy, Plenum Press (Springer), New York, USA

B.Sc. (Hons.) CHEMISTRY SEM-IV

COURSE TITLE: PRACTICALS OF GENERAL CHEMISTRY-V
COURSE CODE: CHE 8.0 04P1 CO

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**TOTAL LECTURES -30** **(Two Hour each)**

Course Objective-To understand students in essential laboratory techniques for gravimetric and conductometric analysis, organic qualitative analysis, and compound separation. The course enhances the ability to perform accurate chemical experiments, interpret analytical data, and apply methods such as derivative preparation and steam distillation.

Learning Outcome-After the completion of the course, the students will be able to: perform gravimetric estimations of copper and nickel using selective precipitation techniques, to conduct conductometric titrations involving combinations of strong and weak acids and bases,separation and analysis of an organic mixture containing two components,understanding steam distillation techniques.

I. Major Exercise – **- 15 Marks**

1. **Gravimetric analysis**
   i. Estimate Cu as CuSCN
   ii. Estimate Ni as nickledimethylglyoxime (Ni-DMG)
2. **Qualitative Analysis**
   Analysis of an organic mixture containing two solid components using water, $NaHCO_3$, NaOH for separation, determine the functional group, M.P., and preparation of suitable derivatives.

- 10 Marks

II. **Minor Exercise –**

Determine the strength of following by conductometric titration

1. Strong acid and strong base
2. Strong acid and weak base
3. Weak acid and strong base
4. Weak acid and weak base

- 10 Marks

III. **Minor Exercise –**

1. Perform simple distillation
2. Perform fractional distillation
3. Perform steam distillation
4. Extract naphthalene from its suspension in water

- 10 Marks

IV. **Viva-Voce** - 05 Marks

V. **Record**

Reference Books :-

1. P.C. Kamboj; University Practical Chemistry,Vishal Publishing Co., Punjab
2. Dr.Gurumeet C Wadhawa, Dr.Vitthal S. Shivankar, Dr.Supriya P. Babar, Dr. Marayappa Sonawale; Chemistry Practical for Undergraduate and Postgraduate Students, IIP, Karnatak
3. K.N. Rastogi· Chemistry Practicals, ABD Publishers, Jaipur (Rajasthan)
4. J N Gurtu and R Kapoor; Advanced Experimental Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
5. Prof. B. C. Joshi, Dr. V. K. Goyal and Dr R. L. Pitaliya; Practical Chemistry, CBH, Jaipur
6. Jagdamba Singh, R.K.P. Singh, Jaya Singh etc.; Advance Practical Chemistry, Pragati Prakashan, Meerut
7. Gurtu&Gurtu; Advance Physical Chemistry Experiments, Pragati Prakashan, Meerut
8. N. K. Vishnoi; Advancede Practical Organic Chemistry, Vikas Publishing House Pvt Ltd., New Delhi
9. S.S. Dara; Text Book on Experiments and Calculations- Engineering Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
10. Anil Kumar et.al.; Practical Chemistry (B.Sc.-I, II and III), Shree Publishers & Distributer, Delhi

B.Sc. (Hons.) CHEMISTRY SEM-IV

COURSE TITLE: GENERAL CHEMISTRY PAPER-VI

COURSE CODE: CHE 8.0 04T2 CO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks: 30** **End of Semester Exam: Max marks: 70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsory questions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-B will consist of 10 questions, at least three questions from each unit, student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.

50 Marks

Course Objective- This course aims to equip students with in-depth knowledge of advanced analytical techniques, heterocyclic and carbohydrate chemistry, organic synthesis *via* enolates, and the physical behavior of matter in various states. The course integrates theoretical principles with real-world chemical applications across chromatography, reaction mechanisms, and molecular interactions in gases, liquids, and colloids.

Learning Outcome- After the completion of the course, the students will be able to: explain the principles, instrumentation, and applications of modern chromatographic techniques like HPLC, GLC, Gel permeation, solvent extraction etc., understanding the preparation, properties and basic characteristics of monocyclic and fused aromatic compounds. Understanding nature and basic characteristics of collides and their classification. Understanding gaseous state by way of kinetic theory of gases, critical phenomenon, distribution of molecular velocities and liquefaction of gases. Understand basics nature, classification and structure of liquid crystals.

Unit – I

A. **High Performance Liquid Chromatography (HPLC):** Basic principle, mode of separation, instrumentation with particular reference to pumps, injector columns, detectors, integrators, recorders, comparison with GLC analytic applications.

B. **Gas Liquid Chromatography:** Introduction, choice of system, instrumentation, applications, qualitative and quantitative analysis.

C. **Gel Permeation or Size Exclusion Chromatography:** Introduction, theory and application.

D. **Ion Exchangers:** Introduction, types cationic, anionic, chelating and liquid ion exchangers, preparation, action and properties of exchangers and application of ion exchangers.

E. **Solvent Extraction:** Introduction, principle, factors enhancing solvent extraction, ion association complexes, applications of solvent extraction.

F. **Zone Electrophoresis:** Introduction, factors affecting ionic migration, detection of separated components and applications of zone electrophoresis.

(20 Lectures)

Unit – II

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 substitution. Mechanism of nucleophilic substitution reactions in pyriding derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

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

A. Organic Synthesis via Enolates

Acidity of α-hydrogens, alkylation of ethylmalonate and ethyl acetoacetate, synthesis of ethyl acetoacetate: Claisen condensation, keto-enoltautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes. Alkylation and acylation of enamines.

B. Carbohydrates

Classification and nomenclature,monosaccharides, mechanism of osazone formation. Inter conversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threodiastereomers,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. Structure of ribose and deoxyribose, disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

(20 Lectures)

Unit – III

Colloidal State

Definition of colloids, classification of colloids.

Solids in liquids (sols): Properties-kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number.

Liquids in liquids (emulsions):Types of emulsions, preparation. emulsifier.

Liquids in solids (gels): Classification, preparation and properties, inhibition, general applications of colloids.

Gaseous States

Postulates of kinetic theory of gases, deviation from ideal behaviour, Vander-Waals equation of state, critical phenomena, PV-isotherms of real gases, continuity of states, the isotherms of Vander-Waals equation, relationship between critical constant and van der Waals constants, the law of corresponding states, reduced equation of state.

Molecular Velocities: Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter liquification of gases (based on Joule-Thomson effect.)

Liquid State: Intermolecular forces, structure of liquids (a qualitative description),structural differences between solids, liquids and gases.

Liquids crystals: Difference between liquid crystal, solid and liquid,classification, structure of nematic and cholestric phases,thermography and seven segment cell.

(20 Lectures)

Reference Books:

1. Physical Chemistry, Gurtu and Gurtu — *Publisher:* Pragati Prakashan — *City & Country:* Meerut, India
2. Physical Chemistry, Puri, Sharma & Pathania — *Publisher:* Shoban Lal Nagin Chand & Co. — *City & Country:* Jalandhar, India
3. Carbohydrate Chemistry (Robyt; Yamaguchi; Rama Rao) — published by Academic Press / Elsevier**or** Yamaguchi & Rao, Narosa Publishing House, New Delhi, India
4. Heterocyclic Chemistry series and textbooks (Weissberger & Taylor; Joule, Mills & Smith; Bansal; Acheson; Alvarez-Builla; Gilchrist) — generally published by Academic Press / Pergamon, Oxford University Press, or CRC Press, Oxford, UK
5. Solvent Extraction titles (Rydberg, Musikas& Choppin; Sekine & Hasegawa; Marcus & Kertes) — usually CRC Press / Taylor & Francis **or** Elsevier;CRC Press / Taylor & Francis — Boca Raton, Florida, **USA** / Abingdon, UK
6. *Introduction to Modern Liquid Chromatography*Lloyd R. Snyder, Joseph J. Kirkland & John W. Dolan — John Wiley & Sons, Hoboken, New Jersey, USA

7. Chromatographic Methods, B. K. Sharma, Krishna Prakashan Media Pvt. Ltd., Meerut, India
8. Analytical Chemistry, G. Chatwal & S. Anand, Himalaya Publishing House, Mumbai, India
9. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, B. S. Bahl & Arun Bahl, S. Chand & Company Ltd., New Delhi, India

B.Sc. (Hons.) CHEMISTRY SEM-IV

COURSE TITLE: PRACTICALS OF GENERAL CHEMISTRY-VI
COURSE CODE- CHE 8.0 04P2 CO

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**TOTAL LECTURES -30** **(Two Hour each)**

Course Objective-To train students in advanced qualitative and quantitative analytical methods including Job's method, mole-ratio method, coordination compound synthesis, and chromatographic separation of ions. The course also develops skills in environmental water analysis and systematic separation of metal ions using modern laboratory techniques.

Learning Outcome-After the completion of the course, the students will be able to: apply Job's method and mole-ratio method to determine metal-ligand stoichiometry.Perform quantitative water analysis and separation of common metal ions like Mg(II) and Fe(II).Synthesize and analyze various inorganic complexes and quantitative separation of cation and anions through chromatographic techniques.

I. Major Exercise – **- 15 Marks**

1. To verify Beers law for solution of $KMnO_4$ and $K_2Cr_2O_7$ and determine the unknown concentration of $KMnO_4$ and $K_2Cr_2O_7$.
2. To find the composition of ferric ions-thiocynate complex by Jobs method.
3. To find out the strength of HCl and CH_3COOH in mixture of both by titrating it against NaOH using P^H meter.

- 10 Marks

II. Minor exercise -
Synthesis and Analysis

1. Preparation of sodium trioxalatoferrate(III), $Na_3[Fe(C_2O_4)_3]$
2. Preparation of Ni-DMG complex, $[Ni(DMG)_2]$
3. Preparation of tetrammine copper complex $[Cu(NH_3)_4]SO_4$
4. Preparation of cis-and trans-bisoxalatodiaquachromate(III) ion

- 10 Marks

III. Minor exercise -
Quantitative Analysis: Separation of cations and anions by

1. Paper Chromatography
2. Column Chromatography-Ion exchange

IV. **VIVA VOCE** - 10 Marks

V. **Record** - 05 Marks

Reference books

1. P.C. Kamboj; University Practical Chemistry,Vishal Publishing Co., Punjab
2. Dr. Gurumeet C Wadhawa, Dr. Vitthal S. Shivankar, Dr. Supriya P. Babar, Dr. Marayappa Sonawale; Chemistry Practical for Undergraduate and Postgraduate Students, IIP, Karnatak
3. K.N. Rastogi; Chemistry Practicals, ABD Publishers, Jaipur (Rajasthan)
4. J N Gurtu and R Kapoor; Advanced Experimental Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
5. Prof. B. C. Joshi, Dr. V. K. Goyal and Dr R. L. Pitaliya; Practical Chemistry, CBH, Jaipur
6. Jagdamba Singh, R.K.P. Singh, Jaya Singh etc.; Advance Practical Chemistry, Pragati Prakashan, Meerut
7. Gurtu & Gurtu; Advance Physical Chemistry Experiments, Pragati Prakashan, Meerut
8. N. K. Vishnoi; Advancede Practical Organic Chemistry, Vikas Publishing House Pvt Ltd., New Delhi
9. S.S. Dara; Text Book on Experiments and Calculations- Engineering Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
10. Anil Kumar et.al.; Practical Chemistry (B.Sc.-I, II and III), Shree Publishers & Distributer, Delhi

B.Sc. (Hons.) CHEMISTRY SEM-IV

COURSE TITLE: FOOD ANALYSIS

COURSE CODE: CHE 8.0 04T SEC CO
SEC – (SKILL ENHANCEMENT COURSE)

CREDITS -02 (Max. Marks -50) **Internal Assessment: Max. marks: 15** **End of Semester Exam: Max marks: 35**	**TOTAL LECTURES -30** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsory questions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry one marks.

10 Marks

Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry five marks.

25 Marks

Course Objectives-To gain knowledge of sampling technique and analysis of foods, the principles and methods of sensory evaluation. To understanding the types and principles of various instruments and to gain the knowledge of analytical procedures used to analyze food components, to acquire knowledge on professional practice in texture analysis

Learning Outcome- After the completion of the course, the students will be able to: Practice a prototype using the knowledge of sampling technique and proximate analysis of foods. To apply the methods of sensory evaluation to create a new product and understand the application of different instruments in the measurements of food components. To utilize the knowledge of food analysis to develop new product.

Unit-I

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations.

a. Analysis of moisture, Ash, crude protein, crude fat, Carbohydrate in foods.
b. Analysis of preservatives and colouring matter.

(10 Lectures)

Unit-II

Food Analysis- Sampling and selective analysis of food flavours, food colour, food preservatives, milk and milk products, floor starches, tea, coffee, sugar content analysis of honey, jam & jelly; alcohol content in beverages; analysis of oils and fats: softening point, congent point, titre point, cloud point, iodine value, saponification value, acid value and Polenske value, Elaiden test; pesticide residue analysis.

(10 Lectures)

Unit-III

Nature and Concept of Food analysis- Basic instrumentation: Principle for pH meter, dialysis, ultra filtration, reverse osmosis. Centrifugation: Principle, theory (RCF, Sedimentation coefficient) and types of rotors, ultracentrifugation.Calorimetry: Bomb calorimeter, principle of rheological Analysis- rheological parameters, rheological methods, instruments and application, texture profile analysis, densimetry, refractometry.

(10 Lectures)

ReferencesBooks:

1. Bioinstrumentation by .Veerakumari,
2. Biochemical & Molecular biology techniques. byWilson& Walker,
3. Food Chemistry, Aurand, L.W. and Woods, A.E. 1973.AVI, Westport.
4. Principles of Food Science: Part-I Food Chemistry. Fennema, O.R. Ed. 1976 Marcel Dekker, New York.
5. Methods in Food Analysis. Joslyn, M.A. Ed. 1970.Academic Press, New York.

6. Developments in Food Analysis Techniques-1. Applied Science King, R.D. Ed. 1978Publishers Ltd., London.
7. Separation Methods in Biochemistry 2nd Ed Morris, C.J. and Morris, P. 1976. Pitman Pub., London.
8. An Introduction to Practical Biochemistry. Plummer, D.T. 1971Mc-Graw Hill Pub.Co., New York.
9. A Manual of Laboratory Techniques. Raghuramulu, N., Madhavan Nair, K., and Kalyanasundaram, S. Ed.1983.National Institute of Nutrition, ICMR, Hyderabad.
10. Hand Book of Food Analysis – S. N. Mahindru. Analytical Biochemistry Holme Peck

SEMESTER-V

B.Sc. (Hons.) CHEMISTRY SEM-V

COURSE TITLE: GENERAL CHEMISTRY-VII

COURSE CODE CHE 8.0 05T CO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **End of Semester Exam: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsoryquestions, The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-Bwillconsistof10questions, at least 3 questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. **50 Marks**

Course Objectives-The course reviews the acid-base interactions, which is a necessary for understanding stability and reactivity of the complexes. It provides basic knowledge about CFT and splitting pattern of coordination compound in different geometries, and their magnetic properties. Students will learn basic features of different spectrometers and qualitative description of selection rules for electronic transitions as well as will also gain knowledge about spectroscopic technique to illustrating the Carbon- Hydrogen Framework of the compounds. Photochemistry will offer to understand the photochemical reactions and this paper also covers important objectives about the fundamentals of chemical dynamics.

Learning Outcomes-After completing this course, students will be ableto: understand the stability and reactivity of acid-base interactions, reaction direction and explains the stability of complexes, describe d-orbital splitting (CFT) patterns in different geometries and determine magnetic properties of transition metal complexes and factors effecting them. To reveal transitions between molecular orbitals and todetermine the conjugation and chromophores. Spectroscopy provides precise values for bond lengthsand bond angles and to identify the different isotopes as well asdifferent functional groups (IR), and alsoto reveal the carbon-hydrogenframework of a compounds and distinguish between different chemical environments of the same element (NMR).To explain unique chemical behaviors and fundamental principles governing the photochemistry and rates of chemical reactions and the mechanisms. The student will gain knowledge about to control and optimize chemical processes.

Unit – I

Hard and Soft Acids and Bases (HSAB):
Classification of acids and bases as hard and soft.Pearson's HSAB concept, acid-base strength and hardness and softness.Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

Metal-ligand bonding in Transition Metal complexes:
Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal-field splitting in octahedral, tetrahedral and square planar complexes factors affecting the crystal-field parameters.

Magnetic properties of Transition Metal Complexes:
Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μ_s and μ_{eff}values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

(20 Lectures)

Unit – II

Spectroscopy:
Introduction: electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

Electronic Spectrum
Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Frank-Condon principle.

Rotational Spectrum
Diatomic molecules, Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor and isotope effect.

Vibrational Spectrum
Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, basic idea of vibrational frequencies of different functional groups.

Raman Spectrum concept of polarizability, pure rotational and pure vibrational Raman Spectra of diatomic molecules and selection rules.

Nuclear magnetic resonance (NMR) spectroscopy

Proton magnetic resonance (^{1}H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signal, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.

(20 Lectures)

Unit – III

Photochemistry

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Drapper law, Stark-Einstein law, Jablonski Diagram, depicting various processes occurring in the excited state, qualitative description of flouorescence, phosphorescence, non-radioactive processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples)

Chemical Kinetics and Catalysis

Chemical kinetics and its scope, rate of a reaction factors influencing the rate of a reaction-concentration, temperature, pressure, solvent, light, catalyst, Concentration dependence of rates, Characterstics and mathematical expression of simple chemical reactions-zero order, first order, second order, pseudo order, half-life and mean life. Determination of the order of reaction-differential method, integration method, half-life method and isolation method. Example of S_N1,S_N2 and solvolysis of alkyl halides.

Radioactive decay as a first order phenomenon.

Experimental methods of chemical kinetics: conductometric, potentiometric, optical methods, polarimetry and spectrophotometer.

Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects. Kinetics of complex reactions- parallel reaction, reversible reaction and conjugative reactions.

(20 Lectures)

Reference Books:

1. Cotton, F. A. G.; Wilkinson &Gaus, P. L. Basic Inorganic Chemistry 3rd Ed.; Wiley India,
2. Huheey, J. E.; Keiter, E. A. &Keiter, R. L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.
3. Sharpe, A. G. Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005
4. Douglas, B. E.; McDaniel, D. H. & Alexander, J. J. Concepts and Models in Inorganic Chemistry 3rd Ed., John Wiley and Sons, NY, 1994.
5. Greenwood, N. N. &Earnshaw, A. Chemistry of the Elements, Elsevier 2nd Ed, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
6. Lee, J. D. Concise Inorganic Chemistry 5th Ed., John Wiley and sons 2008.
7. Powell, F. Principles of Organometallic Chemistry, Chapman and Hall, 1988.
8. Shriver, D. D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.
9. Basolo, F. & Person, R. Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed., John Wiley & Sons Inc; NY.
10. Purcell, K. F. &Kotz, J. C., Inorganic Chemistry, W. B. Saunders Co. 1977
11. Miessler, G. L. & Donald, A. Tarr, Inorganic Chemistry 4th Ed., Pearson, 2010.
12. Puri, B. R.; Sharma L. R.; Pathania, M.S.; Principles of Physical Chemistry 47th Ed.; Vishal Publishing Company
13. Atkins, P. W.; Physical Chemistry Vth Ed.; ELBS Publication
14. Engel, T.; Reid P. Physical Chemistry Low Price Edition, Pearson Education

B.Sc. (Hons.) CHEMISTRY SEM-V

COURSE TITLE: PRACTICALS OF GENERAL CHEMISTRY-VII

COURSE CODE: CHE 8.0 05P CO

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**TOTAL LECTURES -30** **(Two Hour each)**

Course Objective:Students will engage actively to learn conductometric and potentiometric titration to determine the strength, solublity, solublity product, ionization constant and redox potential respectively. The synthesis processes learned will always encourage the students for to doing experiments.

Learning Outcome: After successful completion, students will be able to:to determine the strength,solublity, solublity product, ionization constant and calculate redox potential, students will be able to learn the synthesis process of few important organic compounds.

I. Major Exercise – **- 15 Marks**

1. To determine the strength of the given acid conductometrically using standard alkali solution.
2. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
3. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate with sodium hydroxide conductometrically.
4. To determine the ionisation constant of a weak acid conductometrically.
5. To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4/K_2Cr_2O_7$ as titrant and calculate the redox potential of Fe^{+2}/Fe^{+3} system on the hydrogen scale.

II. Minor exercise - **- 10 Marks**

Synthesis

1. Preparation of m-dinitrobenzene from nitrobenzene
2. Preparation of p-nitroacetanilide from acetanilide
3. Preparation of p-bromoacetanilide from acetanilide
4.

- 10 Marks

III. **Minor exercise -**

Synthesis of the following

1. 2,4,6- tribromophenol from phenol
2. Methyl red from diazotization of anthranillic acid
3. Benzoic Acid from benzene
4. Aniline from nitrobenzene
5. m-Nitroaniline from m-dinitrobenzene

- 10 Marks

IV. **VIVA VOCE**

- 05 Marks

V. **Record**

Reference Books:

1. P.C. Kamboj; University Practical Chemistry,Vishal Publishing Co., Punjab
2. Dr. Gurumeet C Wadhawa, Dr. Vitthal S. Shivankar, Dr. Supriya P. Babar, Dr. Marayappa Sonawale; Chemistry Practical for Undergraduate and Postgraduate Students, IIP, Karnatak
3. K.N. Rastogi; Chemistry Practicals, ABD Publishers, Jaipur (Rajasthan)
4. J N Gurtu and R Kapoor; Advanced Experimental Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
5. Prof. B. C. Joshi, Dr. V. K. Goyal and Dr R. L. Pitaliya; Practical Chemistry, CBH, Jaipur
6. Jagdamba Singh, R.K.P. Singh, Jaya Singh etc.; Advance Practical Chemistry, Pragati Prakashan, Meerut
7. Gurtu & Gurtu; Advance Physical Chemistry Experiments, Pragati Prakashan, Meerut
8. N. K. Vishnoi; Advancede Practical Organic Chemistry, Vikas Publishing House Pvt Ltd., New Delhi
9. S.S. Dara; Text Book on Experiments and Calculations- Engineering Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
10. Anil Kumar et.al.; Practical Chemistry (B.Sc.-I, II and III), Shree Publishers & Distributer, Delhi

B.Sc. (Hons.) CHEMISTRY SEM-V

COURSE TITLE: BIO-INORGANIC CHEMISTRY

COURSE CODE: CHE 8.0 05T E(A)

DSE -A (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks: 30** **End of Semester Exam: Max marks: 70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsory questions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. **50 Marks**

Course Objectives- This course is to make students understand the role of chemistry of metal ions in biological systems,nitrogen fixation, electron transfer in biology, metal storage and transport and biomineralization, metalloenzymes, metals used in Medicine. It also aims to introduce the learners to the physico-chemical properties of nucleic acids.

Learning Outcomes: On completion of this course, students will be able to: Learn the role of metal ions in biological processes.Get knowledge of various metal complexes in transmission of energy .Understand the metal ions and metal complex interactions and metal complex nucleic acids.Gain knowledge about the metals used in diagnosis and and their usage in chemotherapy with particular reference to anticancer drugs.

Unit-I

Metal Ions in Biological Systems:

Bulk and trace metals with special reference to Na, K, Mg, Ca, Fe, Cu, Zn and Co.

K^+/Na^+ pump: role of metal ions in biological processes.

Bioenergetics and ATP Cycle: DNA polymerization, glucose storage, metal

complexes in transmission of energy; chlorophylls, photosystem-I and photosystem-II in cleavage of water.

Nitrogen fixation: Biological nitrogen fixation, and its mechanism, nitrogenase, chemical nitrogen fixation.

Transport and Storage of Dioxygen: Haemo proteins and oxygen uptake, structure and function of haemoglobin, myoglobin,haemocyanin and hemerythrin, model synthetic complexes of iron, cobalt and copper.

Electron Transfer in Biology: Structure and function of metalloproteins in electron transport, processes, cytochromes and ion-sulphur proteins, synthetic models.

(20 Lectures)

Unit-II

Metal Storage and Transport and Biomineralization: Ferritin, transferrin and siderophores.

Calcium in Biology: Calcium in living cells, transport and regulation, molecular aspects of intra-molecular processes, extracellular binding proteins.

Metal-Nucleic Acid Complexes: Metal ions and metal complex interactions. Metal complex nucleic acids.

(20 Lectures)

Unit-III

Metalloenzymes:

Zinc enzymes: carboxypeptidase and carbonic anhydrase. Iron enzymes-catalase, peroxidase and cytochrome P-450. Copper enzymes-superoxide dismutase.Molybdenum oxatransferase enzymes-xanthine oxidase.Coenzyme vitamin B12.

Metals in Medicine:

Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.

(20 Lectures)

Reference Books:

1. Principles of Bioinorganic Chemistry. S.J. Lippard and J.M. Berg University Science Books.
2. Bioinorganic Chemistry, I Bertini, H.B. Gray. S.J. Lippard and J.S. Valentine, University Sci. Books.
3. Inorganic Biochemistry Vols I and II Ed. G.L. Eichhorn, Elsevier.
4. Progress in Inorganic Chemistry Vols. 18 G.L. Eichhorn, Elsevier and 38 Ed J.J. Lippard Wiley.

B.Sc. (Hons.) CHEMISTRY SEM-V

COURSE TITLE: PRACTICALS OF BIOINORGANIC CHEMISTRY

COURSE CODE: CHE 8.0 05P E(A)

DSE -A (ELECTIVE PAPER)

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**TOTAL LECTURES -30** **(Two Hour each)**

Course objectives-The objective of course is to provide students with practical skill in the synthetic, purification, characterization with their IR electronic , Mossbaver, ESR and Magnetic susceptibility measurements so enable inorganic chemistry.

Learning Outcomes- After the completion of the course, the students will be able to: understand fundamental concept of coordination chemistry, predict and explain reactivity interpretation spectral data, determine stoichiometric rate constant of alkaline bleaching of malachite green

15 Marks

I. Major exercise :

Inorganic Preparations: Preparation the following inorganic complexes:

1. $Na_3[Co(ONO)_6]$
2. $[CoCl(NH_3)_5]Cl_3$
3. $TiO(C_9H_8NO)_2 \cdot 2H_2O$

4. $Na[Cr(NH_3)_2(SCN)_4]$
5. $[Co(NH_3)_6]\ [Co(NO_2)_6]$
6. cis-$[Co(trien)(NO_2)_2]Cl{\cdot}H_2O$
7. $Na_2S_4O_6$ (Sodium tetrathionate)

10 Marks

II. Minor exercise :

Spectrophotometry:

1. Determination of stoichiometry and stability constant of Ferric isothiocyanate complex ion in solution
2. Determination of rate constant of alkaline bleaching of Malachite green and effect of ionic strength on the rate of reaction.

10 Marks

III. Minor exercise :

1. Standardization of sodium oxalate by $KMnO_4$ and determination of Ca^{2+} ion. **10 marks**
2. Determination of Cu^{2+} and Ni^{2+} by using masking reagent by EDTA titration.
3. Estimation of the purity of oxalic acid employing standard Ce (IV) solution. **05 marks**

IV. Viva-Voce

V. Record

Reference Books:

1. P.C. Kamboj; University Practical Chemistry,Vishal Publishing Co., Punjab
2. Dr. Gurumeet C Wadhawa, Dr. Vitthal S. Shivankar, Dr. Supriya P. Babar, Dr. Marayappa Sonawale; Chemistry Practical for Undergraduate and Postgraduate Students, IIP, Karnatak
3. K.N. Rastogi; Chemistry Practicals, ABD Publishers, Jaipur (Rajasthan)
4. J N Gurtu and R Kapoor; Advanced Experimental Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
5. Prof. B. C. Joshi, Dr. V. K. Goyal and Dr R. L. Pitaliya; Practical Chemistry, CBH, Jaipur
6. Jagdamba Singh, R.K.P. Singh, Jaya Singh etc.; Advance Practical Chemistry, Pragati Prakashan, Meerut
7. Gurtu & Gurtu; Advance Physical Chemistry Experiments, Pragati Prakashan, Meerut
8. N. K. Vishnoi; Advancede Practical Organic Chemistry, Vikas Publishing House Pvt Ltd., New Delhi

9. S.S. Dara: Text Book on Experiments and Calculations- Engineering Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
10. Anil Kumar et.al.; Practical Chemistry (B.Sc.-I, II and III), Shree Publishers & Distributer, Delhi

B.Sc. (Hons.) CHEMISTRY SEM-V

COURSE TITLE: PHYSICAL ORGANIC CHEMISTRY

COURSE CODE: CHE 8.0 05T E(B)

DSE -B (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks : 30** **End of Semester Exam: Max marks : 70**	**TOTAL LECTURES -60** **(One Hour each)**
Instructions: Part-A will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks** **Part-B** will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50Marks***	
Course Objectives- This course is designed with the aim to introduce the concepts in molecular orbital andvalence bond theory, principles of reactivity, solvation and solvent effects, nucleofugacityand structural effects on reactivity, quantitative MO theory and principles of molecular association and organization as exemplified in biological macromolecules. **Learning Outcomes**– After the completion of the course, the students will be able to: learn the molecular orbital and valence bond theory. Identity the valence bond configuration mixing diagrams,acquire fair hard and soft acids and bases. Understand the concept of Nucleo fugacity and its application.	

Unit-I

Concepts in Molecular Orbital (MO) and Valence Bond (VB)

Introduction to Huckel molecular orbital (HOMO) method as a means to explain modern theoretical methods.Advanced techniques in PMO and FMO theory.Molecular mechanics, semi empirical methods and ab initio and density functional methods.

Quantitative MO Theory:

HMO method as applied to ethene, allyl and butadiene. Qualitative MO theory ionization potential. Electron affinities.MO energy levels.Orbital symmetry. Orbital interaction diagrams. Valence bond (VB) configuration mixing diagrams.Relationship between VB configuration mixing and resonance theory.

(20 Lectures)

Unit-II

Principles of Reactivity:

Mechanistic significance of entropy, enthalpy and Gibb's free energy. Arrhenius equation. Transition state theory.Uses of activation parameters, Hammond's postulate, Bell-Evans-Polanyi Principle.Potential energy surface model. Marcus'stheory of electron transfer. Reactivity and selectivity principles.

Solvation and Solvent Effects:

Qualitative understanding of solvent-solute effects on reactivity. Thermodynamic measure of solvation. Effects of solvation on reaction rates and equilibria. Various empirical indexes of solvation based on physical properties, solvent-sensitive reaction rates, spectroscopic properties and scales for specific solvation. Use of solvation scales in mechanistic studies.Solvent effects from the curve-crossing model.

Structural Effects on Reactivity:

Linear free energy relationships (LFER).The Hammett equation, substituent constants, theories of substituent effects.Interpretation of values.Reaction constant.Deviations from Hammett equation.Dual parameter correlation, inductive substituent. The Taft model, σi and σR scales. Acids, Bases, Electrophiles, Nucleophiles and Catalysis: Acid-base dissociation, Electronic and

structural effects, acidity and basicity. Acidity functions and their application.Hard and soft acids and bases.Nucleophilicity scales.

(20 Lectures)

Unit-III

Nucleofugacity.The α-effect.Ambivalent nucleophiles.Acid-base catalysis-specific and general catalysis.Brőnsted catalysis, Nucleophilic and electrophilic catalysis.Catalysis by noncovalent binding, micellar catalysis.

Steric and Conformation Properties: Various type of steric strain and their influence on reactivity. Steric acceleration.Rotation around partial double bonds.Winstein-Holness and Curtin-Hammett principle.

(20 Lectures)

Reference Books:

1. Molecular Mechanics, U. Burkrt and N.L. Allinger, ACS Monograph 177, 1982.
2. Mechanism and Theory in Organic Chemistry, T.H. Lowry and K.C. Richardson, Harper and Row.
3. Introduction to Theoretical Organic Chemistry and Molecular Modeling.
4. Supramolecular Chemistry: Concepts and Perspective, J.M. Lehn, VCH.
5. The Physical Basis of Organic Chemistry: H. Maskill, Oxford University Press.

B.Sc. (Hons.) CHEMISTRY SEM-V

COURSE TITLE: PRACTICALS OF PHYSICAL ORGANIC CHEMISTRY

COURSE CODE: CHE 8.0 05P E(B)

DSE -B (ELECTIVE PAPER)

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**TOTAL LECTURES -30** **(Two Hour each)**
Course Objectives- The objective of this course is to be provide students with fundamental understanding of the principles and law of law of determination partial molar volume of solute and temperature dependence of the solubility and determination of equilibrium constant of of reaction by spectrophotometry. **Learning outcomes-** After the completion of the course, the students will be able to: understand and explain fundamental law of thermodynamics spectrophotometry, oxidation and reduction titration and electroanalytical analytical methods.	

15 Marks

I. Major exercise :

1. Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.
2. Determination of the temperature dependence of the solubility of a compound in two solvents having similar intra-molecular interactions (benzoic acid in water and in DMSO-Water mixture and calculate the partial molar heat of solution.
3. Determination of equilibrium constant of reaction $KI+I_2=KI_3$ spectrophotometrically.
4. Determination of stoichiometry and stability constant of Ferric isothiocyanate complex ion in solution.
5. Determination of rate constant of alkaline bleaching of Malachite green and effect of ionic strength on the rate of reaction.
6. Determination of the amount of each copper and bismuth or copper and iron (III) from the given mixture at 745 nm by spectrophotometric titration using solution of EDTA.
7. Determination of Al^{3+}, Ti^{3+}, Fe^{3+} using 8-Hydroxyquinoline.
8. Determination of Fe^{2+} using 1,10-phenanthroline method.

10 Marks

II Minor exercise :

Redox Titrations

1. Standardization with sodium oxalate of $KMnO_4$ and determination of Ca2+ ion.
2. Standardization of $K_2Cr_2O_7$ with Fe^{2+} and determination of Fe^{3+} (Ferric alum)
3. Standardization of hypo solution with potassium iodate / $K_2Cr_2O_7$ and determination of available Cl_2 in bleaching powder, Sb^{3+} and Cu^{2+}.

10 Marks

III. Minor exercise :

Precipitation Titrations

1. $AgNO_3$ standardization by Mohr's method by using adsorption indicator.
2. Volhard's method for Cl^- determination.
3. Estimation of magnesium or cadmium as oxinate by titration with standard bromate solution.
4. Estimation of KBr in the given solution by titrating against std. $AgNO_3$ solution using eosin as indicator.

10 marks

05 marks

IV. Viva-Voce

V. Record

Reference books

1. P.C. Kamboj; University Practical Chemistry,Vishal Publishing Co., Punjab
2. Dr. Gurumeet C Wadhawa, Dr. Vitthal S. Shivankar, Dr. Supriya P. Babar, Dr. Marayappa Sonawale; Chemistry Practical for Undergraduate and Postgraduate Students, IIP, Karnatak
3. K.N. Rastogi; Chemistry Practicals, ABD Publishers, Jaipur (Rajasthan)
4. J N Gurtu and R Kapoor; Advanced Experimental Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
5. Prof. B. C. Joshi, Dr. V. K. Goyal and Dr R. L. Pitaliya; Practical Chemistry, CBH, Jaipur
6. Jagdamba Singh, R.K.P. Singh, Jaya Singh etc.; Advance Practical Chemistry, Pragati Prakashan, Meerut
7. Gurtu & Gurtu; Advance Physical Chemistry Experiments, Pragati Prakashan, Meerut
8. N. K. Vishnoi; Advancede Practical Organic Chemistry, Vikas Publishing House Pvt Ltd., New Delhi
9. S.S. Dara; Text Book on Experiments and Calculations- Engineering Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
10. Anil Kumar et.al.; Practical Chemistry (B.Sc.-I, II and III), Shree Publishers & Distributer, Delhi

B.Sc. (Hons.) CHEMISTRY SEM-V

COURSE TITLE: RESEARCH METHODOLOGY
COURSE CODE: CHE 8.0 05T SEC CO
SEC - (SKILL ENHANCEMENT COURSE)

CREDITS -03 (Max. Marks -75) **Internal Assessment: Max. marks : 22** **End of Semester Exam: Max marks : 53**	**TOTAL LECTURES -45** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsory questions.The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry 1.5 marks. **15 Marks**

Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. The first question from Unit-I will be of 8 marks and rest four questions from Part B will consist of 7.5 Marks each. **38 Marks**

Course Objectives- This course is introduced to impart knowledge about the fundamental concepts of research, type of research, and to provide a road map for good research work. Students are expected to identify the research problem, research design, methods of data collection, research ethics, report writing and its presentation. Learn how toexplain and apply basic concepts of research.

Learning Outcome- After completion of this course, students will be able to: Know about various research idea and able to write literature review. Learn about Features of a good research and design research problem. Learner will be able to write research Synopsis, data analysis and policy analysis.

Unit-I

Meaning of Research -Function of Research - Concept, objective and definition; basic assumption of research; objectives of research, motivation in research, typeof research: research approaches: documentary sources, field sources, utility of science research; qualities of a good research worker, general qualities; criteria of good research, problems encountered by researchers – literature review.

Identification of Research Problem Selecting the Research problem–Goals and criteria for identifying problems for research. Perception of research problem – techniques involved in defining the problem – source of problems – personal consideration.

Research Design Formulation of Research design – Need for research design – features of a good design,important concepts related to research design and different research designs.

(15 Lectures)

Unit-II

Hypotheses in research- Review questions, practicum, internet resources.

Sampling techniques- The sampling distribution, review questions, practicum, internet resources, rinted resources.

Measurement, reliability and validity- Levels of measurement, reliability and validity, methods of measuring reliability, methods of measuring validity, review questions, practicum, internet resources, printed resources.

Methods of data collection- Types of questions; questionnaire; problem of response questionnaires; factors affecting response; interview; kinds of interviews; structured interview, unstructured interview;focused interview; repetitive interview; technique of interview; establishing contact; starting aninterview; establishing rapport; recall; probe questions encouragement; guiding the interview;recording;closing the interview; report, observation; kinds of observation; participant observation; non-participant observation; non-controlled observation and controlled observation.

(15 Lectures)

Unit-III

Data analysis- Measures of central tendency, measures of dispersion, correlation, Z-tests, F-tests and T-tests, regression, Chi-Square, Mann-Whitney and Kruskal-Wallis tests and important terms for understanding statistical interpretation.

Research ethics- Regulation of research, examples of bad science research, economic regulation of research, vulnerable population, informed consent, review questions, quiz, practicum, internet resources and print resources.

Programme evaluation and policy analysis- Systems models, the steps of programme evaluation, the steps of policy analysis, review questions, practicum exercises, internet resources and print resources.

Report writing and presentation- Introduction, unit objectives, significance of report writing, different steps in report writing, layout of the research report, types of reports, mechanics of

writing aresearch reports, precautions for writing research reports, oral presentation, summary, answers to check your progress,exercises and questions, further reading, different steps in writing a report, layout of a research report. Types of report, mechanics of writing a research report, precautions for writing a research report and conclusion.

(15 Lectures)

Reference Books:

1. A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMM Vidyalaya press, 1976.
2. Research Methodology Methods and Techniques, C.R. Kothari, New Age international Publishers, 2008.
3. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd., 1997.
4. Research Methodology, Mukul Gupta, DeepaGupta , PHI Learning Private Ltd., 2011.
5. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand and Sons, 1999.
6. Statistica! Methods , G.W. Snedecor and W.G. Cochrans, Lowa state University Press, 1967

SEMESTER -VI

B.Sc. (Hons.) CHEMISTRY SEM-VI

COURSE TITLE:GENERAL CHEMISTRY-VIII

COURSE CODE: CHE 8.0 06TCO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **Semester End Exam: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-Awillconsistof10compulsoryquestions, The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.**20 Marks**

Part-Bwillconsistof10questions, at least 3 questions from each unit, student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry tenmarks.**50 Marks**

Course Objectives- To understand the electronic spectraof d^1 to d^9 states andgain knowledge about classifications, structures, nomenclatures and stereochemistry of the amino acids, peptides, proteins and protein denaturation. To provide conceptual knowledge of thermochemistry at constant pressure and volume. Students will also learn thermodynamic derivatives and principles related to the equilibrium concepts as well as understand about phase equilibria of one and two component systems.

Outcomes-After the completion of the course, the students will be able to: electronic spectra provides valuable insights into the splitting of d-orbitals, structure, bonding, and electronic environment of complexes. Amino acids, peptides, and proteins are the building blocks of life and provides gradual knowledge; amino acid, peptides, proteins and more. Chemical equilibrium provides important insights into reaction behavior, reaction control, their applications and reaction direction productivities. The concepts of acid-baseequilibria explain how buffers resist pH changes? Equilibrium concepts helpto understand pK_a, K_a/K_b, and titration curves.To interpret phase diagrams and their regions where each phase is stable, equilibrium and critical point are exist.

Unit – I

Electron Spectra of Transition Metal Complexes:

Types of electronic transitions, selection rules for d-d transitions, spectroscopy ground states, spectrochemical series, Orgel and Tanabe Sugano energy diagram for d^1- d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complexion and charge transfer spectra.

Thermodynamic and Kinetic Aspects of Metal Complexes:

A brief outline of thermodynamic stability of metal complexes and factor affecting the stability, substitution reactions of square planar complexes. ability, inertness, stability and instability of octahedral complexes and trans effect.

(20 Lectures)

Unit – II

Amino Acids, Peptides, Proteins

Classification, structure and stereochemistry of amino acids.Acid-base behaviour isoelectric point and electrophoresis.Preparation and reactions of α-amino acids.

Structure and nomenclature of peptides and proteins. Classification of protein, peptide structure determination, end group analysis, selective hydrolysis of peptide, classical peptide synthesis, solid-phase peptide synthesis.Structure of peptide and proteins.Levels of protein structure.Protein denaturation/renaturation. Structure and function of nucleic acids and metabolism of nucleotides

(20 Lectures)

Unit – III

Thermochemistry: Standard state, standard enthalpy of formation Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume.Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data. Temperature dependence of enthalpy and Kirchhoff's equation.

Chemical Equilibrium

Equilibrium constant and free energy.Thermodynamic derivation law of mass action.Le Chatelier, reaction isochore –Clapeyron equation and Clausius-Clapeyron equation and applications.

Phase Equilibrium

Statement and meaning of thermo–phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system for water, CO_2 and sulfur systems

Phase equilibria of two component system: Solid – liquid equilibria, simpleand eutectic – Bi-Cd, Pb – Ag systems and de-silverisation of lead.

(20 Lectures)

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry, 5th Ed., Oxford University Press, 2008.
2. Douglas, B.E. and Mc Daniel, D.H., Concepts and Models of Inorganic Chemistry, 3rd Ed. Wiley India, 2006.
3. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. 6th Ed., Wiley-VCH, 2007.
4. Atkins, P.W. & Paula, J. Physical Chemistry, 11th Ed., Oxford University Press, 2018.
5. Housecroft, C.E. and Sharpe, A.G. Inorganic Chemistry, 5th Ed., Pearson, 2018.
6. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, Literary Licensing, LLC, 2012.
7. Morrison, R.N. & Boyd, R.N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar, I.L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Eliel, E.L. &Wilen, S.H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
10. Kalsi, P.S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
11. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. CBS Publishers & Distributors, 2004.
12. Khopkar, S.M.: Basic Concepts of Analytical Chemistry, 3rd Ed. New Age, International Publisher, 2009.

B.Sc. (Hons.) CHEMISTRY SEM-VI
COURSE TITLE: PRACTICALS OF GENERAL CHEMISTRY-VIII
COURSE CODE: CHE 8.0 06 P CO

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**Total lecture-30** **(Two hours each)**

Course Objectives- Students will able to understand chromatographic techniquesfor separation and identification the organic compound mixtures. Some experiments will demonstrate the separation processes of the organic mixtures as well as amino acids. Students will gain deeper understanding of bonding, structure, and reactivity in inorganic compounds via inorganic preparation experiments. Use of the molecular models will enhance the ability to mentally rotate and analyse molecules of the students in 3D space to understand the stereochemistry of organic compounds.

Outcomes-After the completion of the course, the students will be able to: understand separation and identification knowledge of the organic compound mixtures. They will be able to understand the experimental criteria of the preparation of inorganic complexes. Using molecular models will enable them to understand the stereochemistry of organic compounds especially to understanding R/S and E/Z configuration and conformations of the cyclohexane.

I. Major Exercise – **- 15 Marks**

1. Separate the mixture of given amino acids, identify them and also calculate Rf value.
2. To preapre 2,4- dinitrophenylhydrazone of carbonyl compounds namely-acetone, 2-butanone, hexan-2-one and hexan-3-one and separate the mixture using toluene and light petroleum ether (40:60).
3. Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5)
4. Separation of a mixture of phenylalanine and glycine, Alanine and aspartic acid. Leucine and glutamic acid. Spray reagent-ninhydrin.
5. Separation of a mixture of D, L – alanine, glycine and L –leucine using n- butanol:acetic acid: water (4:5:1), spray reagent- ninhydrin.
6. Separation of monosachharides- a mixture of D-galactose and D-fructose using n-butanol:acetone: water (4:5:1), spray reagent-aniline hydrogen phthalate.

II. Minor exercise – Inorganic Preparations **10 Marks**

1. $VO(acac)_2$
2. $Mn(acac)_3$

3. $K_3[Fe(C_2O_4)_3]$
4. Prussian Blue, Turnbull's Blue
5. $Hg[Co(SCN)_4]$
6. $[Ni(NH_3)_6]Cl_2$

III. Minor exercise - **- 10 Marks**

Stereochemical Study of Organic Compounds via Models

1. R and S configuration of optical isomers
2. E, Z configuration of geometrical isomers
3. Conformational analysis of cyclohexane and substituted cyclohexanes.

IV. Viva-Voce **- 10 Marks**

V. Record **-05 Marks**

Reference Books-

1. P.C. Kamboj; University Practical Chemistry,Vishal Publishing Co., Punjab
2. Dr.Gurumeet C Wadhawa, Dr.Vitthal S. Shivankar, Dr.Supriya P. Babar, Dr.MarayappaSonawale; Chemistry Practical for Undergraduate and Postgraduate Students, IIP, Karnatak
3. K.N. Rastogi; Chemistry Practicals, ABD Publishers, Jaipur (Rajasthan)
4. J N Gurtu and R Kapoor; Advanced Experimental Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
5. Prof. B. C. Joshi, Dr. V. K. Goyal and Dr R. L. Pitaliya; Practical Chemistry, CBH, Jaipur
6. Jagdamba Singh, R.K.P. Singh, Jaya Singh etc.; Advance Practical Chemistry, PragatiPrakashan, Meerut
7. Gurtu&Gurtu; Advance Physical Chemistry Experiments, PragatiPrakashan, Meerut
8. N. K. Visnnoi; Advancede Practical Organic Chemistry, Vikas Publishing House Pvt Ltd., New Delhi
9. S.S. Dara; Text Book on Experiments and Calculations- Engineering Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
10. Anil Kumar et.al.; Practical Chemistry (B.Sc.-I, II and III), Shree Publishers & Distributer, Delhi

B.Sc. (Hons.) CHEMISTRY SEM-VI
COURSE TITLE: ADVANCE PHYSICAL CHEMISTRY

COURSE CODE: CHE 8.0 06T E (A)
DSE -A (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **End of Semester Exam: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-Awillconsistof10compulsoryquestions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-Bwillconsistof10questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50Marks***

Course Objectives - This course aims to make the students understand radioactivity, isotope effects and isotopic exchange reactions, atmospheric reactions, transition state, kinetics of enzymes chemical cells, Nernst equation, and applications of EMF measurements in determining various physical chemistry parameters and batteries.

Learning Outcomes- To understand basic concepts of radioactivity, isotopic effect,conductivity and application of conductance measurement in determining various physical chemistry parameters. To provide concepts of standard electrode potential of half cells and calculation of EMF of a cell using Nernst equation. Basic knowledge on chemical dynamics and classical batteries.

Unit-I

Introduction of Radioactivity:

Nuclear models, mass defect, binding energy, mean binding energy of stable nuclei; disintegration theory: nuclear stability and group displacement law; synthesis of radioisotopes: ^{14}C, ^{3}H, ^{32}P, ^{35}S, ^{36}Cl, ^{82}Br, ^{131}I; contribution of the discovery of artificial radioactivity in the field of heavy element chemistry.

Radioactive decay processes: α-decay-penetration of potential barriers hindered α-decay, α-decay energies,β-decay-Fermi theory, Curie plots, comparative half-lives, electron capture, selection rules, forbidden transitions, non-conservation of parity, neutrinos; γ-decay-life-time of

excited states, multi-pole radiation and selection rules, isomeric transition, internal conversion and Auger effect.

Isotope Effects and Isotopic Exchange Reactions:

Isotope effect: Definition, physical and chemical isotope effects, generalities ofisotope effects; Isotopic exchange: Basic concept, characteristics of isotopic exchange, mechanism of isotopic exchange, kinetics of homogenous and heterogeneous isotopic exchange reactions, self-diffusion, and surface measurements.

(20 Lectures)

Unit-II

Chemical Dynamics

Atmospheric Reactions: Physical structure of the atmosphere, chemical composition of the atmosphere, kinetics and mechanism of NO_x, ClO_x cycles and H_2+O_2 reaction. Mechanism ofgeneral methane oxidation.Kinetics and mechanism of low temperature oxidation ofmethane.Concept of global warming.

Transition State: A brief aspect of statistical mechanics and transition state theory. Application in calculation of second order rate constant for reactions involving collision of (1) atom + atom (2)atom + molecule (3) molecule+molecule reactions. Static solvent effects and thermodynamics formulations.Adiabatic electron transfer reactions and energy surfaces.

Kinetics of Enzymes: Kinetics of one enzymes, two substrate systems and their experimental characteristics. Enzyme inhibitors and their experimental characteristics. Kinetics of enzyme inhibited reactions.

(20 Lectures)

Unit-III

Electrochemistry

Conversion and Storage of Electrochemical Energy: Present status of energy consumption: Direct energy conversion by electrochemical means. Maximum intrinsic efficiency ofan electrochemical converter. Physical interpretation of the Carnot efficiency factor in electrochemical energy converters. Power outputs. Electrochemical generators (FuelCells): History of fuel cells, hydrogen oxygen cell, hydrogen air cell, and hydrocarbon air cell, alkaline fuel cell, phosphoric fuel cell, direct NaOH fuel cell and applications of fuel cells.

Electrochemical Energy Storage: Properties of Electrochemical energy stores: Measure of battery performance, charging and discharging of a battery, storage density, energy density. **Classical Batteries**: (i) Lead Acid (ii) Nickel-Cadmium, (iii) Zinc-Manganese dioxide. Modern Batteries:(i) Zinc-Air (ii) Nickel-Metal Hydride, (iii) Lithium Battery, Future Electricity Storages:Storage in (i) Hydrogen, (ii) Alkali Metals, (iii) Non aqueous solutions. **Bio-electrochemistry**: Bioelectronics, Membrane Potentials, Simplistic theory, Modern theory, Electricalconductance in biological organism: Electronic, protonic, electrochemical mechanism of nervous systems and enzymes as electrodes.

(20 Lectures)

Reference Books:

1. Nuclear Chemistry and its applications – By. Haissionsky – Addison Wesley
2. Nuclear and Radio Chemistry – By. G. Friedlander, J. W. Kennedy, E. S. Macias and J. M. Miller – AWiley – Interscience Publication, John Wiley and Sons – III Edition.
3. Modern Electrochemistry Vol. I, IIA, Vol. IIB J'OM Bockris and A.K.N. Reddy, Plenum Pub. NY.
4. Physical Chemistry Vol. 2, Ed. Prof YaGrasimov, Mir publisher.

B.Sc. (Hons.) CHEMISTRY SEM-VI
COURSE TITLE: PRACTICALS OFADVANCE PHYSICAL CHEMISTRY
COURSE CODE: CHE 8.0 06P E (A)

DSE -A (ELECTIVE PAPER)

CREDIT-02, Duration-4 hrs. End of Semester Practical Exam- Max. marks: 50, Min. marks: 20	TOTAL LECTURES -30 (Two Hour each)

Course Objectives-To determine the primary salt effect on the kinetics of ionic reaction, energy and enthalpy of activation in the reaction, energy of activation and entropy of activation, rate constant and formation constant. Kinetics of decomposition of diazonium salt, acidified hydrogen peroxide with KI, emf, standard electrode potential, pK_a of dibasic acid, hydrolysis constant and degree of hydrolysis.

Learning outcomes- After the completion of the course, the students will be able to: develop skill of kinetic studies of various processes, the primary salt effect, enthalpy of activation, energy of activation and entropy of activation, rate constant and formation constant. Kinetic decomposition of various compounds, determination of various values (i.e. EMF, Eo, pKa, formation constant, hydrolysis constant) using potentiometer/pH metry.

(I) Major exercise : **- 15 Marks**

Chemical Kinetics:

1. Determination of the primary salt effect on the kinetics of ionic reaction and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion).
2. Determination of energy and enthalpy of activation in the reaction of KMnO4 and benzyl alcohol in acid medium.
3. Determination of energy of activation of and entropy of activation from a single kinetic run.
4. Determination of rate constant and formation constant of an intermediate complex in the reaction of Ce(IV) and Hypo phosphorous acid at ambient temperature.

(II) Minor exercise: **- 10 Marks**

1 Kinetics of decomposition of benzene diazonium chloride.

2 Kinetics of decomposition of acidified hydrogen peroxide with potassium iodide and determination of activation energy.

(III) Minor Exercise **- 10 Marks**

Potentiometry / pH metry:

1. Determination of EMF of Daniel cell.
2. Determination of standard electrode potential (E_o) value of the ferrous-ferric system by titrating ferrous ammonium sulphate against potassium dichromate potentiometrically.
3. Determination of pK_a of dibasic acid (oxalic acid, succinic acid, etc.).
4. Determination of the formation constant of Ag-ammonia complex and stoichiometry of the complex potentiometrically.
5. Determination of hydrolysis constant and degree of hydrolysis of aniline

(IV) Viva-Voce **- 10 Marks**

(V) Record **- 05 Marks**

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman .
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
4. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
5. Mikes, O. &Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.

B.Sc. (Hons.) CHEMISTRY SEM-VI

COURSE TITLE: ANALYTICAL METHODS IN CHEMISTRY

COURSE CODE: CHE 8.0 06T E (B)

DSE -B (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **End of Semester Exam: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-Awillconsistof10compulsoryquestions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-Bwillconsistof10questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50Marks***

Course Objectives -This course is designed to complement the needs of students who wish to learn more about the qualitative/quantitative characterization and separation techniques. The content of this course aims to cover basic concepts, principles, and techniques of modern analytical chemistry that would empower students with an analytical aptitude and abilities to solve diverse analytical problems in an efficient way. The aim of the laboratory component is to give the students hands-on experience with modern instrumental techniques and chemical analysis.

Learning Outcomes-After the completion of the course, the students will be able to: learn various terminologies and concepts relevant to qualitative and quantitative aspects of analyses and develop an understanding of the importance of separation and analytical techniques in chemistry. To learn various analytical techniques used for qualitative and quantitative characterization of samples. To understand the chemical methods employed for elemental and compound analysis and do chromatographic separation of inorganic ions and organic compounds. Experimentally determine pH values of substances like soil, aerated drinks, fruit juices, shampoos, soaps, etc. and to get introduced to spectrophotometry.

Unit-I

Qualitative and quantitative aspects of analysis:

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and T-test, rejection of data, and confidence intervals.

Optical methods of analysis:

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. *UV-Visible Spectrometry:* Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument.

Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto–enoltautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromatic& detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.

(20 Lectures)

Unit-II

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, and detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Thermal methods of analysis:

Theory of thermogravimetry (TG), basic principle of instrumentation.

Techniques for quantitative estimation of Ca and Mg from their mixture.

Electroanalytical methods:

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pK_a values.

(20 Lectures)

Unit-III

Separation techniques:

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: Extraction by solvation and chelation.

Technique of extraction: Batch, continuous and counter current extractions.Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.

Chromatography: Classification, principle and efficiency of the technique.Mechanism of separation: adsorption, partition & ion exchange.Development of chromatograms: frontal, elution and displacement methods.Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC,TLC and HPLC. Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC).Role of computers in instrumental methods of analysis.

(20 Lectures)

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman .
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wards worth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. &Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.
8. Ditts, R.V. Analytical Chemistry – Methods of separation.

B.Sc. (Hons.) CHEMISTRY SEM-VI

COURSE TITLE: PRACTICALS OFANALYTICAL METHOD IN CHEMISTRY

COURSE CODE: CHE 8.0 06P E (B)

DSE -B (ELECTIVE PAPER)

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**TOTAL LECTURES -30** **(Two Hour each)**
Course Objectives- To understand the separation techniques, chromatography, and solvent extraction. To analyses soil, ion exchange capacity, determination of pK_a value, structural characterization. Determination of DO, COD, BOD, various ions and pH in various drinks. **Learning Outcome-**After the completion of the course, the students will be able to: develop the skills of various separation techniques (i.e. chromatography, solvent extraction, ion exchange, and spectrophotometry and IR spectroscopy) and their applications.	

(I) Major exercise:- 15 Marks

Chromatography separation of mixtures

1. Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.

2. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values.
3. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values.
4. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

(II) Minor exercise : **- 10 Marks**

1. To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry and gallium.
2. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
3. Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques.
4. Determination of pH of soil.
5. Estimation of calcium, magnesium, phosphate and nitrate in soil sample
6. Determination of exchange capacity of cation exchange resins and anion exchange resins.
7. Separation of amino acids from organic acids by ion exchange chromatography.

(III) Minor exercise: **- 10 Marks**

1. Determination of pK_a values of indicator using spectrophotometry.
2. Structural characterization of compounds by infrared spectroscopy.
3. Determination of dissolved oxygen in water.
4. Determination of chemical oxygen demand (COD).
5. Determination of Biological oxygen demand (BOD).

(IV) Viva-Voce **10 Marks**
(V) Record **05 Marks**

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman.

2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wards worth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. &Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.
8. Ditts, R.V. Analytical Chemistry – Methods of separation.

SEMESTER VII

B.Sc. (Hons.) CHEMISTRY SEM-VI

COURSE TITLE: FOOD ADULTRATION AND WASTE WATER TREATMENT

COURSE CODE: CHE 8.0 06T SEC CO

SEC- (SKILL ENHANCMENT COURSE)

CREDITS -03(Max. Marks -75) **Internal Assessment: Max. marks : 22** **End of Semester Exam: Max marks :53**	**TOTAL LECTURES -45** **(One Hour each)**

Instructions: Part-Awillconsistof10compulsoryquestions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry 1.5 marks. **20 Marks**

Part-Bwillconsistof10questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. The first question from Unit-I will be 8 marks and rest four questions from Part B will consist of 7.5 marks each. ***50Marks***

Course Objectives – The objective of the course is to provide students with practical skills regarding detection of food adulteration in different food items and be able to meet the cases of food adulteration at suitable legal platforms as consumer.

Learning Outcomes-After the completion of the course, the students will be able to:

Get basic knowledge on various foods and about adulteration.Understand the adulteration of common food and their adverse impact on health.Comprehend certain skills of detecting adulteration of common foods, be able to extend their knowledge to other kinds of adulteration, detection and remedies.Know the basic laws and procedures regarding food adulteration and consumers rights. Know the steps of waste water treatment methods- Primary, Secondary and Tertiary Treatment.

UNIT-I

Adulterations in common food items:

Adulteration- Definition of Adulteration, legitimate definitions of adulterated food, common adulterants in food, Food Additives – Intentional and accidental. Adverse effects of adulteration on Human Health.

Testing and detection of food adulteration.

Testing and detection of adulterants in the following Food items: Milk, Cheese, Ghee, Oil, Granin, Flours, Sugar, Tea, Coffee, Mustard seeds, Black pepper, Spices and condiments, Processed food, Fruits and vegetables.

(15 Lectures)

UNIT-II

Laws for Prevention of Food Adulteration:

Highlights of Food Safety and Standards Act 2006 (FSSA) – Food Safety and Standards Authority of India – Rules and Procedures of Local Authorities, Prevention of Food Adulteration Act (PFA).

Consumer education, Consumer's problems, rights and responbsibilities, COPRA 2019 – Offenses and Penalties and Procedures to Complain.

(15 Lectures)

UNIT-III

Waste Water Treatment- Waste water, sources of waste water, domestic, industrial, agricultural commercial and others. Primary treatment, secondary treatment and tertiary treatment of waste water.

(15 Lectures)

Reference books:

1. A first course in Food Analysis – A.Y. Sathe, New Age International (P) Ltd., 1999.
2. Food Safety, case studies – Ramesh. V. Bhat, NIN, 1992
3. A first course in Food Analysis, A.Y. Sathe, New Age International (P) Ltd., 1999

4. Food Safety, case studies – R.V. Bhat, NIN, 1992\
5. DART- Detect adulteration with rapid test. FASSAI, Imprinting Trust, assuring safe and nutritious food, Ministry of Health and Family Welfare, Government of India
6. Rapid detection of food adulterants and contaminants Theory and Practice, S.N. Jh, 2016 Kindle Edition.
7. Domestic Test for Food Adulterations, H.G. Christian, Forgotten books. 6. A Laboratory Manual of Food Analysis, S. Sehgal, Wiley Publishers.
8. Food Safety and Standards Act, 2006. Bare ACT, November 2020, Commercial law publishers.

SEMESTER-VII

B.Sc. (Hons.) CHEMISTRY SEM-VII

COURSE TITLE: GENERAL CHEMISTRY-IX

COURSE CODE CHE 8.0 07T1 CO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **End of Semester Exam.: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-Awillconsistof10compulsoryquestions.,The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-B will consis of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50 Marks***

Course Objectives- To understand of the mechanisms and kinetics of reactions involving transition metal complexes.To explore bonding theories in organic molecules including aromaticity and reactivity principles.To introduce group theory and symmetry concepts and apply them to molecular structure and spectroscopy.To discuss the principles of adsorption and surface phenomena with applications in catalysis.

Learning Outcomes After completing this course, students will be able to: explain the kinetic behavior and mechanisms of transition metal complex reactions, including substitution and redox processes.

Unit – I

Fundamentals of Transition Metal Complexes

Energy profile of reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis and conjugate base mechanism direct and indirect evidences in favour of conjugate mechanism.

Reaction Mechanism of Transition Metal Complexes

Anation reactions, reactions without metal ligand bond cleavage, Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reaction, mechanism of one electron transfer reaction, outer-sphere type reactions, cross reactions, Marcus-Hush theory and inner sphere type reactions.

(20 Lectures)

Unit – II

Nature of Bonding in Organic Molecules

Delocalized chemical bonding, conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of π-molecular orbitals, annulenes, anti aromaticity, homoaromaticity and PMO approach.

Bonds weaker than covalent – addition compounds, crown ether complexes and cryptands, inclusion compounds.

Reaction Mechanism: Structure and Reactivity

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin- Hammett principle. Potential energy diagrams.

Generation, structure, stability and reactivity of carbocations, carbanions free radicals, carbenes and nitrenes. Effect of structure on reactivity-resonance and field effects, steric effect, the Hammett & Taft equation- linear free energy relationship, substituent and reaction constants.

(20 Lectures)

Unit – III

Symmetry and Group Theory in Chemistry

Symmetry elements and symmetry operation, definitions of group, sub-group, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Point symmetry group. Schonfilies symbols, representation of groups by matrices (representation for the C_{nh}, C_{nv}, etc. groups to be worked out explicitly). Characters of a representations, Great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscop-y, Derivation of character table for C_{2v} and C_{3v} point group, symmetry aspects of molecular vibrations of H_2O molecule.

Adsorption

Pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation). Gibbs adsorption isotherm, estimation of surface area (BET equation without derivation), mechanism of surface catalytic reactions.

(20 Lectures)

Reference Books -

1. Lee, J.D. Concise Inorganic Chemistry, 5th Ed., Oxford University Press, 2008.
2. Douglas, B.E. and Mc Daniel, D.H., Concepts and Models of Inorganic Chemistry, 3rd Ed. Wiley India, 2006.
3. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. 6th Ed., Wiley-VCH, 2007.
4. Atkins, P.W. & Paula, J. Physical Chemistry, 11th Ed., Oxford University Press, 2018.
5. Housecroft, C.E. and Sharpe, A.G. Inorganic Chemistry, 5th Ed., Pearson, 2018.
6. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, Literary Licensing, LLC, 2012.
7. Morrison, R.N. & Boyd, R.N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar, I.L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Eliel, E.L. & Wilen, S.H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
10. Kalsi, P.S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
11. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. CBS Publishers & Distributors, 2004.
12. Khopkar, S.M.: Basic Concepts of Analytical Chemistry, 3rd Ed. New Age, International Publisher, 2009.

B.Sc. (Hons.) CHEMISTRY SEM-VII

COURSE TITLE: PRACTICALS OF GENERAL CHEMISTRY-IX
COURSE CODE- CHE 8.0 07P1 CO

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**TOTAL LECTURES -30** **(Two Hour each)**

Course Objectives- Analysis of inorganic mixtures. To train students in quantitative estimations using both gravimetric and volumetric methods. To introduce concepts of distribution law, viscosity, and surface tension for studying physical properties of solutions. To enable students to perform complexometric titrations and redox estimations relevant to industrial and environmental chemistry.

Learning Outcomes- By the end of the course, students will be able to: Identify and analyze acidic and basic radicals in complex inorganic mixtures, including rare earth elements. Perform quantitative estimation

I. Major Exercise – **- 15 Marks**

1. To analyse three acidic and three basic radical in given inorganic mixture it may be two acidic radicals dilute and concentrate group with rare earth element.

OR

Estimation of two metal ions involving volumetric and gravimetric methods.
One Gravimetrically and one volumetrically : Ba-Cu, Ag-Cu, Ni-Mg, Pb-Cu, Fe-Cu, Ni-Cu (At least any three)

II. Minor exercise - **- 10 Marks**

1. To study the distribution of iodine between water and CCl_4.
2. To study the distribution of benzoic acid between benzene and water.
3. To determine the viscosity of amyl alcohol in water at different concentrations and calculate the excess viscosity of these solutions.
4. To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone).

III. Minor exercise – Volumetric Analysis **- 10 Marks**

1. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
2. Estimation of hardness of water by EDTA
3. Estimation of ferrous and ferric by dichromate method.
4. Estimation of copper using thiosulphate.

IV. **VIVA VOCE** - **10 Marks**

V. **Record** - **05 Marks**

Reference Books-

1. P.C. Kamboj; University Practical Chemistry,Vishal Publishing Co., Punjab
2. Dr. Gurumeet C Wadhawa, Dr. Vitthal S. Shivankar, Dr. Supriya P. Babar, Dr. MarayappaSonawale; Chemistry Practical for Undergraduate and Postgraduate Students, IIP, Karnatak
3. K.N. Rastogi; Chemistry Practicals, ABD Publishers, Jaipur (Rajasthan)
4. J N Gurtu and R Kapoor; Advanced Experimental Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
5. Prof. B. C. Joshi, Dr. V. K. Goyal and Dr R. L. Pitaliya; Practical Chemistry, CBH, Jaipur
6. Jagdamba Singh, R.K.P. Singh, Jaya Singh etc.; Advance Practical Chemistry, Pragati Prakashan, Meerut
7. Gurtu &Gurtu; Advance Physical Chemistry Experiments, Pragati Prakashan, Meerut
8. N. K. Vishnoi; Advancede Practical Organic Chemistry, Vikas Publishing House Pvt Ltd., New Delhi
9. S.S. Dara; Text Book on Experiments and Calculations- Engineering Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
10. Anil Kumar et.al.; Practical Chemistry (B.Sc.-I, II and III), Shree Publishers & Distributer, Delhi

B.Sc. (Hons.) CHEMISTRY SEM-VII

COURSE TITLE: GENERAL CHEMISTRY-X

COURSE CODE: CHE 8.0 07T2 CO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **End of Semester Exam.: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-Awillconsistof10compulsoryquestions.,The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 MarksPart-B**willconsistof10questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50Marks***

Course Objectives- To understand the formation, bonding, and stability of metal-ligand complexes, including π-complexes. To explore mechanistic pathways in nucleophilic and electrophilic substitution reactions (aliphatic and aromatic). To introduce elementary quantum mechanics and apply it to atomic and molecular systems. To study the structure and behavior of micelles and advanced macromolecular materials.

Learning Outcomes-Aftercompletion of this course, students will be able to: Describe the formation constants and bonding in coordination and π-complexes using MO theory and spectral data.Distinguish between various substituents.

Unit – I

Metal-Ligand Equilibria in Solution

Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-meter and spectrophotometry.

Metal Ligand Bonding

Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π-bonding-and molecular orbital theory.

Metal π-Complexes.

Metal carbonyls, structure and bonding. Vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.

(20 Lectures)

Unit – II

Aliphatic Nucleophilic substitution

The S_N2, S_N1, mixed S_N1 and S_N2 and SET mechanism.

Aromatic Nucleophilic Substitution

The ArS_N1, ArS_N2, benzyne and $S_{RN}1$ mechanism. Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet-Hauser and Smiles rearrangements.

Aliphatic Electrophilic Substitution

Bimolecular mechanism-S_E2 and S_Ei mechanism, electrophilic substitution accompanied by double bond shift. Effect of substrates, leaving group and the solvent polarity on the reactivity.

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring system, quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vismeir reaction and Gattermann-koch reaction.

(20 Lectures)

Unit – III

Elementary quantum Mechanics:

Black-body, radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects. Compton effect.
de-Broglie hypothesis, the Heisenberg's uncertainty principle, Sinusoidal wave equation. Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.
Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave function, radial wave functions and angular wave functions.

Micelles

Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, solubilisation, micro emulsion and revers micelles.

Macromolecules

Electrically conducting, fire or heat resistant and liquid crystal polymers.

(20 Lectures)

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry, 5th Ed., Oxford University Press, 2008.
2. Douglas, B.E. and Mc Daniel, D.H., Concepts and Models of Inorganic Chemistry, 3rd Ed. Wiley India, 2006.
3. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. 6th Ed., Wiley-VCH, 2007.
4. Atkins, P.W. & Paula, J. Physical Chemistry, 11th Ed., Oxford University Press, 2018.
5. Housecroft, C.E. and Sharpe, A.G. Inorganic Chemistry, 5th Ed., Pearson, 2018.
6. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, Literary Licensing, LLC, 2012.
7. Morrison, R.N. & Boyd, R.N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar, I.L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Eliel, E.L. & Wilen, S.H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
10. Kalsi, P.S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
11. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. CBS Publishers & Distributors, 2004.

B.Sc. (Hons.) CHEMISTRY SEM-VII

COURSE TITLE: PRACTICALS OF GENERAL CHEMISTRY-X
COURSE CODE: CHE 8.0 07P 2 CO

CREDIT-02, Duration-4 hrs. **End of Semester Practical Exam-** **Max. marks: 50, Min. marks: 20**	**TOTAL LECTURES -30** **(Two Hour each)**

Course Objectives-To quantitative estimation of amines, phenols, saponification of an ester, acid value of fat or oil, aniline point of an oil. Preparation of various phenolic complexes and organic compounds.

Learning outcome- After the completion of the course, the students will be able to: explain estimation of various organic compounds. Saponification of an ester, acid value of fat or oil, aniline point of an oil. To develop skill of preparation of inorganic and organic synthesis.

- 15 Marks

I. Major Exercise

1. Estimate amines by acetylation method.
2. Estimate phenols using acetylation method.
3. Determine Saponification equivalent of an ester.
4. Determine Acid Value of a fat or oil sample.
5. Determine Aniline Point of an oil sample.

- 10 Marks

II. Minor exercise-

To prepare the following

1. Purssian Blue
2. Hexamminecobalt (III) hexanitrocobaltate (III)
3. Dichloridebis(pyriding)cobalt (II)
4. Tetramminecopper (II) sulphate monohydrate
5. Mercury tetrathiocyanatocobaltate (II)

- 10 Marks

III. Minor exercise

1. To prepare Adipic acid from chromic acid.
2. To prepare p-bromoacetanilide from acetanilide
3. To prepare p-nitroaniline from aniline
4. To prepare 2,4-m –dinitrobenzene from nitrobenzene
5. To prepare Iodoform from ethyl alochol

IV. **VIVA VOCE** - 10 Marks

V. **Record** - 05 Marks

Reference Books -

1. P.C. Kamboj; University Practical Chemistry,Vishal Publishing Co., Punjab
2. Dr. Gurumeet C Wadhawa, Dr. Vitthal S. Shivankar, Dr. Supriya P. Babar, Dr. MarayappaSonawale; Chemistry Practical for Undergraduate and Postgraduate Students, IIP, Karnatak
3. K.N. Rastogi; Chemistry Practicals, ABD Publishers, Jaipur (Rajasthan)
4. J N Gurtu and R Kapoor; Advanced Experimental Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
5. Prof. B. C. Joshi, Dr. V. K. Goyal and Dr R. L. Pitaliya; Practical Chemistry, CBH, Jaipur
6. Jagdamba Singh, R.K.P. Singh, Jaya Singh etc.; Advance Practical Chemistry, Pragati Prakashan, Meerut
7. Gurtu &Gurtu; Advance Physical Chemistry Experiments, Pragati Prakashan, Meerut
8. N. K. Vishnoi; Advancede Practical Organic Chemistry, Vikas Publishing House Pvt Ltd., New Delhi
9. S.S. Dara; Text Book on Experiments and Calculations- Engineering Chemistry, S. Chand & Company Ltd., Ram Nagar, New Delhi
10. Anil Kumar et.al.; Practical Chemistry (B.Sc.-I, II and III), Shree Publishers & Distributer, Delhi

B.Sc. (Hons.) CHEMISTRY SEM-VII

COURSE TITLE: POLYMER CHEMISTRY

COURSE CODE: CHE 8.0 07T E (A)
DSE -A (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **End of Semester Exam.: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50Marks***

Course Objectives- This course is designed with the aim to introduce the theory and applications of polymer chemistry to the students. They will also learn kinetics of polymerization, study of a few industrially important polymers including conducting polymers which are promising classes of polymeric materials for next generation devices.

Learning Outcomes - After completion of this course the students will be able to: Learn the basic concepts, definition and classifications of polymers. Acquire fair knowledge in kinetics of polymerization. Understand the concept of different types of molecular weight of polymers and the theories involved in their determination. Understand various properties of polymers and their solutions. Get introduced to preparation, structure and properties of some industrially important and technologically promising polymers. Carry out laboratory syntheses of a few simple and common polymeric materials. Determine the molecular weight of polymers in laboratory.

Unit-I

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces, chemical bonding in polymers and texture of Polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems and Poly-functional systems.

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations. Mechanism, kinetics of copolymerization and polymerization techniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity. Morphology of crystalline polymers and factors affecting crystalline melting point.

(20 Lectures)

Unit-II

Nature and structure of polymers- Structure Property relationships.

Determination of molecular weight of polymers (*Mn*, *Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Glass transition temperature (Tg) and determination of Tg, Free volume theory, WLF equation. Factors affecting glass transition temperature (Tg).

Polymer Solution – Criteria for polymer solubility, Solubility parameter, thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions. Flory- Huggins theory, Lower and Upper critical solution temperatures.

(20 Lectures)

Unit-III

Properties of Polymers

Brief introduction, preparation, structure, physical, thermal, flow and mechanical properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, polycarbonates, conducting polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphidepolypyrrole, polythiophene)].

(20 Lectures)

Reference Books:

1. Seymour's Polymer Chemistry, Marcel Dekker, Inc.
2. G. Odian: Principles of Polymerization, John Wiley.
3. F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
4. P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
5. R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

B.Sc. (Hons.) CHEMISTRY SEM-VII

COURSE TITLE: INDUSTRIAL CHEMISTRY

COURSE CODE: CHE 8.0 07 T E (B)
DSE -B (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **End of Semester Exam.: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50Marks***

Course Objectives- This course will introduce the students to various industrial gases and inorganic chemicals, their manufacturing processes, applications, storage and hazards in handling them. Students are also expected to learn about metallurgy, energy generation and Synthetic dyes and Nitrogen, Phosphorus, Potasslum (NPK) fertilizers in various industries.

Learning Outcomes- After successful completion of the course, students will be able to: Learn about the manufacture, applications and safe ways of storage and handling of gaseous and inorganic industrial chemicals. Have ideas of industrial metallurgy and energy generation industries. Learn about the chemistry of cement industry. Have fair idea on production of difference types of soap. Get knowledge about classification of synthetic dyes and Manufacture and uses of fertilizers.

Unit-I

Glass Industry

Introduction, Basic raw inaterial of glass, manufacturing process including chemical reaction, types and properties of glass and annealing of glass.

Ceramies (Clay and clay products):-

Formation, classification, composition and plasticity of clay and clay products,

efflorescence on bricks, terracotta ware, Pottery porcelain and other clay products. Sanitary wares, porcelain insulators their chemistry and compositions. Refractories-definition, properties and classification, silica and fire clay refractories.

(20 Lectures)

Unit-II

Cement Industry: Types of cement, manufacture of portland cement, composition, setting and hardening of cement, mortars and concrete, gypsum, plaster of paris, estimation of silica, alumina, calcium oxide and sulphates in portland cement.

Oil, Fats, Soaps:-

Introduction of oils, fats and soaps, chemistry of extraction, refining and bleaching of oil. manufacture of soyabean and cotton seed oils. Extraction of recential oils Phosical chamiel wanania dalle fare and soaps. Manufacture of anionic, cationic, nonionic and ampholytic surfactants and production of difference types of soap.

(20 Lectures)

Unit-III

Synthetic dyes and Nitrogen, Phosphorus, Potassium (NPK) fertilizers:-

Unit process for manufacture of dyestuff-intermediates, general classification of synthetic dyes. Brief ideas of preparation, properties and uses of the nitro, nitroso, azo, triphenylmethane, xanthene and Pthalocyanin dyes. Classification and role of fertilizers. Manufacture and uses of Urea, Ammonium Sulphate, Ammonium Nitrate, Single Super Phosphate, Triple Super Phosphate, Potassium Chloride , Potassium Sulphate fertilizers and Biofertilizers.

(20 Lectures)

References Books :

1. Thermal Engineering Data Handbook, ISDN 978-81-89866-32-7/2007, B. Sreenivasa Reddy, K Hemachandra Reddy
2. Industrial Hygiene and Chemical Safety, ISDN 978-81-888237-92-0. (M.H. Fulekar)
3. Industrial Chemistry, JS Jangwal& A S Mathuria
4. Industrial Chemistry, B K Sharma, Goel Publishing Hose Meerut
5. Industrial Chemistry, Reegel, Reinhold Publishing Co.

B.Sc. (Hons.) CHEMISTRY SEM-VII

COURSE TITLE: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS
COURSE CODE:CHE 8.0 07T E (C)
DSE -C (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **End of Semester Exam.: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-Awillconsistof10compulsoryquestions.,The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-Bwillconsistof10questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50 Marks***

Course Objectives- Students will be introduced to the fundamental concepts/theory and application of different instrumental methods and analytical techniques used in chemistry. It also aims to develop interest among students to take chemistry research in their career ahead.

Learning Outcomes- After completion of this course, students will be able to: Get introduced to a few instrumental methods and analytical techniques needed in chemistry research. Have basic understanding of elemental analyses. Have knowledge on instrumentation part of IR, UV-Vis spectrometry. Learn the concepts behind various chromatographic techniques. Understand the basic concept of mass spectrometry including different ionization processes of samples. Learn separation of binary mixture (metal ions, dyes, organic compound) by chromatographic method in laboratory.

Unit-I

Introduction to spectroscopic methods of analysis:

Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

Molecular spectroscopy:

Infrared spectroscopy:

Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, special problems for portable instrumentation and rapid detection. ***UV-Visible/ Near IR*** – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), single and double beam instruments, interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).

(20 Lectures)

Unit-II

Separation techniques

Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, importance of column technology (packing, capillaries), separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field). Detection: simple vs. specific (gas and liquid), detection as a means of further analysis (use of tags and coupling to IR and MS), electrophoresis (plates and capillary) and use with DNA analysis.

Immunoassays and DNA techniques

Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), separation of ions on basis of mass to charge ratio, magnetic, Time of flight, electric quadrupole, resolution, time, multiple separations, detection and interpretation.

(20 Lectures)

Unit-III

Atomic spectroscopy: Atomic absorption, atomic emission, and atomic fluorescence. excitation and getting sample into gas phase (flames, electrical discharges, plasmas), wavelength separation and resolution (dependence on technique), detection of radiation (simultaneous/scanning, signal noise), interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

NMR spectroscopy: Principle, instrumentation, factors affecting chemical shift, spin-spin coupling and applications.

Electroanalytical Methods: Potentiometry and voltammetry

Radiochemical Methods

X-ray analysis and electron spectroscopy (surface analysis) **(20 Lectures)**

Reference Books:

1. Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler, and Stanley Crouch (ISBN 0-495-01201-7).
2. Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle.
3. P.W. Atkins: Physical Chemistry.
4. G.W. Castellan: Physical Chemistry.
5. C.N. Banwell: Fundamentals of Molecular Spectroscopy.
6. Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
7. W.J. Moore: Physical Chemistry.

B.Sc. (Hons.) CHEMISTRY SEM-VII

COURSE TITLE: INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

COURSE CODE:CHE 8.0 07T E (D)

DSE -D (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **End of Semester Exam.: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-Awillconsistof10compulsoryquestions.,The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-Bwillconsistof10questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50 Marks***

Course Objectives- Students will be able to understand manufacturingof glass Industries, Ceramics, Cements and Fertilizers. They get knowledge of Surface Coatings, Batteries, Alloys, Catalysis and Chemical explosives. It also aims to develop interest among students to take chemistry research in their career ahead.

Learning Outcomes- After completion of this course, students will be able to: Get introduced to a few instrumental methods and analytical techniques needed in of Glass, Ceramics, Cements and FertilizersIndustries.Have basic understanding of Manufacture and processing of glass, Cements, Fertilizersand Oil paintIndustries. Have knowledge Different types of fertilizers..Learn the concepts preparation and explosive properties of Chemical explosives. Understand the basic difference electrolyte battery. Fuel cells, Solar cell and polymer cell.

Unit-I

Silicate Industries

Glass:Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, colored glass and photosensitive glass.

Ceramics:Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes, carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role. Manufacture of cement and the setting process, quick setting cements.

Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride and potassium sulphate.

(20 Lectures)

Unit-II

Surface Coatings:

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, vehicle, modified oils, pigments, toners and lakes pigments. Fillers, Tthinners, enamels, emulsifying agents. Special paints -Heat retardant, fire retardant, eco-friendly paint, plastic paint. Dyes, wax polishing, water and Oil paints. Additives, metallic coatings (electrolytic and electroless), metal spraying and anodizing.

Batteries:

Primary and secondary batteries, battery components, role and characteristics of battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

(20 Lectures)

Unit-III

Alloys:

Classification of alloys, ferrous and non-ferrous alloys, specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

Catalysis:

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications. Deactivation and regeneration of catalysts. Phase transfer catalysts and application of zeolites as catalysts.

Chemical explosives:

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

(20 Lectures)

ReferenceBooks:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics,* Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* Vikas Publications, New Delhi.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut.

SEMESTER-VIII

B.Sc. (Hons.) CHEMISTRY SEM-VIII

COURSE TITLE: PHARMACEUTICAL CHEMISTRY
COURSE CODE: CHE 8.0 08T E (A)
DSE -A (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks :30** **End of Semester Exam.: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsory questions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50 Marks***

Course Objectives- The objective of this paper is to develop basic understanding of drugs discovery, drug design, development and their side effects. It also covers the synthesis of major classes of drugs. The course is also designed to give an overview of fermentation process and production of certain dietary supplements.

Learning Outcomes- After the completion of the course, the students will be able to: Gain an insight into the synthetic approaches of different classes of drugs. Understand the fermentation processes and production of ethanol, citric acids, antibiotics and a few of vitamins. They will be able to carry out laboratory syntheses of a few drug molecules. Get knowledge about the synthesis of Antibiotics like- Sterptomycin, Ampicillin, Amoxicillin, Tetracycline etc.

Unit-I

Drug Design-1

Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrug and soft drugs. Structure-activity relationship (SAR), factors affecting bioactivity. Theories of drug activity-occupancy theory, rate theory and induced fit theory.

Drug Design-II

Quantitative structure activity relationship (QSAR), history and development of QSAR.Concept of drug receptors.Elementary treatment of drug receptor interactions.Physico-chemical parameters-lipophilicity, partition coefficient, electronic ionization constants, steric, Free-Wilson analysis, relationships between Free-Wilson and Hansch analysis. LD-50 ED-50 (Mathematical derivations of equations excluded.)

(20 Lectures)

Unit-II

Pharmacokinetics

Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in therapeutics, uses of pharmacokinetics in drug development process.

Pharmacodynamics

Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, membrane active drugs, drug metabolism, biotransformation, significance of drug metabolism in medicinal chemistry.

(20 Lectures)

Unit-III

Drugs against infection

Introduction and general mode of action.

Synthesis of sulphonamidesfurazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicyclic acid, isoniazedethionamide, ethambutol, fluconazole, ecozole, griseofulvin, chloroquin and primaquine.

Antibiotics

Cell wall biosynthesis, inhibitors, a-lactum rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G, Cephalosporin, Sterptomycin, Ampicillin, Amoxicillin Tetracycline.

(20 Lectures)

References Books-

1. Burger's Medical Chemistry, M.E. Wolff Jolan Wiley Sons N.Y.
2. Principles of Medicinal Chemistry, WO. Foye lea and FebigerPhilabiphia
3. The Organic Chemistry of drugs synthesis, D ledsrocar and LN Mitscher, John Wiley & Sons. N.Y.
4. Medicinal Chemistry, Akar, Wiley Eastern Ltd. N.U.
5. A Text Book of synthetic Drugs, O.D. Tyagi M. Yadav, Anmol Publication
6. An Introduction to drug desigu, S N Pandeya, JR Demmock, New age International Publishers.
7. Biopharmaceuticals & Pharmacokinetics, D.M. Brahanabankar, Sunil B Jaiswal

8. Introduction of Pharmaceutical II, AK Gupta SS Bajaj, CBS Publishers and Distributors.
9. Computer for Chemists, Pundir, PragatiPrakashan

B.Sc. (Hons.) CHEMISTRY SEM-VIII

COURSE TITLE: SPECTROSCOPY
COURSE CODE: CHE 8.0 08T E (B)
DSE -B (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks:30** **End of Semester Exam.: Max marks :70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsory questions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-B will consist of 10 questions; at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50 Marks***

Objectives- To introduce principles and applications of UV, IR, NMR, and Mass spectrometry in organic chemistry. To understand the Woodward–Fieser rules for UV absorption in conjugated systems. To interpret IR spectra using characteristic group frequencies. To learn chemical shift, spin-spin coupling, and signal splitting in ^{1}H and ^{13}C NMR. To analyze mass spectra, including molecular ion and fragmentation patterns. To apply combined spectral data (UV, IR, NMR, MS) for structure elucidation of organic molecules.

Learning Outcomes- After the completion of the course, the students will be able to: Predict λ_{max} values of conjugated systems using Woodward–Fieser rules. Identify functional groups from IR spectra based on group frequencies. Interpret ^{1}H and ^{13}C NMR spectra, including chemical shifts, multiplicity, and coupling patterns. Recognize molecular ions and fragmentation peaks in mass spectra. Correlate UV, IR, NMR, and MS data to determine the structure of organic compounds.Differentiate between structurally similar compounds using combined spectroscopic techniques.

Unit-I

Ultraviolet-Visible (UV-VIS) Spectroscopy:

Electromagnetic radiation and spectroscopy, principles of absorption spectroscopy, nature of electronic excitations, chromophores, auxochromes, origin of UV bands, types of absorption bands, factors affecting the position of UV bands, calculation of $\lambda_{max}$of organic compounds, visible spectra, qualitative and quantitativeapplications.

Infrared (IR) Spectroscopy:

IR regions, molecular vibrations, force constant and bond strength, calculation of vibrational frequencies, Fermi resonance, combination bands, overtones, hot bands, factors affecting the band positions and intensities, sample handling, anharmonicity, group frequencies and applications **(20 Lectures)**

Unit-II

Nuclear Magnetic Resonance (NMR) Spectroscopy:

Nuclear angular momentum, nuclear spin, magnetization and nuclear precession, types of NMR spectrometers, free induction decay, population densities of nuclear spin states, basic principle, equivalent & non-equivalent protons, shielding and de-shielding of nuclei, chemical shift and its measurements, factors affecting chemical shift, spin-spin interactions.Coupling constant J and factors affecting it. Characteristics 1H NMR absorption signals of various type of compounds. Spin systems andits classification, splitting patterns of AB and AX; A_2B_2 and ABX and AMX spin systems. Simplification of spectra: shift reagents and spin decoupling; protonexchange, Nuclear Overhauser Effect. Applications of NMR spectroscopy.

Carbon-13 NMR Spectroscopy:

Carbon-13 nucleus, operating frequency, chemical shifts and their calculation, factors affecting chemical shifts, spin-spin coupling, proton-coupled, proton-decoupled and off-resonance ^{13}C NMR spectra. Applications of ^{13}C NMR spectroscopy.

(20 Lectures)

Unit-III

Electron Spin Resonance (ESR) Spectroscopy:

Basic principle, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value, hyperfine splitting, isotropic and anisotropic hyperfine coupling constants, spin-orbit coupling, significance of g-tensor, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques and applications.

Mass Spectrometry:

Basic principle, production of ions by electron impact, chemical ionization and field desorption techniques, separation and detection of ions. Mass spectrum: molecular ion peak, base peak, isotopic peak, metastable peak, fragmentation patterns of organic molecules with examples of various classes of compounds, McLafferty rearrangement, factors affecting the fragmentation pattern and governing the reaction pathways, identification of molecular ion peaks, determination of molecular weight and molecular formula of compounds, hydrogen deficiency index, nitrogen rule, negative ion mass spectrometry, brief introduction to high resolution mass spectrometry (HRMS) and applications of mass spectrometry.

(20 Lectures)

Reference Books-

1. Encyclopedia of Spectroscopy and Spectrometry, Three-Volume Set: Encyclopedia of Spectroscopy and Spectrometry, Second Edition: 3 volume set
2. NMR Spectroscopy: Basic Principles, Concepts, and Applications in Chemistry, HaraldGünther, Wiley; 2e, 1995.
3. Carbon-13 NMR spectroscopy, Hans-Otto Kalinowski, Stefan Berger, Siegmar Braun, Wiley, 1988.
4. Introduction to Spectroscopy, Donald L. Pavia, Cengage Learning, 2009
5. Organic Structure Determination Using 2-D NMR Spectroscopy: A Problem-Based Approach, Jeffrey H. Simpson, Academic Press, 2008.
6. High-Resolution NMR Techniques in Organic Chemistry, Timothy D. W. Claridge, Elsevier, 1999
7. Identification of Organic Compounds, R. M. Silverstein, G. C. Hassler and T. C. Morill, John Wiley.
8. Organic Spectroscopy, Jag Mohan, Narosa Publication.
9. Spectroscopy of Organic Compounds, P. S. Kalsi, New Age International.
10. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R. V. Parish, Ellis Harwood.
11. Physical Methods in Chemistry, R. S. Drago, Saunders College.
12. Introduction to Magnetic Resonance, A. Carrington and A. D. Maclachalan, Harper & Row.
13. Instrumental Methods of Chemical Analysis, Gurdeep Raj Chatwal and ShyamAnand, Himalaya Publications.

B.Sc. (Hons.) CHEMISTRY SEM-VIII

COURSE TITLE: RESEARCH METHODOLOGY FOR CHEMISTRY
COURSE CODE:CHE 8.0 08T E (C)
DSE -C (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks: 30** **End of Semester Exam.: Max marks: 70**	**TOTAL LECTURES -60** **(One Hour each)**
Instructions: Part-Awillconsistof10compulsoryquestions.The answer to each question should be limited to a	

maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-B will consist of 10 questions, at least three questions from each unit. Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50 Marks***

Course Objectives- This course is introduced to impart knowledge about the basic concepts of research and to provide a road map for conducting research. Students are expected to identify, explain and apply basic concepts of research; acquire information, recognize various issues related to research and to learn instrumental methods required for research in chemistry.

Learning Outcome- After completion of this course, students will be able to: Know about various print and e-resources, search engines needed for carrying out literature survey in a topic. Have some idea about writing literature survey report, review and scientific articles. Learn about plagiarism and how to avoid it. Learn about safe storage of chemicals, disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals. Acquire basic understanding of data analysis andusing statistical tests.

Unit-I

Literature Survey:

Print: Sources of information: Primary, secondary, tertiary sources. Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents. Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples.

Digital: Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books. Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki- Databases, Chemspider, Science Direct, Scifinder and Scopus.

Information Technology and Library Resources: The Internet and World Wide Web Internet resources for chemistry. Finding and citing published information.

(20 Lectures)

Unit-II

Methods of Scientific Research and Writing Scientific Papers:

Reporting practical and project work. Writing literature surveys and reviews.Organizing a poster display.Giving an oral presentation.Writing scientific papers – justification for scientific contributions, Bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics and Avoid plagiarism.

Chemical Safety and Ethical Handling of Chemicals:

Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric – safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals.

(20 Lectures)

Unit-III

Data Analysis

The Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments.

Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests. Chemometrics. Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse. Basic aspects of multiple linear regression analysis.

(20 Lectures)

Reference Books-

1. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011) *Practical skills in chemistry*. 2nd Ed. Prentice-Hall, Harlow.
2. Hibbert, D. B. & Gooding, J. J. (2006) *Data analysis for chemistry*. Oxford University Press.
3. Topping, J. (1984) *Errors of observation and their treatment.* Fourth Ed., Chapman Hall, London.
4. Harris, D. C. *Quantitative chemical analysis*. 6th Ed., Freeman (2007).
5. Levie, R. de, *How to use Excel in analytical chemistry and in general scientific dataanalysis*. Cambridge Univ. Press (2001).
6. Chemical safety matters – IUPAC – IPCS, Cambridge University Press, 1992.
7. OSU safety manual 1.01.

B.Sc. (Hons.) CHEMISTRY SEM-VIII

COURSE TITLE: RESEARCH DESIGN AND IPR
COURSE CODE: CHE 8.0 08T E (D)
DSE -D (ELECTIVE PAPER)

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks: 30** **End of Semester Exam.: Max marks: 70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-A will consist of 10 compulsory questions.The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. ***50 Marks***

Course Objectives: To understand the knowledge on basics of research and its types. To learn the concept of literature review, technical reading, qualitative and quantitative research.To learn about data analysisof research and plagiarism.To discuss the concepts of Intellectual Property Rights in chemistry. Brief concepts of World Trade Organization and Intellectual Property Rights.

Learning Outcomes: On completion of this course, students will be able to: understand the concept and importance in research and exploratory research design.Understand theinterpretation of data and paper writing.Learn about various software for paper formatting. Gain knowledge about the univariate analysis and bivariate analysis. Learn various concepts on Patents, Trademarks and Copyrights.

Unit-I

Research Design: Concept and Importance in Research – Features of a good research design, exploratory research design – concept, types and uses. Descriptive research resigns – concept, types and uses. Experimental design,concept of independent anddependent variables. qualitative and quantitative research, concept of measurement, causality, generalization, replication and merging the two approaches.

(20 Lectures)

Unit-II

Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper Writing – layout of a

research paper, Journals in chemistry, Impact factor of Journals, Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Use of tools and techniques for research: methods to search required information. Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.

(20 Lectures)

Unit-III

Intellectual Property Rights (IPR):

Concept and fundamentals of IPR, need and economic importance of IPR, detaildescription of various IP Properties (Patents, Trademarks, Copyrights, Geographical Indications Industrial Designs and Trade secrets), IPR with emphasis on patent regime, factors affecting IP protectior., penalties for violation or infringement, trade related aspects of IPR.

Brief concepts of World Trade Organization (WTO), General Agreement on Tariffs and Trade (GATT), General Agreement on Trade in Services (GATS), Trade-RelatedAspects of Intellectual Property Rights (TRIPS), Trade-Related Investment Measures(TRIMs).

(20 Lectures)

Reference Books-

1. Basic principles and acquisition of Intellectual Property Rights by Ramakrishna, CIPRA, NSLIU 2005.
2. Intellectual Property Law Handbook by Dr. B. L.Wadhera, Universal Law Publishing Co. Ltd. 2002.
3. Intellectual Property Law (Bare Act with short comments)-Universal Law Publishing Co. Ltd. 2007.
8. The Trademarks Act 1999 (Bare Act with short comments)-Universal Law Publishing Co. Ltd. 2005. Hibbert, D. B. & Gooding, J. J. (2006) *Data analysis for chemistry*. Oxford University Press.
9. Topping, J. (1984) *Errors of observation and their treatment*. Fourth Ed., Chapman Hall, London.
10. Harris, D. C. *Quantitative chemical analysis*. 6th Ed., Freeman (2007).
11. Levie, R. de, *How to use Excel in analytical chemistry and in general scientific dataanalysis*. Cambridge Univ. Press (2001).

12. The Patents Act, 1970 (Bare Act with short comments) - as amended by Patents (Amendment) Rules 2006 w.e.f. 5-5-2006. Commercial law publishers (India) Pvt. Ltd. 2006.

13. Research Methodology – C.R.Kothari

B.Sc. (Hons.) CHEMISTRY SEM-VIII

COURSE TITLE: SUPRA MOLECULAR CHEMISTRY

COURSE CODE: CHE 8.0 08T1 CO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks: 30** **End of Semester Exam.: Max marks: 70**	**TOTAL LECTURES -60** **(One Hour each)**
Instructions: Part-A will consist of 10 compulsory questions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks** **Part-B** will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. **50 Marks**	
Course Objectives- Understanding specificity in molecular interaction. To explore how molecule selectively recognize and bind to specific targets, to identify non covalent forces, hydrogen bonding, Vander Waals, electrostatic, hydrophobic interactions involved in molecular recognition. Designing supramolecular assemblies. To design host-guest systems with desired binding affinities and selectivity. **Learning Outcomes**:-After the completion of the course, the students will be able to: understand fundamental concepts of supramolecular chemistry. Explain principle of non-covalent interaction- hydrogen bonding,π-π stacking, electrostatic, hydrophobic course, describe lock and key and induced fit models in host-gest chemistry, experimental and computational skills and critical thinking and research skill.	

Unit-I

Molecular Recognition and Supramolecular Chemistry

Molecular recognition between crown ether and specific cation (cation diameters for alkali metals and crown ether cavity sizes). Synthesis of crown ethers: 18- crown -6, dibenzo18-crown-6, an ɛza crown with pyridine ring system related to 18 - crown -6 and diamino crown ether related to 18- crown-6. Applications of supramolecular chemistry - crown ethers, synthetic cationchannels and crown ether as phase transfer catalysis.

Natural occurring ionophores (valinomycine and nonactine). Recognition of ammomiunm and alkyl ammonium cation by crown ethers (tetrahedral recognition receptors for ammonium ions).

(20 Lectures)

Unit –II

Supramolecular Crystal Engineering

Guinidine group (anion receptors involving both electrostatic interaction and hydrogen bonding). Polyazamicrocyclic system (anion bonding involving both electrostatic interaction and hydrogen bonding). Expanded Porphyrins- sapphyrins (anion bonding involving both electrostatic interaction and hydrogen bonding). Organometalic receptors (anion bonding involving both electrostatic interaction and hydrogen bonding). Binding of Zwitter ion (coreceptors for complexing simultaneously with cationic anionic sites multiple recognition, chiral recognition).

(20 Lectures)

UNIT-III

Supermolecular Devices

Supermolecular Devices. Light conversion and energy transfer devices. Photoinduced electron transfer in photoactive devices. Tubular mesophases. electroswitching devices banquet type molecule and the chundle approach to molecular channels.

(20 Lectures)

References Books-

1. J.M. Lehn Supra molecular chemistry -Concept and perspective VCH 20062. J.W. Steed and J.L. Atwood-Supra molecular Chemistry-John Willey and Sons Inc. 2009

3. P.S. Kalsi and J.P.Kalsi- Bio-organic, Bio-inorganic and Supra molecular chemistry, New age International 2010.

4. Donald J. Cram-Comprehensive Supra molecular chemistry- Elsevier series

5. Anslyn E. V. - Supramolecular analytical chemistry J. Org. Chem 2003, 68

B.Sc. (Hons.) CHEMISTRY SEM-VIII

COURSE TITLE: IMPORTANT BIOMOLECULES

COURSE CODE: CHE 8.0 08T2 CO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks: 30** **End of Semester Exam.: Max marks: 70**	**TOTAL LECTURES -60** **(One Hour each)**

Instructions: Part-will consist of 10 compulsory questions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **20 Marks**

Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks. **50 Marks**

Course Objectives- This course is to make students understand the significant features of the chemistry of the biomolecules viz. carbohydrates, proteins, lipids, vitamins and nucleic acids. Classification, characteristic reactions, biological importance of these biomolecules will be thoroughly discussed. It also aims to introduce the learners to the physic-chemical properties of nucleic acids.

Learning Outcomes: On completion of this course, students will be able to: Know the occurrence, classification and biological importance of carbohydrates. Learn various reactions of aldoses and ketoses as well as their interconversions. Understand the structure and synthesis of peptide chains and proteins. Gain knowledge about the Ramachandran plots. Get introduced to lipids, oils and fats. Learn about the properties and types of Vitamins

Unit-I

Carbohydrates: Classification, physico-chemical properties, chemistry, biological roles and structural elucidation of polysaccharides-homo and heteropolysaccharides, Peptidoglycans, Glycosaminoglycans; Glycoconjugates Proteoglycans, Glycoproteins and Glycolipids; Oligo saccharides. Lectin interactios in biochemical processes.

Amino acids: Classification, Structure and physico-chemical properties; peptide bond, peptides of biological importance; chemical synthesis of peptides – solid phase peptide synthesis; Proteins – classification, isolation, purification and characterization of proteins, criteria of homogeneity; protein sequencing; structural organization of proteins – Ramachandran plots and denaturation of proteins.

(20 Lectures)

Unit-II

Lipids: Classification, structure, properties and biological roles of phospholipids and sphingolipids, fatty acids and their physic-chemical properties. Fats and waxes –physico-chemical properties and characterization of fats and oils. Structure, properties and functions of Eicosanoids - Prostaglandins, Prostacyclins, Thromboxanes, Leukotrienes; chemistry and properties of Sterols and Steroids – Bile acids and Bile salts; salient features of Bacterial and Plant lipids.

Vitamins-Definition, occurrence, properties and types with special reference to Vitamins A and B.

(20 Lectures)

Unit-III

Nucleic acids: Bases, Nucleosides, Nucleotides; Nucleotides as energy carriers, chemistry of purines, pyrimidine and uric acid-synthesis and uses of uracil, cytosine, thymine, adenine, guanine. Isolation of caffeine from its natural source. Constitution of RNA and DNA, DNA profiling. DNA finger printing. physico-chemical properties of nucleic acids: denaturation and renaturation kinetics of nucleic acids. Melting temperature, cot curves; sequencing of nucleic acids enzymatic and chemical methods. Structure and properties of porphyrins – Heme, chlorophylls, bacteriochlorophylls and cytochromes

(20 Lectures)

Reference Books:

1. Text book of Biochemistry –E.S.West, W.R.Todd et al., 4th ed
2. Principles of Biochemistry by Lehninger –D.L.Nelson, M.M.Cox7th ed
3. Text book of Biochemistry with clinical correlations-Thomas M.Devlin, 7th ed
4. Harper's review of Biochemistry –D.W. Martin, 19th ed
5. Biochemistry – J.M.Berg, J.L.Tymockzo, L.Stryer, 5th ed Biochemistry-Reginald H. Garret, Charles M.G

B.Sc. (Hons.) CHEMISTRY SEM-VIII

COURSE TITLE: SPECTROSCOPY AND STRUCTURE DETERMINATION OF ORGANIC COMPOUND

COURSE CODE: CHE 8.0 08T3 CO

CREDITS -04 (Max. Marks -100) **Internal Assessment: Max. marks: 30** **End of Semester Exam.: Max marks: 70**	**TOTAL LECTURES -60** **(One Hour each)**
Instructions: Part-A will consist of 10 compulsory questions.The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.	**20 Marks**
Part-B will consist of 10 questions; at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.	**50 Marks**
Subject Objectives -To introduce principles of UV, IR, PNMR, CNMR and Mass spectrometry in the field of chemistry. To understand the UV absorption in various systems. To understand IR spectra using characteristic group frequencies. To learn chemical shift, spin-spin coupling, and signal splitting in ^{1}H and ^{13}C NMR. To interpretate mass spectra,.including molecular ion and fragmentation patterns. **Learning Outcomes**After the completion of the course, the students will be able to: Predict λ_{max} values of conjugated systems using. Identify functional groups from IR spectra based on group frequencies. Interpret ^{1}H and ^{13}C NMR spectra, including chemical shifts, multiplicity, and coupling patterns. Recognize molecular ions and fragmentation peaks in mass spectra.	

Unit-I

Ultraviolet and Visible spectroscopy - Woodward Fieser rules for calculating λ_{max} in dienes, trienes, α, β- unsaturated carbonyl compounds,ester,amide, nitriles and carboxylic acid, Aromatic systems-benzene and its substituted derivatives. Conjugation in two aromatic rings and polycyclic aromatic hydrocarbons. Effect of structure-strain-steric effect in Biphenyls and Chromophore distrortion.

IR Spectroscopy-Interpretation of infrared spectra of organic compounds. IR group frequencies alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohol, carbonyl compounds, amines, phenols, ethers, nitro compounds and carboxylic acid their derivatives. Applications of IR.

(20 Lectures)

Unit-II

NMR Spectroscopy-

Proton NMR- Chemical Shift, splitting of the signals, chemical shift equivalence, spin--spin coupling and splitting of signals in different environment. Interpretation of the spectra of common organic compounds. Proton exchange reactions and Hydrogen Bonding. Influence on hydroxyl and amino groups.

Carbon -13 NMR- Chemical shift and factors affecting it. Multiplicity-Broad Band (BB), Proton Decoupled Spectra, Hydrogen Decoupled Spectra. Equivalence, chemical shift in alkanes, alkenes,alkynes, aromatic hydrocarbons, alcohol, carbonyl compounds, carboxylic acid and its derivatives.

(20 Lectures)

Unit -III

Mass spectrometry–Molecular weights of organic compounds, molecular ion peak, base peak, metastable peak, isotopic abundance peaks, McLafferty rearrangement, Nitrogen Rule, detection of isotopes, Characterization of organic compounds on the basis of fragmentation and mass spectra of various class of organic compounds.

Structure elucidation by joint application of UV, IR, PNMR, CNMR and Mass spectroscopic techniques.

(20 Lectures)

References Books:

1. Identification of Organic Compounds, R. M. Silverstein, G. C. Hassler and T. C. Morill, John Wiley.
2. Spectroscopy of Organic Compounds, P. S. Kalsi, New Age International.
3. Carbon-13 NMR spectroscopy, Hans-Otto Kalinowski, Stefan Berger, Siegmar Braun, Wiley, 1988.
4. Introduction to Spectroscopy, Donald L. Pavia, Cengage Learning, 2009
5. Organic Structure Determination Using 2-D NMR Spectroscopy: A Problem-Based Approach, Jeffrey H. Simpson, Academic Press, 2008.
6. High-Resolution NMR Techniques in Organic Chemistry, Timothy D. W. Claridge, Elsevier, 1999

7. Organic Spectroscopy, Jag Mohan, Narosa Publication.
8. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R. V. Parish, Ellis Harwood.
9. LC/MS: A Practical User's Guide by Marvin McMaster, Wiley-Interscience