University of Rajasthan
Jaipur

SYLLABUS

(Three/Four Year Under Graduate Programme)

B.Sc. Chemistry

I & II Semester

Examination-2024-25

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PROGRAMME PREREQUISITES/ELIGIBILITY
12th standard pass in science from CBSE, RBSE or a recognized board of education.
PROGRAMME OUTCOMES (POs)

1. Basic Knowledge of Science: Students will get acquainted with the knowledge of chemical science which helps them to understand various phenomena happening in their surroundings.
2. Dealing with untoward incidence: The knowledge of science will help them to deal with untoward incidents in the neighborhood. For example, sudden explosion by chemicals and excessive misuse of unwanted substances can be managed with basic knowledge of chemistry and environmental pollution can be controlled by the students by spreading awareness in the society about the harmful pollutants.
3. Proficiency in Scientific Principles: Students will demonstrate a strong understanding of fundamental scientific principles in chemistry and they will be able to apply these principles to analysis and solution.
4. Quantitative and Computational Skills: Students will acquire proficiency in quantitative, analytical and computational principles. They will be able to perform calculations, manipulate mathematical expressions, and use computational tools to solve scientific problems.
5. Experimental and Laboratory Skills: Students will.gain practical experience conducting experiments, using laboratory apparatus and equipment, and performing experimental data analysis. They will understand the importance of accurate measurement, data interpretation, and documentation.
6. Employability: Students will get employment in the following sectors:
   - The students can go in chemical and related industries viz. Pharmaceutical, Agrochemicals, Metallurgical, Fertilizer, Biofertilizer, Organic fertilizer, Textile, Food ceramic, Cement, Petrochemicals, Pesticides Plastics and Polymers etc.
   - The students can go for Ballistics, Forensic Lab, Bio Warfare Labs, CBIR Labs, DRDO, Industrial Chemistry etc.
   - They can opt a career in Petroleum, Soil Testing Labs environment conservation, preservation, and as Analytical Chemist, Chemical Product Officer, Radiologist and Toxicologist.
7. Development of communication skills: Students will develop effective oral and written communication skills. They will be able to clearly and concisely communicate scientific ideas, principles and experimental results to both technical and non-technical audiences.
8. Development of Teamwork and Collaboration Skills: Students will develop teamwork and collaboration skills through group projects, laboratory work, and research activities. They will be able to work effectively in diverse teams and contribute to collective goals.

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SEMESTER-WISE PAPER TITLES WITH DETAILS

UG0806 – Four Year Bachelor of Science (Chemistry) Subject/Discipline - Chemistry					
Credit Framework for Four Year Bachelor of Science (Chemistry) under NEP – 2020					
Academic Session 2023-2024					
Semester	Course Code	Course Title	Credits		Marks
			L	P	
I	CHM-51T-101	Chemical Bonding and Chemistry of Representative and Transition elements.	4	0	100
	CHM-51T-102	State of Matter, Chemical Kinetics and Thermodynamics.	4	0	100
	CHM-51P-103	Practical I	0	2	50
	CHM-51P-104	Practical II	0	2	50
II	CHM-52T-105	Organic reaction mechanism, Stereochemistry, Hydrocarbons, Aliphatic and aromatic halides	4	0	100
	CHM-52T-106	Principles of Analytical methods	4	0	100
	CHM-52P-107	Practical I	0	2	50
	CHM-52P-108	Practical II	0	2	50

Scheme of Examination:

1 credit = 25 marks for examination/evaluation

Notes:

Continuous assessment, in which sessional work and the terminal examination will contribute to the final grade. Each course in Semester Grade Point Average (SGPA) has two components- Continuous assessment (20% weightage) and (End of Semester Examination) EoSE (80% weightage).

1. Sessional work will consist of class tests, mid-semester examination(s), homework assignments, etc., as determined by the faculty in charge of the courses of study.
2. Each Paper of EoSE shall carry 80% of the total marks of the course/subject. The EoSE will be of 3 hours duration.
   - **Part-A** of the paper shall have multiple questions of equal marks. This first question shall be based on knowledge, understanding and applications of the topics/texts covered in the syllabus.
   - **Part B** of the paper shall consist of 4 questions with an internal choice of each. The four questions will be set with one from each of the units with internal choice. Third to fourth questions shall be based on applications of the topics/texts covered in the syllabus (60% weightage) and shall involve solving Problems (40% weightage) if applicable.

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3. 75% Attendance is mandatory for appearing in EoSE.
4. To appear in the EoSE examination of a course/subject student must appear in the mid-semester examination and obtain at least a C grade in the course/subject.
5. Credit points in a Course/Subject will be assigned only if, the student obtains at least a C grade in midterm and EoSE examination of a Course/Subject.

Syllabus: UG0806 - B.Sc. (Honors)

CHEMISTRY

Semester I (2023-2024)

Course Code	Course Title	Duration	Maximum Marks	Minimum Marks
CHM-51T-101	Chemical Bonding and Chemistry of Representative and Transition elements.	MT - 1 Hr. EoSE - 3 Hrs.	MT - 20 EoSE - 80	MT - 08 EoSE - 32
CHM-51T-102	States of Matter, Chemical kinetics and Thermodynamics.	MT - 2 Hrs. EoSE - 4 Hrs.	MT - 10 EoSE - 40	MT - 04 EoSE - 16
CHM-51P-104	Practical I	MT - 2 Hrs. EoSE - 4 Hrs.	MT - 10 EoSE - 40	MT - 04 EoSE - 16
CHM-51P-104	Practical II	MT - 2 Hrs. EoSE - 4 Hrs.	MT - 10 EoSE - 40	MT - 04 EoSE - 16
Prerequisites/Eligibility	12^{th} standard pass in science from CBSE, RBSE or a recognized board of education.			
Course Objectives: The aim of this course is to provide students with a theoretical understanding of the basic constituents of matter, atoms, ions and molecules in terms of their electronic structure and chemical bonding of these are to be explained by applying basic quantum chemistry, and to explain periodicity in the physical and chemical properties of s, p and d block elements and also to explain chemistry of their compounds. The objective of this course is also to explain the basic concepts of thermodynamics in addition to heat capacity, Joule's law, different types of enthalpies and bond enthalpies and their applications, and to explain the structural differences and transformations between states of matter and structural determination of solids. In addition, the laboratory courses are designed to provide students with practical experience in basic qualitative analytical techniques related to radicals, quantitative analytical techniques related to volumetric analysis, and the determination of physical properties of matter, p^{K_a} of an acid and kinetic parameter for various reactions.				
Course Outcomes: By the end of this course, students will have a clear understanding of various concepts related to atomic and molecular structure, chemical bonding, periodicity in the physical and chemical properties of s, p and d block elements and chemistry of their compounds. Students will also have practical experience in calibration of glassware, qualitative analysis of radicals, quantitative analytical techniques including volumetric analysis, determination of various				

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physical properties of substances, crystallization and preparation of standard solutions of different concentrations and determination of order and rate constant of various reactions.

Syllabus

CHM-51T-101: Chemical Bonding and Chemistry of Representative and Transition elements.
4 Hrs./week

Duration	Maximum Marks	Minimum Marks
1 Hour	Midterm – 20 Marks	Midterm – 08 Marks
3 Hours	EoSE – 80 Marks	EoSE – 32 Marks

Unit-I

Ionic Bond:

General characteristics, types of ions, size effects, radius ratio and coordination number, Madelung-constant, Born-Haber cycle, applications of lattice energy, polarizing power, polarizability, Fajan's rules, hydration energy, solubility of ionic-compounds, defects in structures, Frankel and Schottky defects, non-stoichiometric compounds.

Solids:

Metallic bond: Qualitative idea of free electron, valence bond and band theories, semiconductors and insulators, conduction in ionic solids, electrical and magnetic properties of solids, introduction to superconductors and super-conductivity. **15 Lecture**

Unit-II

Covalent bond: General characteristics, Valence bond theory and its limitations. Directional characteristics of covalent bond, Resonance and resonance energy, Hybridization involving s, p and d-orbitals.

Valence Shell Electron Pair Repulsion (VSEPR) Theory to NH_3, H_2O, H_3O^+, SF_4, ClF_3, $IC1_2^-$, shapes of simple inorganic molecules and ions. Dipole moment, percentage ionic-character from dipole moment and electronegativity difference.

Molecular Orbital Theory: Detailed description of linear combination of atomic orbital (LCAO), Homonuclear (H_2, He_2, B_2, C_2, N_2, O_2, F_2) and heteronuclear diatomic molecules (CO, NO) and their ions, comparison of valence bond and molecular orbital theories, multicenter bonding in electron deficient molecules, bond strength and bond energy.

Weak Interactions:

Hydrogen bond, theories of hydrogen bonding. Weak intermolecular forces of attraction, Vander Waals forces. **15 Lecture**

Unit-III

s-Block Elements:

Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their functions in biosystems, an introduction to alkyls and aryls.

p-Block Elements:

Comparative study of the p-block elements and group trends, electronic configuration, physical and chemical properties, diagonal relationship, atomic and ionic radii, ionization potentials, electron affinity, electronegativity and oxidation states, oxidation state diagrams on the basis of redox potentials, inert pair effect, catenation.

Compounds of p-Block Elements:

Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), silicones, oxygen fluorides, peracids of sulphur, tetrasulphur tetranitride, basic properties of halogens, interhalogen compounds and polyhalides.

Chemistry of Noble Gases:

Position in the periodic table, discovery, isolation, important compounds of noble gases with special references to xenon compounds: Synthesis, bonding and their stereochemistry. **15 Lecture**

Unit-IV

d-Block elements:

Chemistry of the elements of first transition series: Electronic configuration and comparative study with respect to atomic and ionic radii, oxidation states and ionization potentials. Redox potentials, oxidation state diagrams on the basis of redox potentials, binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry, metallic nature, magnetic properties, catalytic activity, colour and spectral properties of transition metal ions.

Chemistry of the elements of second and third transition series: Electronic configuration, general characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry. **15 Lecture**

Suggested Books and References:

1. Lee, J.D. Concise Inorganic Chemistry Wiley, India.
2. Housecroft, Catherine E. & Sharpe, Alan G. Inorganic Chemistry, Pearson Education Ltd.
3. Tuli, G. D. Advanced Inorganic Chemistry, S. Chand, New Delhi.
4. Satya Prakash Advanced Inorganic Chemistry, S. Chand, New Delhi.
5. Adams, D. M. Inorganic Solids – Introduction to Concepts in Solid-state Structural Chemistry, John Wiley, London.
6. Puri, Sharma & Kalia, Principles of Inorganic Chemistry, S. Chand, New Delhi.
7. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, Wiley.

8. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
9. Sharpe G., Inorganic Chemistry, Pearson Education Ltd.
10. Pfennig Brian W. Principles of Inorganic Chemistry, John Wiley & Sons.

Syllabus

CHM-51T-102: Stats of Matter, Chemical Kinetics and Thermodynamics.
4 Hrs./week

Duration	Maximum Marks	Minimum Marks
1 Hour	Midterm – 20 Marks	Midterm – 08 Marks
3 Hours	EoSE – 80 Marks	EoSE – 32 Marks

Unit I

States of matter:

Ideal gases: Kinetic Theory of Gases, Concept of molar mass and molar volume. Determination of molar mass of a gas and volatile substances. The barometric distribution laws. Maxwell distribution law of molecular velocities. The Maxwell energy distribution. The Maxwell Boltzmann distribution law and its experimental verification, Derivation of average, root mean square velocities and most probable velocities. Collision properties: Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules.

Real gases: Deviations of real gases from ideal behaviour, compressibility factor, causes of deviation. Van der Waal's equations and its implications. Isotherms of van der Waals gas. Critical phenomenon and critical constants. Reduced equation of state and law of corresponding states.

15 Lecture

Unit II

Mathematical Concepts: Logarithmic relations, curve sketching, linear graphs and calculations of slopes, differentiation of functions like k_x, e^x, x^n, sinx and log x; maxima and minima, partial differentiation and reciprocity relations, integration of some useful/relevant functions; permutations and combinations, factorials, probability. Matrices and Determinant.

Liquid State:

Thermal expansion and compressibility, Heat of vaporization. Determination of vapour pressure and heat of vaporization. Disorder in liquid state and structure of liquid water. Intermolecular forces. Cohesion of liquids. Eyring theory of liquids, seven segment cell.

Solid state: Crystalline and amorphous states. Isotropy and anisotropy. Elements of symmetry. Law of rational indices. Weiss and miller indices and equation of plane in intercept form. Law of constancy of interfacial angles. Unit cell and lattice, Laue's method and powder method of X-ray examination of crystals,

15 Lecture

Unit III

Chemical Kinetics:

Rate, Initial rate, specific rate, rate constant and units. Method of determination of initial rate. Order, molecularity and stoichiometry of reaction. Methods of determination of order of reaction. Derivation of integrated rate equations- zero order, first order, second order and third order. Graphical applications of these equations for the determinations of rate constant. Effect of temperature on rate constant, Arrhenius equation, energy of activation and its determination. Complex reactions and their nature. Derivation of rate equation for the opposing or reversible reactions ($A + B \leftrightarrow C$), parallel reactions and consecutive reactions ($A \rightarrow B \rightarrow C$), characteristics of consecutive reactions. **15 Lecture**

Unit IV

Thermodynamics:

Definitions of thermodynamic terms: system, surroundings, thermodynamic process. Concept of work and heat, Internal energy, Enthalpy. State and path functions and their exact and inexact differential, Work of expansion and compression under isothermal and adiabatic conditions. Zeroth law of thermodynamics, first law of thermodynamics. Changes in enthalpy at constant temperature and pressure. Concept of heat capacity (C_p and C_v) and their thermodynamic relationship. Application of first law of thermodynamics. The heat of reaction and heat of formation. Hesse's Law. Heat of reaction at constant Pressure and volume. Variation of heat of reaction with temperature. Bond enthalpies and bond energies. **15 Lecture**

Suggested Books and References:

1. Puri, B. R., Sharma, L. R. & Pathania, M. S. Principles of Physical Chemistry, Vishal Publishing Co.
2. Gurdeep Raj, Advanced Physical Chemistry, Goel Publishing House.
3. Atkins, W. Physical Chemistry, Oxford University Press.
4. Silby, R. J. & Alberty, R. A. Physical Chemistry, John Wiley & Sons.
5. Barrow, G.M. Physical Chemistry, Tata McGraw-Hill.
6. Kapoor, K. L. A Textbook of Physical Chemistry, (Volume 1) Macmillan India Ltd.
7. Kapoor, K. L. A Textbook of Physical Chemistry, (Volume 1) Macmillan India Ltd.

Syllabus

CHM-51P-103: Practical I **4 Hrs./week**

Duration	Maximum Marks	Minimum Marks
2 Hours	Midterm – 10 Marks	Midterm – 04 Marks
4 Hours	EoSE – 40 Marks	EoSE – 16 Marks

Inorganic Chemistry

A. **Qualitative analysis:** **15 marks**

Analysis of the given inorganic mixture containing six radicals (three acidic and three basic) including interfering acid radicals - fluoride, borate, oxalate, phosphate and excluding insoluble.

B. **Quantitative analysis: Volumetric analysis** **15 marks**

1. Estimation of Ca^{2+} & Mg^{2+} using EDTA solution.
2. Estimation of Cu (II) ions iodometrically, using sodium thiosulphate solution.
3. Determination of total hardness of water.
4. Determination of number of molecules of water of crystallization in oxalic acid crystals.
5. Estimation of sodium carbonate and bicarbonate in mixed solution.
6. Estimation of sodium carbonate and sodium hydroxide in a mixed solution.
7. Estimation of Ferrous and Ferric sulphates in a mixed solution.

Viva voce **5 marks**

Practical Record **5 marks**

Suggested Books and References:

1. Vogel, A. I. Vogel's Qualitative Inorganic Analysis, Prentice Hall.
2. Vogel, A. I. Vogel's Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, ELBS.
3. Gurdeep Raj, Advance Practical Inorganic Chemistry, Goel Publishing House.

Syllabus

CHM-51P-104: Practical II **4 Hrs./week**

Duration	Maximum Marks	Minimum Marks
2 Hours	Midterm – 10 Marks	Midterm – 04 Marks
4 Hours	EoSE – 40 Marks	EoSE – 16 Marks

Physical Chemistry: **(any two exercise, 2 × 15 = 30 marks)**

1. To study the solubility curve of salts such as potassium nitrate, etc.
2. To Study the solubility curve of phenol in water and hence study the effect of separate addition of substances such as naphthalene, potassium chloride and acetic acid.
3. Determination of pH of different buffer solutions and evaluate the p^{K_a} of an acid by Handerson equation.
4. Determine the relative viscosity of a liquid by using viscometer.

5. Determine the relative surface tension of a liquid by using stalagmometer.
6. Determine the heat of neutralization of an acid and base.
7. Determine the molecular complexity of benzoic acid in benzene by Distribution Law.
8. Determine the heat of reaction and verify Hess's law.

Viva voce **5 marks**

Practical Record **5 marks**

Suggested Books and References:

1. Yadav, J. B. Advanced Practical Physical Chemistry, Goel Publishing House.
2. Khosla, B. D. Practical Physical Chemistry, S. Chand & Company.

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CHEMISTRY

Semester – II (2023-2024)

Course Code	Course Title	Duration	Maximum Marks	Minimum Marks
CHM-52T-105	Reaction mechanism, Stereochemistry and Hydrocarbons	MT - 1 Hr. EoSE - 3 Hrs.	MT - 20 EoSE - 80	MT - 08 EoSE - 32
CHM-52T-106	Principles and Methods of Analytical Techniques.	MT - 1 Hr. EoSE - 3 Hrs.	MT - 20 EoSE - 80	MT - 08 EoSE - 32
CHM-52P-107	Practical I	MT - 2 Hrs. EoSE - 4 Hrs.	MT - 10 EoSE - 40	MT - 04 EoSE - 16
CHM-52P-108	Practical I	MT - 2 Hrs. EoSE - 4 Hrs.	MT - 10 EoSE - 40	MT - 04 EoSE - 16

Course Objectives: The objective of this course is to provide students with a theoretical understanding of the types of organic reactions and their mechanisms, generation and stability of various intermediates, determination of rection mechanism, stereochemistry of organic compounds with an understanding of the enantiomers, diastereomers, D/L and R/S nomenclature. The aim of this course is to explain the structure and reactivity of aliphatic and aromatic hydrocarbons, alkyl and aryl halides, and to explain principles and methods of different analytical techniques viz. quantitative analysis including volumetric and gravimetric analysis, solvent extraction, distillation. In addition, the laboratory course is designed to provide students with practical experience in basic quantitative analytical techniques including volumetric and gravimetric analysis, qualitative analytical techniques, and the laboratory techniques.

Course Outcomes: By the end of this course, students will have a clear understanding of drawing logical and detailed reaction mechanisms for various fundamental reactions of aliphatic and aromatic hydrocarbons, methods of determining the reaction mechanisms, classifying the

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molecules as chiral or achiral, determining the D/L and R/S nomenclature of stereoisomers and identifying the formation of racemic mixture or optically active compounds during the reactions. Students will also have an understanding about principles and methods of analytical techniques. Students will also have practical experience in quantitative analytical techniques including volumetric and gravimetric analysis, identification of organic compounds by determination of functional groups, thin layer and paper chromatography.

Syllabus

CHM-52T-105: Reaction mechanism, Stereochemistry, Hydrocarbons, Aliphatic and aromatic halides.
4 Hrs./week

Duration	Maximum Marks	Minimum Marks
1 Hour	Midterm – 20 Marks	Midterm – 08 Marks
3 Hours	EoSE – 80 Marks	EoSE – 32 Marks

Unit-I

Structure and Bonding: Hybridization, inductive effect, hyperconjugation, resonance, Vander Waals interactions, inclusion compounds, clathrates, charge transfer complexes, hydrogen bonding.

Mechanism of Organic Reactions: Free radical and ionic reactions, homolytic and heterolytic bond breaking, electrophiles and nucleophiles, types of organic reactions, energy considerations, transition state, reactive intermediates-carbocations, carbanions, free radicals, carbenes, arynes and nitrenes. Methods of determination of reaction mechanism.

Alkanes: Nomenclature of branched and unbranched alkanes. Classification of carbon atoms in alkanes. Isomerism in alkanes, methods of formation (with special reference of Wurtz reaction. Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids) physical properties and chemical reaction of alkanes. Mechanism of free-radical halogenation of alkanes, orientation, reactivity and selectivity. **15 Lecture**

Unit-II

Stereochemistry of Organic Compounds: Concept of isomerism. Types of isomerism.

Optical Isomerism: Elements of symmetry, molecular chirality, enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resoltuion of enantiomers, inversion, retention and racemization, Asymmetric synthesis.

Relative and absolute configuration, sequence rule, D & L and R & S systems of nomenclature.

Geometric isomerism: Determination of configuration of geometrical isomers, E & Z system of

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nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational isomerism: Conformational analysis of ethane and n-butane. Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **15 Lecture**

Unit-III

Cycloalkanes: Nomenclature, methods of formation, chemical reactions. Baeyer's strain theory and its limitations. Ring strain in small rings (cyclo-propane and cyclo-butane). Theory of strain less rings. The case of cyclopropane ring: banana bonds.

Alkenes: Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff 's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes, mechanisms involved in hydrogenation, electrophilic and free radical additions. Markovnikov's rule, hydroboration-oxidation, oxymercuration- demercuration, epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.

Cycloalkenes: Methods of formation, conformations and chemical reactions.

Dienes: Nomenclature and classification, isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reaction-1,2 and 1,4 additions. Diels-Alder reaction.

Alkynes: Nomenclature, structure and bonding, Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **15 Lecture**

Unit-IV

Arenes and Aromaticity: Nomenclature of benzene derivatives. The aryl group, aromatic nucleus and side chain. Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

Aromaticity: The Huckel rule and its applications. Energy level, molecular orbital diagram (ethene, 1-3-butadiene, benzene) Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and π-complexes, mechanism of nitration, halogenation, sulphonation, and Friedel-Crafts reaction. Effect of substituent groups (inductive, mesomeric and hyperconjugative effect), activating and deactivating groups, directive influence of groups, determination of orientation up to disubstituted derivatives; ortho/para ratio, Birch Reduction.

Method of formation and chemical reactions of benzene, alkyl benzenes and biphenyl.

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution, reactions of alkyl halides S_N2 and S_N1 reactions with energy profile diagrams.

Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and elimination-addition mechanisms of nucleophilic aromatic substitution reactions.

Relative reactivities of alkyl halides V/s allyl vinyl and aryl halides. Preparation and properties of vinly, allyl and benzyl halides. Synthesis and uses of DDT and BHC. **15 Lecture**

Suggested Books and References:

1. Gupta, S. S. Organic Chemistry, Oxford University Press.
2. Ahluwalia, V. K. Organic Reaction Mechanisms, Narosa Publishing House, New Delhi.
3. Agarwal, O. P. Organic Chemistry – Reactions and Reagents: Covering Complete Theoretical Organic Chemistry, Goel Publishing House, Meerut.
4. Morrison R. T. & Boyed R. N. Organic Chemistry, Prentice Hall.
5. Finar, I. L. Organic Chemistry (Vol. I & II) ELBS.
6. Bahl A. & Bahl B. S. Advanced Organic Chemistry, S. Chand.
7. Pillai, C. N. Organic Chemistry, Oxford University Press.
8. Jain, M.K. & Sharma, S.C. Modera Organic Chemistry, Vishal Publishing Co.
9. March, J. & Smith, M. B. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Wiley.
10. Ahluwalia, V. K. Stereochemistry of Organic Compounds, Springer.

Syllabus

CHM-52T-106: Principles and Methods of Analytical Techniques.
4 Hrs./week

Duration	Maximum Marks	Minimum Marks
1 Hour	Midterm – 20 Marks	Midterm – 08 Marks
3 Hours	EoSE – 80 Marks	EoSE – 32 Marks

Unit-I

Principle of Gravimetric analysis, precipitation methods, super saturation and precipitate formation, the purity of the precipitate, coprecipitation, post precipitation, conditions of precipitation, precipitation from homogeneous solution, washing of the precipitate. Ignition of the precipitate, masking and demasking agents. **15 Lecture**

Unit-II

Solvent extraction: Principles and process of solvent extraction, the distribution law and the partition coefficient, liquid-liquid extraction, factors favouring solvent extraction, choice of solvent for solvent extraction, stripping, solid liquid extraction, organic reagents used in solvent extraction.

Organic reagents in quantitative inorganic analysis. Application of the following organic reagents-

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DMG, Cupferron, 8-hydroxyquinoline, cupron, salicylaldehyde, oxime, l-nitroso-2- naphthol, 4-bromoandelic acid, nitron, tannic acid, arsonic acids, pyridine, anthranilic acid, pyrogallol and ethylenediamine. **15 Lecture**

Unit-III

Completion of gravimetric results, compilation of results, reliability of results-accuracy and precision, cleaning and calibration of glassware, standard deviation, T, Q and F tests, correction, significant figures, errors in analysis.

Volumetric analysis: Principle and applications of redox titrations, iodometry and iodimetry. Theory of complexation titrations. Methods of end point detection, EDTA as Titrant, types of EDTA titration of mixtures, metal indicators. **15 Lecture**

Unit-IV

Distillation methods of organic solvents, steam, fractional, vacuum and molecular distillations, monometers and monostates. Analysis of oils and fats, saponification value, iodine value, RM value, acid value.

Quantitative estimation of following functional groups-alcoholic phenolic, carboxylic acids and unsaturated groups (olefinic & acetylenic).

Polarimetry: Basic principle, instrumentation, experimental techniques, determination of (a) specific rotation of a substance (b) concentration of the substance & applications. An elementary idea of Refractometry, Interferometry-circular dichroism & optical rotatory dispersion. **15 Lecture**

Suggested Books and References:

1. Chatwal, Gurdeep R., Anand, S. Instrumental Methods of Chemical analysis (Analytical Chemistry), Himalaya Publishing House.
2. Chatwal, Gurdeep R., Analytical Chemistry, Himalaya Publishing House.
3. Douglas, A. Skoog & Donald M. West et al, Fundamentals of Analytical Chemistry, Cengage Learning India Pvt. Ltd. 2022.

Syllabus

CHM-52P-107: Practical I **4 Hrs./week**

Duration	Maximum Marks	Minimum Marks
2 Hours	Midterm – 10 Marks	Midterm – 04 Marks
4 Hours	EoSE – 40 Marks	EoSE – 16 Marks

Organic Chemistry: **(any two exercise, $2 \times 15 = 30$ marks)**

1. Identification of organic compounds through functional groups analysis, determination of melting point, boiling point and specific test and preparation of a suitable derivative.
2. Purification of solid substance by recrystallization.
3. Separation of two miscible liquids by fractional distillation.
4. Preparation of acetanilide from aniline.
5. Preparation of an azo-dye.
6. Determination of m.p. and mixed m.p.

Viva voce **5 marks**

Practical Record **5 marks**

Suggested Books and References:

1. Ahluwalia, V. K. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, Universities Press, Hyderabad.
2. Ahluwalia, V. K. Laboratory Techniques in Organic Chemistry, I K International, New Delhi.
3. Arora Amit Advanced Practical Organic Chemistry, Discovery Publishing House, New Delhi.
4. Furniss, Brian S., Hannaford, Antony J. et al, Vogel's Textbook of Practical Organic Chemistry, Pearson.

Syllabus

CHM-52P-108: Practical II **4 Hrs./week**

Duration	Maximum Marks	Minimum Marks
2 Hours	Midterm – 10 Marks	Midterm – 04 Marks
4 Hours	EoSE – 40 Marks	EoSE – 16 Marks

Gravimetric Analysis **15 marks**

(a) Estimation of Cu as CuSCN
(b) Estimation of Ni as Ni (dimethylglyoxime)

Laboratory Techniques **15 marks**

A. **Thin Layer Chromatography:** Determination of R_f values and identification of organic compounds.
(a) Separation of green leaf pigments (spinach leaves may be used).

(b) Preparation and separation of 2,4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2-one and hexan-3-one using toluene and light petroleum (40-60) solvent system.
(c) Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5: 1.5)

B. Paper Chromatography: Ascending and Circular: Determination of R_f values and identification of organic compounds.

(a) Separation of mixture of phenylalanine and glycine. Alanine and aspartic acid, leucine and glutamic acid. Spray reagent – ninhydrin.
(b) Separation of a mixture of DL – alanine, glycine and L-Leucine using n-butanol: acetic acid: water (4:1:5), Spray reagent-ninhydrin.
(c) Separation of monosaccharides a mixture of D- galactose and D-Fructose Using n-butanol: acetone: water (4:5:1) Spray reagent -aniline hydrogen phthalate.

Viva voce **5 marks**

Practical Record **5 marks**

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