As per NEP 2020

S. Z. S. P. Mandal's

Shri Pancham Khemraj Mahavidyalaya,

Sawantwadi-416510

(Autonomous)

Affiliated to University of Mumbai

Title of the Programme: Science

B.Sc. (Chemistry)

1. F.Y.B.Sc. 2023-2024
2. S.Y.B.Sc. 2024-2025
3. T.Y.B.Sc. 2025-2026

Syllabus for

Semester V

and

Semester VI

Reference: GR dated 16th May 2023 for Credit structure

AC ITEM NO:

S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA

(AUTONOMOUS)

NAAC Accredited 'A' Grade (3rd Cycle)

SAWANTWADI-416510

Affiliated to

University of Mumbai, Mumbai

Syllabus For

T.Y.B. Sc (Chemistry), Autonomous

As per Choice based Credit System Pattern of UGC

To be implemented for Academic year 2025-26

S. Z. S. P. Mandal's

Shri Pancham Khemraj Mahavidyalaya (AUTONOMOUS)

Course Structure T.Y.B.Sc

Department of CHEMISTRY

Under Autonomous Status

To be implemented from Academic Year: 2025-2026

Sr.No.	SEM	Course Category	Corse Code	Course Titles	Credits
1	**V**	Major	UGSC5CHT301	Physical Chemistry-I	**02**
2	**V**	Major	UGSC5CHT302	Inorganic Chemistry-II	**02**
3	**V**	Major	UGSC5CHT303	Organic Chemistry- III	**02**
4	**V**	Major	UGSC5CHT304	Analytical Chemistry-IV	**02**
5	**V**	Major	UGSC5CHEP305	Physical Chemistry & Inorganic Chemistry	**03**
6	**V**	Major	UGSC5CHEP306	Organic Chemistry & Analytical Chemistry	**03**
7	**V**	AC	UGSC5CHACT307	Applied Components	**02**
8	**V**	AC	UGSC5CHACP308	Applied Components Practical	**02**
9	**V**	FP/CEP /OJT	UGSC6CHFP/CEP/ OJT02	Field Project/ Community Engagement Program/ On Job Training	**02**
10	**V**	MINOR	UGSC5CHT309	General Chemistry	**02**
11	**VI**	Major	UGSC6CHT310	Physical Chemistry-I	**02**
12	**VI**	Major	UGSC6CHT311	Inorganic Chemistry-II	**02**
13	**VI**	Major	UGSC6CHT312	Organic Chemistry- III	**02**
14	**VI**	Major	UGSC6CHT313	Analytical Chemistry-IV	**02**
15	**VI**	Major	UGSC6CHEP314	Physical Chemistry & Inorganic Chemistry	**03**
16	**VI**	Major	UGSC6CHEP315	Organic Chemistry & Analytical Chemistry	**03**
17	**VI**	AC	UGSC6CHACT316	Applied Components	**02**
18	**VI**	AC	UGSC6CHACP317	Applied Components Practical	**02**
19	**VI**	VSC	UGSC6CHVS05	Experimental Chemistry-V	**02**
20	**VI**	FP/OJT/CEP	UGSC6CHFP/CEP/ OJT02	Field Project/ Community Engagement Program/ On Job Training	**02**

PREAMBLE:

S. P. K. Mahavidyalata (Autonomous) believes in implementing several measures to bring equity, efficiency and excellence in higher education system in conformity to the guidelines laid down by the University Grants Commission (UGC). In order to achieve these goals, all efforts are made to ensure high standards of education by implementing several steps to enhance the teaching-learning process, examination and evaluation techniques and ensuring the all-round development of students.

The three-year course in B.Sc. Chemistry has been designed to have a progressive and innovative curriculum in order to equip our students to face the future challenges in the field of higher education. In semesters I and II students are introduced to the basic areas of Chemistry such as Thermodynamics, Periodic table, Chemical Kinetics, Reaction and Mechanism.

In semesters III and IV the course content is made more rigorous by introducing the details of each of the above area. In semesters V and VI, course are designed to help in specialization in the core areas of Chemistry such as Molecular spectroscopy, Nuclear Chemistry, Chemical thermodynamics, Chemical kinetics, Molecular Symmetry and Chemical Bonding, Solid state Chemistry, Electrochemistry polymers, Quantum chemistry with Renewable energy resources Chemistry of inner transition elements, Theories of the metal-ligand bond, Organometallic chemistry, Mechanism of organic reactions , Stereochemistry, Synthesis of organic compounds, Quality in Analytical Chemistry, Chemical Calculations, Optical Methods, Electro analytical techniques and Applied components dyes and drugs. The practical course has been designed to help the student have a firm grip on the theoretical concepts through relevant experiments in each course.

OBJECTIVES:

- To help students in developing a scientific attitude through the Chemistry curriculum that involves basic and core areas of Chemistry along with the recent scientific and technological advancements in applied areas of Chemistry
- To enhance knowledge of Chemistry through problem solving, tutorials and seminars
- To develop practical skills in Chemistry using a range of a activities such as projects in experimental Chemistry, study tours, industrial and research institutes visit.
- To inculcate a research attitude by involving students in simple research projects review of research articles/papers, participation in scientific events etc.
- To help students in developing analytical abilities and skills so as to address real world problems
- To help students to plan a progressive and successful career in Chemistry, education and industry

Program Outcome: After successful completion of this Course (B.SC.) students are able to

- Develop the knowledge of basic concepts of different branches of science required for postgraduate studies.
- Inculcate the skills useful in science laboratories for pursuing jobs in Industries.
- Introduce students to the concepts useful for environment protection.
- Follow interdisciplinary approach for developing scientific temperament.
- Identify, formulate and analyze scientific problems and reach concrete solutions for societal benefits.

Program Specific Outcome: After successful completion of this Course (B.Sc. Chemistry) students are able to

- Develop the knowledge of basic concepts in chemistry.
- Inculcate the skills useful in chemistry laboratory.
- Introduce students to the green chemistry needs and concepts.
- Identify, formulate and analyze scientific problems and reach concrete solutions for societal benefits using various principles of chemical sciences.
- Acquire & explore essential skills to succeed in various chemical industries.
- Get a hold on higher educational opportunities like post-graduation in chemistry.
- Pursue higher studies in interdisciplinary areas such as biochemistry, genetics, pathology etc.
- Explore research areas in chemistry and related fields.

Structure of the Course:

The Board of Studies in Chemistry in its meeting held on **Tuesday, 25.03.2025** has discussed, finalized and unanimously accepted the revised syllabus (as per CBCS pattern) prepared by committee. The titles of the papers for T.Y.B.Sc. (Chemistry) are given below:

Semester	Course Code	Course Title	No of Credits	No of Lectures in Hours
V	UGSC5CHT301	Physical Chemistry-I	**2**	**30**
	UGSC5CHT302	Inorganic Chemistry-II	**2**	**30**
	UGSC5CHT303	Organic Chemistry-III	**2**	**30**
	UGSC5CHT304	Analytical Chemistry-IV	**2**	**30**
	UGSC5CHEP305	Physical Chemistry & Inorganic Chemistry	**03**	**90**
	UGSC5CHEP306	Organic Chemistry & Analytical Chemistry	**03**	**90**
	UGSC5CHACT307	Applied Components	**02**	**30**
	UGSC5CHACP308	Applied Components Practical	**02**	**60**
	UGSC6CHFP/CEP/ OJT02	FP/CEP/OJT	**02**	**60**
	UGSC5CHT309	General Chemistry	**02**	**30**
VI	UGSC6CHT310	Physical Chemistry-I	**02**	**30**
	UGSC6CHT311	Inorganic Chemistry-II	**02**	**30**
	UGSC6CHT312	Organic Chemistry-III	**02**	**30**
	UGSC6CHT313	Analytical Chemistry-IV	**02**	**30**
	UGSC6CHEP314	Physical Chemistry & Inorganic Chemistry	**03**	**90**
	UGSC6CHEP315	Organic Chemistry & Analytical Chemistry	**03**	**90**
	UGSC6CHACT316	Applied Components	**02**	**30**
	UGSC6CHACP317	Applied Components Practical	**02**	**60**
	UGSC6CHVS05	Vocational Skill Course: Experimental Course	**02**	**60**
	UGSC6CHFP/CEP/ OJT02	FP/CEP/OJT	**02**	**60**

SEMESTER-V
Chemistry Paper-I
Course code: UGSC5CHT301
Title: - Physical Chemistry

Pre-requisites:

Knowledge of Molecular Spectroscopy, Chemical Thermodynamics, Adsorption, Colloids, Nuclear Chemistry.

Course Objectives:

1. Generate novel approaches for data analysis and property determination in molecular spectroscopy and colligative properties.
2. Evaluate the appropriateness of selection rules, thermodynamic derivations and experimental methods used in spectroscopy and colligative properties.
3. Analyze the electrical properties of colloidal particles and models of electrical double layers to gain insights into colloid science.
4. Apply the knowledge gained in spectroscopy to analyze and interpret real-world data related to molecular structures, interatomic forces, and colligative properties.
5. Achieve a comprehensive understanding of the fundamental principles underlying molecular spectroscopy and colloid science, including the postulates of Langmuir adsorption isotherm and the quantum theory of Raman spectra.
6. Develop the ability to recall and describe key concepts, terminologies, mathematical expressions, and fundamental principles related to both molecular spectroscopy and colloid science.

Course Outcomes: After the completion of this course, learners will be able to:

1. Understand the fundamental principles of nuclear chemistry and measurement of radioactivity. They will also be able to understand the postulates of Langmuir adsorption isotherm and the quantum theory of Raman spectra.
2. Analyse the types of reactions in chemical kinetics, the electrical properties of colloidal particles and models of electrical double layers. They will be able to analyse colligative properties, such as vapor pressure lowering, boiling point elevation, and freezing point depression.
3. Evaluate the appropriateness of selection rules, thermodynamic derivations and experimental methods used in both spectroscopy and colligative properties. They will make informed judgements about the significance and practical applications of these techniques.
4. Remember the action of surfactants based on adsorption and flash photolysis in chemical kinetics. They will be able to describe key concepts, terminologies and mathematical expressions of chemical thermodynamics.
5. Apply their knowledge of spectroscopy for the interpretation of structure of a compound. They will be able to conduct quantitative analysis and draw meaningful conclusions.
6. Create a design of an experiment and execute the experiments for both molecular spectroscopy and the measurement of colligative properties. Learners will be adept at proposing innovative methodologies for data analysis and property determination in these fields.

Course Content

UNIT	Description	Lectures in Hours
I	**1.0 MOLECULAR SPECTROSCOPY**	**10**
	1.1 Rotational Spectrum: (3L) Introduction to dipole moment, polarization of a bond, bond moment, molecular structure, Rotational spectrum of a diatomic molecule, rigid rotor, moment of inertia, energy levels, conditions for obtaining pure rotational spectrum, selection rule, nature of spectrum, determination of internuclear distance and isotopic shift. (Numerical are necessary)	
	1.2 Vibrational spectrum: (3L) Vibrational motion, degrees of freedom, modes of vibration, vibrational spectrum of a diatomic molecule, simple harmonic oscillator, energy levels, zero-point energy, conditions for obtaining vibrational spectrum, selection rule, nature of spectrum. (Numerical are necessary)	
	1.3 Vibrational-Rotational spectrum of diatomic molecule: (2L) Energy levels, selection rule, nature of spectrum, P and R branch lines. Anharmonic oscillator - energy levels, selection rule, fundamental band, overtones.	
	1.4 Raman Spectroscopy: (2L) Scattering of electromagnetic radiation, Rayleigh scattering, Raman scattering, nature of Raman spectrum, Stoke's lines, anti-Stoke's lines, Raman shift, quantum theory of Raman spectrum,	
II	**2.0 CHEMICAL THERMODYNAMICS**	**10**
	2.1.1Colligative properties: (02L) Vapour pressure and relative lowering of vapour pressure. Measurement of lowering of vapour pressure - Static and Dynamic method.	
	2.1.2 Solutions of Solid in Liquid: (05L) **2.1.2.1** Elevation in boiling point of a solution, thermodynamic derivation relating elevation in boiling point of the solution and molar mass of non-volatile solute.	
	2.1.2.2 Depression in freezing point of a solution, thermodynamic derivation relating the depression in the freezing point of a solution and the molar mass of the non-volatile solute. Beckmann Method and Rast Method.	

	2.1.3 Osmotic Pressure: Introduction, thermodynamic derivation of Van't Hoff equation, Van't Hoff Factor. Measurement of Osmotic Pressure - Berkeley and Hartley's Method, Reverse Osmosis.	
	3.3 Nuclear Chemistry (3L)	
	.1. Introduction: Basic terms-radioactive constants (decay constant, half-life and average life) and units of radioactivity **.2 Detection and Measurement of Radioactivity:** Types and characteristics of nuclear radiations, behaviour of ion pairs in electric field, detection and measurement of nuclear radiations using G. M. Counter and Scintillation Counter.	
III	**3.1 SURFACE CHEMISTRY (03L)**	**10**
	3.1.1 Adsorption: Physical and Chemical Adsorption, types of adsorption isotherms. Langmuir's adsorption isotherm (Postulates and derivation expected). B.E.T. equation for multilayer adsorption, (derivation not expected). Determination of surface area of an adsorbent using B.E.T. equation.	
	3.2 COLLOIDAL STATE (07L)	
	3.2.1 Introduction to colloids - Emulsions, Gels and Sols **3.2.2 Electrical Properties:** Origin of charges on colloidal particles, Concept of electrical double layer, zeta potential, Helmholtz and Stern model. Electro-kinetic phenomena - Electrophoresis, Electro-osmosis, Streaming potential, Sedimentation potential; Donnan Membrane Equilibrium. **3.2.3 Colloidal electrolytes:** Introduction, micelle formation	
	Total	**30**

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2) Fundamental of Molecular Spectroscopy, 4 th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
3) Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
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10) Surface Chemistry: Of Solid and Liquid Interfaces. Prof. H. Yidirim Erbil, 1st Edition - 6 June 2006. Wiley Publication.
11) Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011.
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14) Thermodynamics for Chemists, S. Glasstone, Affileated East West Press Pvt.Ltd., 2006.
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16) Chemical Kinetics, K. Laidler, Pearson Education India, 1987.
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Chemistry Paper- II
Course code: UGSC5CHT302
Title: - Inorganic Chemistry

Pre-requisites:

Knowledge of Molecular Symmetry and Chemical Bonding, Structure of Solids, Chemistry of Non-aqueous solvents.

Course Objectives: To introduce students to

1. Apply the various symmetry operations and recognize the point groups of various Molecules.
2. To describe general characteristics of solid state and distinguish between amorphous and crystalline solids
3. To classify crystalline solids on the basis of the nature of binding forces and define crystal lattice and unit cell.
4. To correlate the density of a substance with its unit cell properties.
5. Understand the consequences of lanthanide contraction and method of separation of Lanthanide.
6. Understand the concept of symmetry elements, symmetry operations and point groups as it will be helpful in study of structure of molecules.
7. To study the Superconductivity and their applications.
8. To Understand concept of solvents and study of 16^{th} and 17^{th} group.
9. Application of molecular orbital theory to explain certain properties of polyatomic Species.

Course Outcomes: On successful completion of this course students will be able to:

1. Understand the basic concepts of molecular orbital theory.
2. Explain the various heteronuclear diatomic molecules.
3. Understanding the types of solids.
4. Superconducting material and their applications.
5. Differentiate between the homonuclear and heteronuclear diatomic molecules.
6. Calculate the bond order of CO,NO and HCl molecules.
7. Illustrate the various point groups with suitable examples.
8. Understand the consequences of lanthanide contraction and method of separation of Lanthanides.
9. To understand the types of solvent.

Course Content

UNIT	Description	Lectures in Hours
I	**1.0:Molecular Symmetry and Chemical Bonding**	10
	1.1 Molecular Symmetry (4L)	
	1.1.1 Symmetry elements and Symmetry operations. 1.1.2 Concept of a Point Group with illustrations using the following point groups : :(i)C∞v (ii) D∞h (iii) C_2V (iv) C_3v (v)C_2h and (vi)D_3h	
	1.2 Molecular Orbital Theory for heteronuclear diatomic molecules and polyatomic species (6L)	
	1.2.1 Comparison between homonuclear and heteronuclear diatomic molecules	

	1.2.2 Heteronuclear diatomic molecules like CO, NO. 1.2.3 Molecular orbital theory for H_3 and H_3^+ (correlation diagram expected). 1.2.4 Molecular shape to molecular orbital approach in AB_2 molecules. Application of symmetry concepts for linear and angular species considering σ- bonding only. (Examples like : i) BeH_2, ii) H_2O (Any One)	
II	**2.0: Chemistry of Inner Transition Elements**	**10**
	2.1 Introduction: Position in periodic table and electronic configuration of lanthanides and actinides. (**2L**)	
	2.2 Chemistry of Lanthanides with reference to (i) lanthanide contraction and its consequences(ii) Oxidation states (iii) Ability to form complexes (iv) Magnetic and spectral properties (**4L**)	
	2.3 Occurrence, extraction and separation of lanthanides by (i) Ion Exchange method and (ii) Solvent extraction method (Principles and technique) and Applications of lanthanides. (**4L**)	
III	**3.0 Solid State Chemistry**	**10**
	3.1 Structures of Solids (6L)	
	3.1.1 Explanation of terms viz. crystal lattice, lattice point, unit cell and lattice constants. **3.1.2** Closest packing of rigid spheres (hcp, ccp), packing density in simple cubic, bcc and fcc lattices. Relationship between density, radius of unit cell and lattice parameters.	
	3.2 Superconductivity (4L)	
	3.2.1 Discovery of superconductivity. **3.2.2** Explanation of terms like superconductivity, transition temperature, Meissner effect. **3.2.3** Different types of super conductors viz. conventional superconductors, alkali metal fullerides, high temperature super conductors.	

	Total	30

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1) Per Jensen and Philip R. Bunker, Fundamentals of Molecular Symmetry , Series in Chemical Physics, Taylor & Francis Group .
2) J. S. Ogden, Introduction to Molecular Symmetry, Oxford University Press
3) Derek W. Smith, Molecular orbital theory in inorganic chemistry Publisher: Cambridge University Press
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6) R.G. Sharma Superconductivity: Basics and Applications to Magnets
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Chemistry Paper III
Course code: UGSC5CHT303
Title: - Organic Chemistry

Pre-requisites:

Knowledge of basic organic chemistry and the conceptual terms involved in organic chemistry, awareness about stereochemistry and organic reaction mechanisms.

Course Objectives:

1. To provide a comprehensive understanding of fundamental organic chemistry concepts and reaction mechanisms.
2. To familiarize students with various organic reactions, including acyl nucleophilic substitution, pericyclic reactions and photochemistry.
3. To introduce the importance of chirality and symmetry in organic molecules.
4. To explore the reactivity and preparation of heterocyclic compounds
5. To synthesize and know the applications of agrochemicals, with a focus on their advantages and disadvantages.
6. To impart knowledge of IUPAC nomenclature for a range of organic compounds and principles of green chemistry
7. To examine natural products and their structural elucidation, including terpenoids, alkaloids, nicotine, and hormones.
8. To enhance skills in spectroscopic analysis and stereochemistry of organic compounds.

Course Outcomes: On successful completion of this course students will be able to:

1. Explain organic chemistry fundamentals, reaction mechanisms, and basic terms.
2. Analyze and predict the mechanisms and stereochemical outcomes of organic reactions.
3. Differentiate and describe specific reaction types, such as acyl nucleophilic substitution and pericyclic reactions.
4. Understand the significance of chirality and symmetry in organic molecules.
5. Predict the reactivity of various heterocyclic compounds towards reactions.
6. Evaluate the synthesis, application, advantages, and disadvantages of agrochemicals.
7. Apply IUPAC nomenclature and principles of green chemistry in organic synthesis.
8. Utilize spectroscopic techniques for structural analysis of organic compounds.
9. Analyze structures and methods of structural elucidation of natural products, including terpenoids, alkaloids, nicotine, and hormones.

Course Content:

UNIT	Description	Lectures in Hours
I	**1.1 Mechanism of organic reactions (05L)**	10
	1.1.1 The basic terms & concepts: Electrophilicity vs. acidity & nucleophilicity vs basicity. **1.1.2** Neighbouring group participation in nucleophilic substitution reactions**:** participation of lone pair of electrons, kinetics and stereochemical outcome. **1.1.3** Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalysed esterification of carboxylic acids ($A_{AC}2$) and base promoted hydrolysis of esters ($B_{AC}2$). **1.1.4** Pericyclic reactions, classification and nomenclature **1.1.4.1** Electro cyclic reactions (ring opening and ring closing), cycloaddition, sigma tropic Rearrangement, group transfer reactions, cheletropic reaction (definition and one example of each type)	
	1.2 Photochemistry (03L)	
	1.2.1 Introduction: Difference between thermal and photochemical reactions. Jablonski diagram, singlet and triplet states, allowed and forbidden transitions, fate of excited molecules, photosensitization. **1.2.2** Photochemical reactions of olefins: photoisomerization, photochemical rearrangement of 1,4-dienes (di- π methane) **1.2.3** Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photo reduction (e.g.benzophenone to benzpinacol)	
	1.3 Heterocyclic chemistry: (02L)	
	1.3.1 Reactivity of pyridine-N-oxide, quinoline and iso-quionoline. 1.3.2 Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) and iso-quinoline (Bischler-Napieralski synthesis). 1.3.3 Reactions of pyridine-N-oxide: halogenation, nitration and reaction with $NaNH_2$/liq.NH_3, n-BuLi. 1.3.4 Reactions of quinoline and is quinoline; oxidation, reduction, nitration, halogenation and reaction with $NaNH_2$/liq.NH_3,n-BuLi.	
II	**2.1 IUPAC (03L)**	10
	IUPAC Systematic nomenclature of the following classes of compounds (including compounds upto two substituents / functional groups): 2.1.1 Bicyclic compounds – spiro, fused and bridged (upto 11 carbon atoms) – saturated and unsaturated compounds. 2.1.2 Biphenyls 2.1.3 Cumulenes with upto 3 double bonds 2.1.4 Quinolines and is quinolines	

	2.2 Synthesis of organic compounds (05L)	
	2.2.1 Introduction: Linear and convergent synthesis, criteria for an ideal synthesis, concept of chemo selectivity and regioselectivity with examples, calculation of yields. 2.2.2 Multicomponent Synthesis: Mannich reaction and Biginelli reaction. Synthesis with examples (no mechanism) 2.2.3 Green chemistry and synthesis: Introduction: Twelve principles of green chemistry, concept of atom economy and E-factor, calculations and their significance, numerical examples. i) Green reagents: dimethyl carbonate. ii) Green starting materials : D-glucose iii) Green solvents : supercritical CO_2 iv) Green catalysts: Bio catalysts.	
	2.3 Stereochemistry I (02L)	
	2.3.1 Molecular chirality and elements of symmetry: Mirror plane symmetry, inversion center, roation -reflection (alternating) axis. 2.3.2 Chirality of compounds without a stereo genic center: cummulenes and biphenyls.	
III	**3.1 Spectroscopy I (04 L)**	**10**
	3.1.1 Introduction: Electromagnetic spectrum, units of wavelength and frequency 3.1.2 UV – Visible spectroscopy: Basic theory, solvents, nature of UV-Visible spectrum, concept of chromophore, auxochrome, bathochromic and hypochromic shifts, hyperchromic and hypochromic effects, chromophore-chromophore and chromophore-auxochrome interactions. 3.1.3 Mass spectrometry: Basic theory. Nature of mass spectrum. General rules of fragmentation. Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula. Fragmentation of alkanes and aliphatic carbonyl compounds.	
	3.2 Natural Products: (04L)	
	3.2.1. Terpenoids: Introduction, Isoprene rule, special isoprene rule and the gem-dialkyl rule. 3.2.2 Citral: a) Structural determination of citral. b) Synthesis of citral from methyl heptenone c) Isomerism in citral. (cis and trans form).	

	3.2.3. Alkaloids Introduction and occurrence. Hofmann's exhaustive methylation and degradation in**:** simple open chain and N – substituted monocyclic amines. 3.2.4 Nicotine: a) Structural determination of nicotine. (Pinner's work included) b) Synthesis of nicotine from nicotinic acid c) Harmful effects of nicotine.	
	3.3 Agrochemicals (02L)	
	3.3.1 General introduction & scope, meaning & examples of insecticides, herbicides, fungicide, rodenticide, pesticides, plant growth regulators. 3.3.2 Advantages & disadvantages of agrochemicals 3.3.3 Synthesis & application of IAA (Indole Acetic Acid) & Endosulphan, 3.3.4 Bio pesticides – Neem oil & Karanj oil.	
	Total	**30**

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3) Absorption spectroscopy of organic molecules by V.M.Parikh.

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15) Name Reactions in Heterocyclic Chemistry, Jie-Jack Li, Wiley-Interscience publications, 2005.

16) Handbook of Heterocyclic Chemistry, 2nd Edition, Alan R. Katritzky and Alexander F. Pozharskii, Elsevier Science Ltd, 2000.

17) Heterocyclic Chemistry, 5th Edition, John A. Joule and Keith Mills, Wiley publication, 2010.

18) Heterocyclic chemistry, 3rd Edition, Thomas L. Gilchrist, Pearson Education, 2007.

19) Nomenclature of Organic Chemistry**:** IUPAC recommendations and preferred Names 2013,RSC publication.
20) IUPAC nomenclature by S.C.Pal.
21) Green chemistry an introductory text : Mike Lancaster.
22) Green chemistry: V. K. Ahluwalia (Narosa publishing house pvt. ltd.)
23) Green chemistry an introductory text : RSC publishing.
24) New trends in green chemistry V. K. Ahluwalia , M. Kidwai, Klumer Academic publisher
25) L. Eliel , stereochemistry of carbon compounds, Tata McGraw Hill Stereochemistry P.S.Kalsi , New Age International Ltd.,4th Edition

Chemistry Paper IV

Course code: UGSC5CHT304

Title: - Analytical Chemistry

Pre-requisites: knowledge of quality control, quality assurance, chromatographic techniques, sampling terms, basics of instrumental and optical methods.

Course Objectives: To introduce students to

1. Impart knowledge of quality assurance and quality concepts.
2. Influence Chromatographic techniques like HPLC, HPTLC.
3. Sampling procedures and Sampling methods of solid, liquids and gaseous samples.
4. Familiarise redox and complexometric titrations.
5. Enhance skill in optical methods of analysis like AAS, FES, Flourimetry, Phosphorimetry, Turbidimetry and Nephelometry.

Course Outcomes: On successful completion of this course students will be able to:

1. Justify quality control and quality assurance of products.
2. Differentiate HPLC, HPTLC techniques of analysis.
3. Judge the method and techniques of sampling.
4. Apply various redox and complexometric titrations for analysis.
5. Implement the knowledge for analysing the samples by the techniques like AAS, FES, Flourimetry, Phosphorimetry, Turbidimetry and Nephelometry.

Course Content:

UNIT	Description	Lectures in Hours
I	**1.1 Quality in Analytical Chemistry (3L)**	10
	1.1.1 Concepts of Quality, Quality Control and Quality Assurance 1.1.2 Importance of Quality concepts in Industry 1.1.3 Chemical Standards and Certified Reference Materials; Importance in chemical analysis. Quality of material: Various grades of laboratory reagents	
	1.2 High Performance Liquid chromatography (HPLC) (4L)	
	1.2.1 Introduction and Principle, Instrumentation- components with their significance: Solvent Reservoir, Degassing system, Pumps-(reciprocating pumps, screw driven- syringe type pumps, pneumatic pumps, advantages and disadvantages of each pump), Precolumn, Sample injection system, HPLC Columns, Detectors(UV – Visible detector, Refractive index detector) 1.2.2 Qualitative and Quantitative Applications of HPLC	
	1.3 Sampling (3L)	
	1.3.1 Purpose, significance and difficulties encountered in sampling.	

	1.3.2 Sampling of solids: Sample size – bulk ratio, size to weight ratio, multistage and sequential sampling, size reduction methods, sampling of compact solids, equipment's and methods of sampling of compact solids, sampling of particulate solids, methods and equipments used for sampling of particulate solids. 1.3.3 Sampling of liquids: Homogeneous and heterogeneous, Static and flowing liquids.	
II	**CLASSICAL AND INSTRUMENTAL METHODS OF ANALYSIS**	**10**
	2.1 Redox Titrations (Numerical & Word problems are expected) (4L) 2.1.1 Introduction 2.1.2 Construction of the titration curves and calculation of E_{system} in aqueous medium in case of: (1) One electron system (2) Multielectron system 2.1.3 Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators	
	2.2 Complexometric Titrations (3L) 2.2.1 Introduction, construction of titration curve 2.2.2 Use of EDTA as titrant and its standardisation, absolute and conditional formation constants of metal EDTA complexes, Selectivity of EDTA as a titrant. Factors enhancing selectivity with examples. Advantages and limitations of EDTA as a titrant.	
	2.3 High Performance Thin Layer Chromatography(HPTLC) (3**L**) 2.3.1 Introduction and Principle Stationary phase, Sample application and mobile phase 2.3.2 Detectors a) Scanning densitometer- Components. Types of densitometer- Single beam and Double beam b) Fluorometric Detector 2.3.3 Advantages, disadvantages and applications	
III	**3.0 : OPTICAL METHODS**	**10**
	3.1 Atomic Spectroscopy: Flame Emission spectroscopy(FES) and Atomic Absorption Spectroscopy(AAS) (4L) 3.1.1 Introduction, Energy level diagrams, Atomic spectra, Absorption and Emission Spectra. 3.1.2 Flame Photometry – Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors) 3.1.3 Atomic Absorption Spectroscopy – Principle, Instrumentation (Source, Chopper, Flame and Electrothermal Atomiser) 3.1.4 Quantification methods of FES and AAS – Calibration curve method, Standard addition method and Internal standard method.	

3.1.5 Comparison between FES and AAS 3.1.6 Applications, Advantages and Limitations	
3.2 Molecular Fluorescence and Phosphorescence Spectroscopy (4L)	
3.2.1 Introduction and Principle 3.2.2 Relationship of Fluorescence intensity with concentration 3.2.3 Factors affecting Fluorescence and Phosphorescence 3.2.4 Instrumentation and applications 3.2.5 Comparison of Fluorimetry and Phosphorimetry 3.2.6 Comparison with Absorption methods	
3.3 Turbidimetry and Nephelometry (2 L)	
3.3.1 Introduction and Principle 3.3.2 Instrumentation and Applications 3.3.3 Comparison between Turbidimetry and Nephelometry	
Total	**30**

References:

1. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd.
2. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman
3. A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002),
4. Handbook of quality assurance for the analytical chemistry laboratory, 2ndEdn., James P. DuxVanNostr and Reinhold, 1990.
5. Quality control and Quality assurance in Analytical Chemical Laboratory, Piotr Konieczka and Jacek Namiesnik, CRC press (2018)
6. Quality in the Analytical Chemistry Laboratory, Elizabeth Prichard, Neil T. Crosby, Florence Elizabeth Prichard, John Wiley and Sons, 1995
7. Analytical Chemistry, Gary.D Christan, 5th edition.
8. Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication
9. Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International (p) Limited
10. Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969
11. Fundamentals of Analytical Chemistry by Skoog and West , 8th Edition.
12. High Performance Thin Layer Chromatography by Dr P.D. Sethi, CBS Publisher.
13. High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributer.
14. A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001).
15. Analytical Chemistry Skoog, West ,Holler,7th Edition.
16. Analytical Chemistry, Gary.D Christan, 5th edition.
17. Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication.
18. Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International
19. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman

Semester-V :Chemistry Practicals
Course code: UGSC5CHEP305
Title: - Physical Chemistry-I

Learning Objectives:

1. To gai hands-on experience of the various instruments to be used for measurements of physical properties.
2. To familiarize the learners about the methods of determination of rate of reaction in
3. chemical kinetics.
4. To develop skills of observation, recording and analysing data.
5. To co-relate the theoretical principles of adsorption with experimental observations.

Leaning Outcome: On successful completion of this course students will be able to:

1. Perform instrument-based experiments and non-instrumental experiments with proper techniques.
2. Present the experimental work in a systematic manner.
3. Determine order of reaction in chemical kinetics.
4. Apply the knowledge of colligative properties in determination of molecular weight of a compound.

List of the experiments:

Physical Chemistry Experiments	
	Non Instrumental
1.	**Chemical Kinetics:** To determine the order between $K_2S_2O_8$ and KI by different concentration
2.	**Surface phenomena:** To investigate the adsorption of acetic acid on activated charcoal and test the validity of Freundlich adsorption isotherm.
	Instrumental
3.	**Potentiometry:** To determine the solubility product and solubility of AgCl potentiometrically using chemical cell.
4.	**pH-metry:** To determine acidic and basic dissociation constants of amino acid and hence to calculate isoelectric point.

Chemistry Practicals
Course code: UGSC5CHEP305
Title: - Inorganic Chemistry-II

Leaning Outcome: On successful completion of this course students will be able to:

1 Analyse the Inorganic mixture only by wet tests.
2 Detect the cation and anion in supplied compounds as impurities.
3 Determine the percentage yield in Inorganic preparations.
4 Prepare a definite volume of solution from supplied compounds and determine Its percentage purity.
5 Conclude the supplied compound contains the impurity as cation and anion From its percentage purity.

List of the experiments:

1.	**INORGANIC PREPARATIONS:**
	(a) Preparation of potassium disaquo bis (oxalato) cuprate (II) .
	(b) Preparation of bis acetylacetonato copper (II) .
2.	Determination of percentage purity of the given water soluble salt and qualitative detection with respect to added cation and/or anion (qualitative analysis only by wet tests) : any three salts

Chemistry Practical
Course code: UGSC5CHEP306
Title: - Organic Chemistry-III

Leaning Outcome: On successful completion of this course students will be able to:

1. Handle various types of apparatus and chemicals during the experiments.
2. Determine the chemical type of the mixture and separate the components of the mixture by physical or chemical separation methods.
3. Detection of elements, functional groups and identification of M.P. of the organic compounds.

List of the experiments:

Organic Mixture separation	
	1) Separation of Binary solid-solid mixture (2.0 gms mixture to be given).
	2) Minimum Four mixtures to be completed by the students
	3) Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols(2-naphthol, 1-naphthol), water insoluble bases (nitroanilines) , water soluble neutral (thiourea) and water insoluble neutral compounds (anilides , amides, m-DNB, hydrocarbons) After correct determination of chemical type, the separating reagent should be decided by the student for separation
	4) Follow separation scheme with the bulk sample of binary mixture
	5) After separation into component A and component B, one component (decided by the examiner) is to be analysed and identified with Melting Point.

References:

1. Practical organic chemistry – A. I. Vogel
2. Practical organic chemistry – H.Middleton.
3. Practical organic chemistry – O.P.Aggarwal.

Chemistry Practical
Course code: UGSC5CHEP306
Title: -Analytical Chemistry-IV

Leaning Outcome: On successful completion of this course students will be able to:

1. Operate and use Spectrophorometer, Turbidimeter, flame photometer for analysis of sample.
2. Perform complexometric and redox titrations.
3. Analyse water sample for COD.
4. learn various operational skills and techniques of instruments.

List of the experiments:

	1. Spectrophotometric estimation of fluoride.
	2. Estimation of magnesium content in Talcum powder by complexometry, using standardized solution of EDTA
	3. To determine the amount of persulphate in the given sample solution by back titration with standard Fe (II) ammonium sulphate solution.
	4. To determine the amount of sulphate in given water sample turbidimetrically.
	Note: Calculation of percent error is expected for all the experiments.

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).
2. Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al

Student should complete all the experiments assigned for Semester-V. Certified journal is a must to be eligible for appearing the semester end practical Examination.

SEMESTER-VI

Chemistry Paper-I
Course code: UGSC6CHT310
Title: - Physical Chemistry

Pre-requisites:

Knowledge of Chemical Thermodynamics, Electrochemistry, Chemical Bonding, Reaction and reactivity of organic compounds

Course Objectives:

1. Ensure that learners can recall and articulate key concepts related to activity and activity coefficients, such as the Lewis concept, ionic strength, mean ionic activity and mean ionic activity coefficients for electrolytes.
2. Develop learners' ability to analysed and categorize polymers based on their source, structure, thermal response, and physical properties.
3. Enable learners to critically assess and make informed judgments about renewable energy resources, such as solar energy, and its conversion through solar cells.
4. Facilitate learners, comprehension of the principles and working mechanisms of nuclear magnetic resonance spectroscopy and electron spin resonance spectroscopy.
5. Cultivate learners & ability to generate innovative applications for renewable energy resources, considering the unique characteristics and future potential of solar cells and hydrogen as alternative energy sources.
6. Ensure learners can apply their knowledge of basic quantum chemistry to understand the fundamental distinctions between classical and quantum mechanics and help learners relate various quantum theories, such as the De Broglie Hypothesis and the Uncertainty Principle, to differentiate between classical and quantum mechanics.

Course Outcomes: After the completion of this course, learners will be able to:

1. Recall the key concepts related to activity and activity coefficients, including the Lewis concept, ionic strength, mean ionic activity, and mean ionic activity coefficients for electrolytes and memorize the classification of cells, understanding the differences between chemical cells and concentration cells.
2. Analyse and classify polymers based on their source, structure, thermal response and physical properties and evaluate molar masses of polymers using the viscosity method with the Ostwald viscometer and be able to derive relevant equations.
3. Make informed judgments regarding renewable energy resources, such as solar energy, its conversion through solar cells, and the advantages of hydrogen as a universal energy medium.
4. Understanding of the principles and working of the nuclear magnetic resonance spectroscopy and electron spin resonance spectroscopy.
5. Create innovative applications for renewable energy resources, taking into account the unique features and potential of solar cells and hydrogen as a future energy source.
6. Apply knowledge of basic quantum chemistry to the understand the basic difference between classical and quantum mechanics based on the various theories like Debroglie Hypothesis, Uncertainty principle etc.

Course Content

UNIT	Description	Lectures in Hours
I	**1.1 ELECTROCHEMISTRY (6L)**	**10**
	1.1.1 Activity and Activity Coefficient: Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. DebyeHuckel limiting law (No derivation). **1.1.2 Classification of cells:** Chemical cells and Concentration cells. Chemical cells with and without transference, Electrode Concentration cells, Electrolyte concentration cells with and without transference (derivations are expected)	
	1.2 APPLIED ELECTROCHEMISTRY (4L)	
	1.2.1 Polarization: concentration polarization and it's elimination **1.2.2 Decomposition Potential and Overvoltage:** Introduction, experimental determination of decomposition potential, factors affecting decomposition potential. Tafel's equation for hydrogen overvoltage, experimental determination of over –voltage	
II	**2.1 POLYMERS (6L)**	**10**
	2.1.1 Basic terms: Macromolecule, monomer, repeat unit, degree of polymerization. **2.1.2. Classification of polymers:** Classification based on source, structure, thermal response and physical properties. **2.1.3. Molar masses of polymers:** Number average, Weight average, Viscosity average molar mass, Monodispersity and Polydispersity **2.1.4. Method of determining molar masses of polymers :** Viscosity method using Ostwald Viscometer. (derivation expected) **2.1.5. Light Emitting Polymers:** Introduction, Characteristics, Method of preparation and applications. **2.1.6. Antioxidants and Stabilizers:** Antioxidants , Ultraviolet stabilizers, Colourants, Antistatic agents and Curing agents.	
	2.2 ELECTRON SPIN RESONANCE SPECTROSCOPY (04)	
	2.2.1. Principle: fundamental equation, g-value -dimensionless constant or electron g-factor, hyperfine splitting. 2.2.2. Instrumentation: ESR spectrometer, ESR spectrum of hydrogen and deuterium.	
III	**3.1 BASICS OF QUANTUM CHEMISTRY (06L)**	**10**
	3.1.1 Classical mechanics: Introduction, limitations of classical mechanics, Black body radiation, photoelectric effect, Compton effect.	

	3.1.2 Quantum mechanics : Introduction, Planck's theory of quantization, wave particle duality, de –Broglie's equation, Heisenberg's uncertainty principle. **3.1.3 Progressive and standing waves:** Introduction, boundary conditions, Schrodinger's time independent wave equation (No derivation expected), interpretation and properties of wave function. **3.1.4 Quantum mechanics:** State function and its significance, Concept of operators - definition, addition, subtraction and multiplication of **3.1.5** operators, commutative and non - commutative operators, linear operator, Hamiltonian operator, Eigen function and Eigen value.	
	3.2 RENEWABLE ENERGY RESOURCES (04L)	
	2.1. Renewable energy resources: Introduction. **3.2.2** Solar energy: Solar cells, Photovoltaic effect, Differences between conductors, semiconductors, insulators and its band gap, Semiconductors as solar energy converters, Silicon solar cell **3.2.3.** Hydrogen: Fuel of the future, production of hydrogen by direct electrolysis of water, advantages of hydrogen as a universal energy medium	
	Total	**30**

References:

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.
3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]
4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer
6. Fundamental of Molecular Spectroscopy, 4 th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.

11. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.
12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.
13. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011.
14. Chemical Kinetics. Laidler, Pearson Education India, 1987.

Chemistry Paper- II
Course code: UGSC6CHT311
Title: - Inorganic Chemistry

Pre-requisites:

Knowledge of crystal field theory, molecular orbital theory for complex compounds, stability and electronic spectra of complexes, organometallic compounds, metallocenes, catalysis, metallurgy, Group 18 elements and Bioinorganic chemistry.

Course Objectives: To introduce students to

1 Apply the crystal field theory, molecular orbital theory to the complex compounds.
2 Understand the concept of crystal field stabilization energy and factors affecting the crystal Field splitting.
3 Learn the stability of the metal complexes and their electronics spectra.
4 Describe the distortion from octahedral geometry.

Course Outcomes: On successful completion of this course students will be able to:

1 Understand the basic concepts of molecular orbital theory for complex compounds.
2 Explain the crystal field splitting of various complex compounds.
3 Differentiate the inert and labile complexes
4 Calculate the ground state terms for p2 configuration.
5 Evaluate the stability of the various complexes.
6 Describe the nature and magnetic properties of octahedral complexes.

Course Content

UNIT	Description	Lectures in Hours
I	**1.0 Theories of the metal-ligand bond (I) (10L)** 1.1.1 Splitting of d orbital's in octahedral, square planar and tetrahedral crystal fields 1.1.2 Distortions from the octahedral geometry : (i) effect of ligand field and (ii) Jahn-Teller distortions. 1.1.3 Crystal field splitting parameters Δ ; its calculation and factors affecting it in octahedral complexes, Spectro-chemical series. 1.1.4 Crystal field stabilization energy(CFSE), calculation of CFSE for octahedral complexes with d0 to d10 metal ion configurations. 1.1.5 Consequences of crystal field splitting on various properties such as ionic radii, hydration energy and enthalpies of formation of metal complexes of the first transition series.	10
II	**2. Theories of the metal-ligand bond (II)** **2.1 Molecular orbital Theory for coordination compounds (4L)** 2.1.1 Identification of the central metal orbital's and their symmetry suitable for formation of σ-bonds with ligand orbital's. 2.1.2 Construction of ligand group orbital's 2.1.3 Construction of σ-molecular orbital's for an ML_6 complex. 2.1.4 Effect of π-bonding on complexes. 2.1.5 Examples like $[FeF_6]^{-4}$, $[Fe(CN)_6]^{-4}$, $[FeF_6]^{-3}$, $[Fe(CN)_6]^{-3}$,$[CoF_6]^{-3}$, $[Co(NH_3)_6]^{+3}$ **2.2 Stability of Metal-Complexes (2L)** 2.2.1 Thermodynamic and kinetic perspectives of metal complexes with examples. 2.2.2 Stability constants: stepwise and overall stability constants and their interrelationship. 2.2.3 Factors affecting thermodynamic stability **2.3 Reactivity of metal complexes. (2L)**	10

	2.3.1 Types of reactions in metal complexes. 2.3.2 Inert and labile complexes : correlation between electronic configurations and lability of complexes. 2.3.3 Ligand substitution reactions : Associative and Dissociative mechanisms.	
	2.4 Electronic Spectra . (2L)	
	2.4.1 Origin of electronic spectra 2.4.2 Selection rules for electronic transitions. 2.4.3 Electronic configuration and electronic micro states, Terms and Term symbols for transition metal ions, rules for determination of ground state term.	
III	**Organometallic Chemistry**	**10**
	3.1 Organometallic Compounds of main group metal (4L) 3.1.1 General characteristics of various types of organometallic compounds, viz. ionic, σ-bonded and electron deficient compounds. 3.1.2 Some chemical reactions of organometallic compounds:	
	(i) Reactions with oxygen and halogens, (ii) Alkylation and arylation reactions (iii) Reactions with protic reagents, (iv) Redistribution reactions and (v) Complex formation reactions.	
	3.2 Metallocenes (3L)	
	Introduction, Ferrocene : Synthesis, properties, structure and bonding on the basis of VBT.	
	3.3 Catalysis (3L)	
	3.3.1 Comparison between homogeneous and heterogeneous catalysis 3.3.2 Basic steps involved in homogeneous catalysis 3.3.3 Mechanism of Wilkinson's catalyst in hydrogenation of alkenes.	
	Total	**30**

Reference Books :

1) Geoffrey A. Lawrance Introduction to Coordination Chemistry John Wiley & Sons.
2) R. K. Sharma Text Book of Coordination Chemistry Discovery Publishing House.
3) Shukla P R, Advance Coordination Chemistry , Himalaya Publishing House.
4) Glen E. Rodgers, Descriptive Inorganic, Coordination, and Solid-State Chemistry Publisher: Thomson Brooks/Cole.
5) Ramesh Kapoor and R.S. Chopra, Inorganic Chemistry, R. Chand publishers,
6) R.K. Sharma Inorganic Reaction Mechanisms Discovery Publishing House
7) M. L. Tobe Inorganic Reaction Mechanisms Publisher Nelson, 1972
8) Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition..
9) H.W. Porterfield, Inorganic Chemistry, Second Edition, Academic Press, 2005.
10) Purecell, K.F. and Kotz, J.C., Inorganic Chemistry W.B. Saunders Co. 1977.
11) Robert H. Crabtree ,The Organometallic Chemistry of the Transition Metals, Publication by John Wiley & Sons.
12) R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
13) D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press.
14) Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
15) Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
16) R.Gopalan, Chemistry for undergraduates. Chapter 18. Principles of Metallurgy.(567-591).
17) Puri ,Sharma Kalia Inorganic chemistry. Chapter 10, Metals and metallurgy.(328-339)
18) Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
19) Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.

Chemistry Paper- III
Course code: UGSC6CHT312
Title: - Organic Chemistry

Pre-requisites:

Knowledge of biomolecules like carbohydrates, proteins, polymers, etc., in organic chemistry and awareness about stereochemistry, spectroscopy and organic reactions.

Course Objectives:

1. Develop a deep understanding of stereochemistry, focusing on mechanisms and stereochemical aspects.
2. Gain knowledge of α-amino acids, proteins and carbohydrate, general structure and classification including properties and methods of preparation.
3. Understand the nature of peptide bonds, nomenclature and synthesis.
4. Analyze various molecular rearrangements and name reactions.
5. Apply advanced spectroscopy techniques, specifically IR and PMR spectroscopy, for the interpretation of spectra related to different classes of organic compounds.
6. Examine the principles of polymer chemistry including polymer types, polymerization mechanisms, and the stereochemistry of polymers.
7. Explore catalysts and reagents used in organic synthesis, understanding their applications for functional group transformations and selectivity.

Course Outcomes:

1. Demonstrate a strong understanding of stereochemistry, being able to apply concepts like stereoselectivity and enantioselectivity and explaining stereochemical outcomes.
2. Analyze and explain the mechanisms and stereochemical aspects of reactions and molecular rearrangements in organic synthesis.
3. Explain the properties, configuration and classification of α-amino acids, proteins, carbohydrates, including synthesis.
4. Differentiate between carbohydrate and protein types based on their structures.
5. Interpret IR and NMR spectra for various organic compounds, using these techniques for structural analysis.
6. Apply the principles of polymer chemistry to analyze polymerization processes and understand the stereochemistry of polymers.
7. Analyze the applications of catalysts and reagents in functional group transformations and assess their selectivity in organic synthesis.

Course Content:

UNIT	Description	Lectures in Hours
I	**1.1 Stereochemistry II (06 L)** 1.1.1 Stereoselectivity and stereospecificity: Idea of enantioselectivity (ee) and diastereoselectivity (de) , Topicity : enantiotopic and diasterotopic atoms, groups and faces. 1.1.2 Stereochemistry of – i) Substitution reactions: S_{Ni} (reaction of alcohol with thionyl chloride) ii) Elimination reactions: E_2–Base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane. iii) Addition reactions to olefins: a) bromination (electrophilic anti addition) b) syn hydroxylation with O_sO_4 and $KMnO_4$ **1.2 Polymer (04L)** 1.2.1 Introduction Addition polymers, Condensation polymers 1.2.2 Stereochemistry of polymers: Tacticity, mechanism of stereochemical control of polymerization using Ziegler Natta catalysts. 1.2.3 Natural and synthetic rubbers: Polymerisation of isoprene: 1,2 and 1,4 addition (cis and trans), Styrene butadiene copolymer. 1.2.4 Additives to polymers: Plasticisers, stabilizers and fillers. 1.2.6 Biodegradable polymers: Classification and uses. polylactic acid structure, properties and use for packaging and medical purposes. (Note : *Identification of monomer in a given polymer & structure of polymer for a given monomer is expected. condition for polymerization is not expected*)	10
II	**2.1 Molecular Rearrangements (03L)** Mechanism of the following rearrangements with examples and stereochemistry wherever applicable. 2.1.1 Migration to the electron deficient carbon: Pinacol-pinacolone rearrangement. 2.1.2 Migration to the electron deficient nitrogen: Beckmann rearrangement. 2.1.3 Migration involving a carbanion : Favorski rearrangement. 2.1.4 Name reactions: Michael addition, Wittig reaction. **2.2 Carbohydrates (04L)**	10

	2.2.1 Introduction: classification, reducing and non-reducing sugars, DL notation 2.2.2 Structures of monosaccharides: Fischer projection (4-6 carbon monosaccharides) and Haworth formula (furanose and pyranose forms of pentoses and hexoses) Interconversion: open chain and Haworth forms of monosaccharides with 5 and 6 carbons. Chair conformation with stereochemistry of D-glucose. 2.2.3 Stereoisomers of D-glucose: enantiomer, diastereomers, anomers, epimers. 2.2.4 Mutarotation in D-glucose with mechanism 2.2.5 Chain lengthening & shortening reactions: Modified Kiliani-Fischer synthesis (D-arabinose to D-glucose and D-mannose), Wohl method (D-glucose to D-arabinose) 2.2.6 Reactions of D-glucose and D-fructose: (a) Osazone formation (b) reduction: Hi/Ni, $NaBH_4$ (c) oxidation: bromine water, HNO_3, HIO_4 (d) acetylation (e) methylation:(d) and (e) with cyclic pyranose forms 2.2.7 Glycosides: general structure	
	2.3 Amino acids & Proteins (3L) **2.3.1** α-Amino acids: General Structure, configuration, and classification based on structure and nutrition. Properties: pH dependency of ionic structure, isoelectric point and zwitter ion. Methods of preparations: Strecker synthesis, Gabriel phthalimide synthesis. **2.3.2** Polypeptides and Proteins: nature of peptide bond. Merrifield solid phase polypeptide synthesis. Protiens :general idea of primary, secondary, tertiary & quaternary structure	
III	**3.1 Spectroscopy II (06L** **3.1.1** IR Spectroscopy: Basic theory, nature of IR spectrum, selection rule, fingerprint region. **3.1.2** PMR Spectroscopy: Basic theory of PMR, nature of PMR spectrum, chemical shift (δ-unit), standard for PMR, solvents used. Factors affecting chemical shift: (1) inductive effect (2) anisotropic effect (with reference to C=C, C≡C, C=O and benzene ring). Spin- spin coupling and coupling constant. application of deuterium exchange technique. application of PMR in structure determination. **3.1.3** Spectral characteristics of following classes of organic compounds, including benzene and monosubstituted benzenes, with respect to IR and PMR: (1) alkanes (2) alkenes (3) alkynes (4) haloalkanes (5) alcohols (6) carbonyl compounds (7) ethers (8) amines (broad regions characteristic of different groups are expected). Problems of structure elucidation of simple organic compounds using individual or combined use of UV-Vis, IR, Mass and NMR spectroscopic technique are expected. (Index of hydrogen deficiency should be the first step in solving the problems).	**10**

	3.2 Nucleic Acids **(2 L)**	
	Controlled hydrolysis of nucleic acids. sugars and bases in nucleic acids. Structures of nucleosides and nucleotides in DNA and RNA. Structures of nucleic acids (DNA and RNA) including base pairing.	
	3.3 Catalysts and Reagents **(2L)**	
	Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism). **3.3.1** Catalysts: Catalysts for hydrogenation: a. Raney Nickel b. Pt and PtO_2 (C=C, CN, NO_2, aromatic ring) c. Pd/C : C=C, COCl→ CHO (Rosenmund) d. Lindlar catalyst: alkynes **3.3.2** Reagents**:** a. $LiAlH_4$ (reduction of CO, COOR, CN,NO_2) b. $NaBH_4$ (reduction of CO) c. SeO_2 (Oxidation of CH_2 alpha to CO) d. mCPBA (epoxidation of C=C) e. NBS (allylic and benzylic bromination)	
	Total	**30**

References:

1) Polymer chemistry by M.G.Arora, K.Singh.
2) Polymer science – a text book by Ahluwalia and Mishra
3) Introduction to polymer chemistry - R.Seymour, Wiley Interscience.
4) Organic chemistry (fourth edition),G,Marc Loudon,Oxford University press.
5) Introduction to Organic Chemistry (Third edition), Andrew Streitwieser, Jr. Clayton H. Heathcock, Macmilan publishing. Organic chemistry fourth edition.
6) Morrision and Boyd. Introduction to Organic chemistry,John McMurry.
7) Organic chemistry volume-1&2 (fifth and sixth edition) IL Finar.
8) Biochemistry, 8th Ed., Jeremy Berg, Lubert Stryer, John L. ymoczko, Gregory J. Gatto Pub.
9) H. Freeman Publishers Lehninger Principles of Biochemistry 7th Ed., David Nelson and Michael Cox, Publisher W. H. Freeman Name Reactions – Jie Jack Li, 4th Edition, Springer
10) Organic chemistry by Francis Carey – McGrawHill . Oranic chemistry by Carey and Sundberg, Part A & B

Chemistry Paper- IV
Course code: UGSC6CHT313
Title: - Analytical Chemistry

Pre-requisites: Basic knowledge of electroanalytical techniques, chromatography and thermal methods.

Course Objectives: To introduce students to

1. Familiar with polarographic and amperometric concepts.
2. Learn gas chromatography and ion exchange methods of analysis.
3. Understand about thermal methods of analysis like TGA, DTA, TT.
4. Learn steps and procedures of method validation.

Course Outcomes: On successful completion of this course students will be able to:

1. Enrich with methods and operations of polarographic, amperometric techniques.
2. Use GC and Ion exchange techniques as separation methods for analysis of sample.
3. Enhance application of thermal methods like TGA, DTA, TT.
4. Judge methods of analysis for samples.

Course Content:

UNIT	Description	Lectures in Hours
I	**ELECTRO ANALYTICAL TECHNIQUES**	**10**
	1.1 Polarography(Numerical & word problems are expected) (7L)	
	1.1.1 Difference between potentiometry and voltammetry, Polarizable and non-polarizable electrodes 1.1.2 Basic principle of polarography, H shaped polarographic cell, DME (construction, working, advantages and limitations) 1.1.3 DC polarogram: Terms involved - Residual current, Diffusion current, Limiting current, Half-Wave Potential, Role and selection of supporting electrolyte, Interference of oxygen and its removal, polarographic Maxima and Maxima Suppressors, Qualitative aspects of Polarography: Half wave potential E1/2, Factors affecting E1/2. Quantitative aspects of polarography: Ilkovic equations: various terms involved in it (No derivation) 1.1.4 Applications advantages and limitations	

	1.2 Amperometric Titrations (3L)	
	1.2.1 Principle, Rotating Platinum Electrode (Construction, advantages and limitations) 1.2.2 Titration curves with example 1.2.3 Advantages and limitations	
II	**METHODS OF SEPARATION - II**	**10**
	2.1 Gas Chromatography (5L)	
	2.1.1 Introduction, Principle, Theory and terms involved **2.1.2** Instrumentation: Block diagram and components, types of columns, stationary phases in GSC and GLC, Detectors: TCD, FID, ECD **2.1.3** Qualitative, Quantitative analysis and applications **2.1.4** Comparison between GSC and GLC	
	2.2 Ion Exchange Chromatography (5L)	
	2.2.1 Introduction, Principle.	
	2.2.2 Types of Ion Exchangers, Ideal properties of resin	
	2.2.3 Ion Exchange equilibria and mechanism, selectivity coefficient and separation factor Factors affecting separation of ions	
	2.2.4 Ion exchange capacity and its determination for cation and anion exchangers.	
	2.2.5 Applications of Ion Exchange Chromatography with reference to Preparation of demineralised water, Separation of amino acids	
III	**THERMAL METHODS AND ANALYTICAL METHOD VALIDATION**	**15**
	3.1 Thermal Methods (8L)	
	3.1.1 Introduction to various thermal methods (TGA, DTA and Thermometric titration) 3.1.2 Thermogravimetric Analysis (TGA) 3.1.3 Instrumentation-block diagram, thermobalance, Thermogram (Basic components: balance, furnace, temperature measurement and control, recorder) 3.1.4 Factors affecting thermogram-Instrumental factors and Sample characteristics 3.1.5 Applications: Determination of drying and ignition temperature range 3.1.6 Determination of percent composition of binary mixtures (Estimation of Calcium and Magnesium oxalate) 3.1.7 Differential Thermal Analysis (DTA) 3.1.8 Principle, Instrumentation, and Reference material used, Applications, Comparison between TGA and DTA, thermogram .	

	3.1.9 Applications 3.1.10 Comparison between TGA and DTA 3.1.11 Thermometric Titrations – 3.1.12 Principle and Instrumentation 3.1.13 Thermodynamic Titration of HCl vs NaOH	
	3.2 Analytical Method Validation (02L)	
	3.2.1. Introduction and need for validation of a method	
	3.2.2 Validation Parameters: Specificity, Selectivity, Precision, Linearity, Accuracy and Robustness	
	References: 1) .Egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8. 2) Introduction to Polarography and Allied Techniques, By Kamala Zutshi, New Age International, 2006. 3) Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd 4) Principles of Polarography by Jaroslav Heyrovský , Jaroslav Kůta, 1st Edition, Academic Press, eBook 5) Analytical Chemistry, Gary.D Christan, 5th edition 6) Analytical chemistry, R. K. Dave. 7) Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969. 8) Fundamentals of Analytical Chemistry, D .A. Skoog and D. M. West and F. J. Holler Holt., Saunders 6th Edition(1992). 9) Analytical Chemistry of Open Learning(ACOL),James W. Dodd & Kenneth H. Tonge. 10) Analytical chemistry David Harvey The ,McGraw Hill Companies, Inc. 11) Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd 12) Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Newman	
	Total	**45**

Chemistry Practical
Course code: UGSC6CHEP314
Title: - Physical Chemistry

Learning Objectives:

1. To gain hands-on experience of the various instruments to be used for measurements of physical properties.
2. To familiarize the learners about the interpretation of order of reaction in chemical
3. kinetics by graphical method.
4. To develop skills of observation, recording and analysing data.
5. To acquire knowledge about theory and working of a viscometer.

Leaning Outcome: On successful completion of this course, students will be able to:

1. Perform instrument-based experiments and non-instrumental experiments with proper techniques.
2. Present the experimental data by graphical methods.
3. Recognize the various electrodes and set-up a chemical cell in potentiometry.
4. Determine molecular weight of a polymer solution using viscometer.
5. Measure absorbance of various solutions using a colorimeter.

List of the experiments:

	Non-Instrumental
1.	**Viscosity** **1.** To determine the molecular weight of high polymer polyvinyl alcohol (PVA) by viscosity measurement.
	Instrumental
2.	**Potentiometry:** To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate.
3.	**Conductometry:** To titrate a mixture of weak acid and strong acid against strong base and estimate the amount of each acid in the mixture conductometrically.
4.	**Colorimetry** To estimate the amount of Fe(III) in the complex formation with salicylic acid by Static Method. Reference books 1. Practical Physical Chemistry

Chemistry Practical
Course code: UGSC6CHEP314
Title: - Inorganic Chemistry

Leaning Outcome: On successful completion of this course students will be able to:

1) Analyse the Inorganic mixture only by wet tests.
2) Detect the cation and anion in supplied compounds as impurities.
3) Determine the percentage yield in Inorganic preparations.
4) Prepare a definite volume of solution from supplied compounds and determine its percentage purity.
5) Conclude the supplied compounds contains the impurity as cation and anion from its percentage purity.

List of the experiments:

I	**INORGANIC PREPARATIONS:**
	(a) Preparation of tris (acetyl acetonato) iron (III) .
	(b) Preparation of potassium tri oxalato aluminate(III) .
II	Determination of percentage purity of the given water soluble salt and qualitative detection with respect to added cation and/or anion (qualitative analysis only by wet tests) : Any Three Salts

Chemistry Practical
Course code: UGSC6CHEP315
Title: - Organic Chemistry

Leaning Outcome: On successful completion of this course students will be able to:

1. Handle various types of apparatus and chemicals during the experiments.
2. Determine the physical type of the given mixture.
3. Use the distillation method for separation of organic mixture.
4. Identify the chemical type of the separated organic compounds.
5. Detect the elements, functional groups , B.P and identify the organic compound.

List of the experiments:

Separation of Binary liquid-liquid and liquid- solid mixture.	
	1) Minimum Four mixtures to be completed by the students.
	2) Components of the liquid-liquid mixture should include volatile liquids like acetone, methyl acetate, ethyl acetate, isopropyl alcohol, ethyl alcohol, EMK and non-volatile liquids like chlorobenzene, bromobenzene, aniline, N,N dimethylaniline, acetophenone, nitrobenzene, ethyl benzoate
	3) Components of the liquid- solid mixture should include volatile liquids like acetone, methyl acetate, ethyl acetate, ethyl alcohol, IPA, EMK and solids such as water insoluble acids, phenols, bases, neutral
	4) A sample of the mixture one ml to be given to the student for detection of the physical type of the mixture
	5) After correct determination of physical type, separation of the binary mixture to be carried out by distillation method using microscale technique.
	6) After separation into component A and component B, the compound to be identified can be decided by examiner.

Chemistry Practical

Course code: UGSC6CHEP315

Title: - Analytical Chemistry

Leaning Outcome: On successful completion of this course students will be able to:

1. Operate spectrophotometer, pH meter for sample analysis.
2. Use the redox methods for the analysis of sugar.
3. Apply ion exchange chromatography technique for sample analysis.
4. Enrich with various operational and practical skills.

List of the experiments: Any Four

1. Estimation of Chromium in water sample spectrophotometrically by using Diphenyl carbazide.
2. Estimation of reducing sugar in honey by Willstatter method.
3. Estimation of Mg^{+2} & Zn^{+2} by anion exchange resin using an anion exchange resin.
4. Estimation of acetic acid in Vinegar sample by using Quinhydrone electrode potentiometrically.
5. Determination of phosphoric acid in cola sample pH metrically.
Note: Calculation of percent error is expected for all the experiments.
Reference Books: 1. Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989). 2. Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al 3. The chemical analysis of food and food products III edition Morris Jacob . 4. The chemical analysis of food by David Pearson and Henry Edward

Student should complete all the experiments assigned for Semester-VI. Certified journal is a must to be eligible for appearing the semester end practical Examination.

Chemistry Paper V

Course code: UGSC5CHACT307

Title: - Applied Components (Dyes and Drugs)

Course Objectives:

1. To impart comprehensive knowledge of terms, concepts, theories used in drugs and Dyes
2. To comprehend the routes of drug administration, dosage forms of drugs
3. To understand the classes of drugs used for different therapeutic uses.
4. To learn synthesis of commercially important drugs and dye intermediates
5. To carry out advanced study of unit processes used in industry
6. To differentiate between various classes of dyes, dyeing methods.

Course Outcomes: On successful completion of this course students will be able to:

1. Describe different terms and concepts used in drugs and dyes
2. Classify the drugs and dyes in various different ways
3. List different classes of various pharmacodynamic agents
4. Wwrite the synthesis of some important pharmacodynamic drugs and dye intermediates
5. Describe unit processes used in dye synthesis
6. Apply different theories to relate colour and constitution of dyes
7. Compare different dying methods &choose the correct method depending on the substrate

Course Content:

UNIT	Description	Lectures in Hours
I	**1.1 General Introduction to Drugs (04L)**	**10**
	1.1.1 Definition of a drug, sources of drugs, requirements of an ideal drug, classification of drugs (based on therapeutic action), 1.1.2 Nomenclature of drugs: Generic name, Brand name, Systematic name 1.1.3 Definition of the following medicinal terms: Pharmacon, Pharmacology, Pharmacophore, Prodrug, Half – life efficiency, LD50, ED50, GI50 Therapeutic Index. 1.1.4 Brief idea of the following terms: Receptors, Agonists, Antagonists, Drug-receptor interaction, Drug Potency, Bioavailability, Drug toxicity, Drug addiction, Spurious Drugs, Misbranded Drugs, Adulterated Drugs, Pharmacopoeia.	
	1.2 Routes of Drug Administration and Dosage Forms (2L)	
	1.2.1 Oral and Parenteral routes with advantages and disadvantages. 1.2.2 Formulations & combination formulation.	
	1.3 Pharmacodynamic agents (4L)	
	A brief introduction of the following pharmacodynamic agents and the study with respect to their chemical structure, chemical class, therapeutic uses, and side effects.	

	1.3.1 Analgesics and Antipyretics: a) Morphine (Phenanthrene alkaloids), b) Tramadol (Cyclohexanols) (Synthesis from salicylic acid) , c)Aspirin (Salicylates) , d) Paracetamol (p-Amino phenols) **1.3.3 Anti-inflammatory Drugs:** Mechanism of inflammation and various inflammatory conditions. ▪ Steroids: Prednisolone, Betamethasone ▪ Sodium Diclofenac, Aceclofenac (N- Aryl anthranilic acids) (Synthesis from 2,6-dichlorodiphenyl amine)	
II	**2.1 Pharmacodynamic agents- (5L)**	**10**
	2.1.1 Antidiabetic Agents General idea and types of diabetes; Insulin therapy Glibenclamide (Sulphonyl ureas) Metformin (Biguanides) Dapagliflozin (Pyranose)	
	2.1.2 Antiparkinsonism Drugs Idea of Parkinson's disease. Procyclidine hydrochloride (Pyrrolidines) Ethopropazine hydrochloride (Phenothiiazines) Levodopa (Amino acids) (Synthesis from Vanillin)	
	2.1.3 Drugs for Respiratory System General idea of: Expectorants; Mucolytes; Bronchodilators; Decongestants; Antitussives Ambroxol (Cyclohexanol) (Synthesis from paracetamol) Salbutamol (Phenyl ethyl amines) Oxymetazoline (Imidazolines) Codeine Phosphate (Opiates)	

	2.2 Introduction to the dye-stuff Industry- **Dyes-**Definition of dyes, requirements of a good dye, Solubility, Linearity, Coplanarity, Fastness, Substantivity, Economic viability. Definition of fastness and its properties and Mordants with examples Explanation of nomenclature or abbreviations of commercial dyes with at least one example suffixes – G, O, R, B, K, L, C, S H, 6B, GK, 6GK, Naming of dyes by colour index (two examples) used in dye industries. **2.2.1** ***Natural and Synthetic Dyes***-Natural Dyes: Definition and limitations of natural dyes. Examples and uses of natural dyes w.r.t Heena, Turmeric, Saffron, Chlorophyll [structures not expected], **2.2.2** ***Synthetic dyes:*** Definition of synthetic dyes, primaries and intermediates. Important milestones in the development of synthetic dyes.	
III	**3.1 Classification of dyes based on applications and dyeing methods(4L)** **3.1.1** Dyeing methods Basic Operations involved in dyeing process: i. Preparation of fibres ii. Preparation of dyebath iii.Application of dyes iv.Finishing Dyeing	**10**
	Method of Cotton Fibres: (i) Direct dyeing, (ii) Vat dyeing, (iii) Mordant dyeing, (iv) Disperse dyeing	
	3.1.2 Classification of dyes based on applicability on substrates **(2)** (examples with structures) (a) Acid Dyes- Orange II, (b) Basic Dyes- methyl violet, (c) Azoic Dyes – Diazo components; Fast yellow G, Fast orange R. Coupling components. Naphthol AS, Naphthol ASG, (d) Mordant Dyes- Eriochrome Black A, Alizarin. (e) Vat Dyes- Indanthrene brown RRD, (f) Sulphur Dyes- Sulphur Black T (no structure) .	
	3.1.3 Unit process and Dye Intermediates- (4L) Introduction to primaries and intermediates. Unit processes: definition and brief ideas of below unit processes: (a)Nitration (b)Sulphonation (c)Halogenation (d) Oxidation NB: Definition, Reagents, Examples of each unit processes mentioned above with reaction conditions (mechanism is not expected	
	Total	**30**

Reference Books: **(For Drugs)**

1) Foye's principles of medicinal chemistry. 6th Edition, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippmcolt Williams & Wilkins.
2) Text book of organic medicinal & pharmaceutical chemistry. Wilson &Gisovolds, 11th Edition by John H Block, John M Beale Jr.
3) Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
4) Burger's Medicinal Chemistry, Drug Discovery and Development. Abraham and Rotella. Wiley
5) Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
6) Medicinal chemistry. V.K. Ahluwalia and Madhu Chopra, CRC Press.
7) Principle of medicinal chemistry. Vol 1 &2 S. S. Kadam, K. R. Mahadik, K. G. Bothara
8) The Art of Drug synthesis. Johnson and Li. Wiley, 2007.
9) The Organic Chemistry of Drug Synthesis. Lednicer and Mitsher, Wliey.

For Dyes:

1. Chemistry of Synthetic Dyes, Vol I – VIII, Venkatraman K., Academic Press 1972
2. The Chemistry of Synthetic Dyes and Pigments, Lubs H.A., Robert E Krieger Publishing Company, NY ,1995
3. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications, 1973

Applied Components Practical
Course code:
UGSC5CHACP308
Title: - Applied Components

Leaning Outcome: On successful completion of this course students will be able to:

1. Estimate the drugs by using volumetric methods
2. synthesise the simple drugs
3. separate the components of mixture by TLC
4. apply the knowledge of dyeing for dyeing fabrics

List of Experiments

1	Estimation of Ibuprofen (back titration method)
2	Estimation of Acid neutralizing capacity of a drug
3	Preparation of Aspirin from salicylic acid.
4	Separation of components of natural pigments by paper chromatography (eg: chlorophyll)II]

Project: Preparation of Orange II dye (semi-microscale1.0gms) and its use for dyeing different fabrics.

Student should complete all the experiments assigned for Semester-V. Certified journal is a must to be eligible for appearing the semester end practical Examination.

Semester-VI

Applied Components

Course code: UGSC6CHACT316

Title: - Applied Components (Dyes and Drugs)

Course Objectives:

1. To give extensive knowledge of Chemotherapeutic drugs and their classes.
2. To comprehend the drug discovery, design, development and metabolism.
3. To know the recent global advances in drugs.
4. To learn synthesis of commercially important drugs and dye.
5. To carry out advanced study of non-textile uses of dyes used in industry.
6. To study the environmental and health hazards of dyes.

Course Outcomes: On successful completion of this course students will be able to:

1. Describe different steps involved in Drug Discovery, Design and Development.
2. Classify the dyes based on chemical constitution.
3. List different classes of various chemotherapeutic agents.
4. Write the synthesis of some important chemotherapeutic drugs and dyes.
5. Describe the various non-textile uses of dyes.
6. Predict the remediation methods for different health hazards of dyes.
7. Explain recent developments in pharmaceuticals and Dyes.

Course Content:

UNIT	Description	Lectures in Hours
I	**1.1 Drug Discovery, Design and Development- (3L)** 1.1.1 Discovery of a Lead compound: Screening, drug metabolism studies and clinical observation, Lipinski's rule of 5 1.1.2 Development of drug: The Pharmacophore identification, modification of structure or functional group, Structure activity relationship (Sulphonamides). 1.1.3 Computer assisted drug design.	**10**
	1.2 Drug Metabolism: (2L) Introduction, Absorption, Distribution, Biotransformation, Excretion Different types of chemical transformation of drugs with specific examples.	
	1.3 Chemotherapeutic Agents: (5L) Study of the following chemotherapeutic agents with respect to their chemical structure, chemical class, therapeutic uses, side effects and introduction to MDR wherever applicable.	

	1.3.1 Antibiotics and antivirals: Definition, – Amoxicillin (®- lactam antibiotics) – Doxycycline (Tetracyclines) – Levofloxacin (Quinolones) (Synthesis from 2,3,4 –Trifluro -1-nitrobenzene) – Aciclovir/Acyclovir (Purines)	
	1.3.2 Antimalarials: Types of malaria; Symptoms; Pathological detection during window period (Life cycle of the parasites not to be discussed) –Chloroquine (3-Amino quinolones) -Artemether (Benzodioxepins)	
	1.3.3 Anthelmintics and Antifungal agents: Drugs effective in the treatment of Nematodes and Cestodes infestations. Diethyl carbamazine (Piperazines) Clotrimazole (Imidazole) Fluconazole (Triazole) (Synthesis from 1- Bromo – 2,4- difluorobenzene)	
II	**2.1. Some more chemotherapeutic agents - (5L)** **2.1.1 Antitubercular and Antileprotic Drugs:** Types of Tuberculosis; Symptoms and diagnosis of Tuberculosis. Types of Leprosy. General drugs used. PAS (Amino salicylates) Isoniazide (Hydrazides) Pyrazinamide (Pyrazines) (+) Ethambutol (Aliphatic diamines) (Synthesis from 1- Nitropropane) Clofazimine (Phenazines)	**10 L**
	2.1.2 Anti-Neoplastic Drugs: Defination, Types of tumors, Causes and treatment Lomoustine (Nitrosoureas) Anastrozole (Triazoles) (Synthesis from 3,5-bis (bromo methyl) toluene) Cisplatin (Chloro Platinum)	
	2.1.3 Anti-HIV Drugs: Idea of HIV pathogenicity, Symptoms of AIDS AZT/Zidovudine, Lamivudine, DDI (Purines)	

	2.1 Classification of Dyes based on Chemical Constitution and Synthesis of Selected Dyes (Synthesis of the dyes marked with * is expected) **(5L)** i) Nitro Dye: Naphthol Yellow S ii) Nitroso Dye: Gambine Y iii) Azo dyes: a) Monoazo dyes: Orange IV *(from sulphanilic acid) & Eriochrome Black T (from β- naphthol) b) Bisazo dyes: Congo Red* (from nitrobenzene) iv) Diphenylmethane dye: Auramine O (from N,N-dimethyl aniline) v) Quinone Dyes: a) Naphthazarin b) Indanthrene Blue* (from anthraquinone)	
	3.1 Remediation processes of synthetic dyes (2L) Effluent Treatment Strategies: Brief introduction to effluent treatment plants (ETP) Primary Remediation processes:(Physical Processes) Sedimentation, Aeration, Sorption (activated charcoal, fly ash etc.) Secondary Remediation processes: Biological Remediation – Bio sorption, bioremediation and biodegradation. Chemical Remediation: Oxidation Processes (chlorination), Coagulation- flocculation-Precipitation	**10 L**
	3.2 Non-textile uses of dyes: (6L) **3.2.1** Dyes used in food and cosmetics: Properties of dyes used in food and cosmetics Introduction to FDA and FSSAI	
	3.2.3 Pigments **(2L)** I. Definition, examples, properties of pigments II. Difference between dyes and pigments	
	Total	**30**

Reference **Books (For Drugs):**

1. Foye's principles of medicinal chemistry. 6th Edition, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippmcolt Williams & Wilkins.
2. Text book of organic medicinal & pharmaceutical chemistry. Wilson &Gisovolds, 11th Edition by John H Block, John M Beale Jr.
3. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
4. Burger's Medicinal Chemistry, Drug Discovery & Development. Abraham & Rotella. Wiley
5. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
6. Medicinal chemistry. V.K. Ahluwalia and Madhu Chopra, CRC Press.
7. Principle of medicinal chemistry. Vol 1 & 2 S. S. Kadam, K. R. Mahadik, K. G. Bothara
8. The Art of Drug synthesis. Johnson and Li. Wiley, 2007.
9. The organic chemistry of drug design & drug action. 2 nd ed. By Richard B Silvermann, Academic Press.
10. The Organic Chemistry of Drug Synthesis. Lednicer and Mitsher, Wliey.
11. Text book of drug design and discovery. Povl-Krog-Sgaard-Larsen, Tommy Liljefors and ULF Madsen, 3rd Edition Taylor & Francis.
12. Bio-applications of nanoparticles. Edited by Warren C.W. Chan, Springer Publication.
13. Nanoparticle and technology for drug delivery (Drugs and pharmaceutical sciences). Ram B.Gupta& Uday B.Kompella Pub. Informa Healthcare.
14. Nano forms of carbon and its applications. Edited by Maheshwar Sharon and Madhuri Sharon.MonadNanotechPvt. Ltd.
15. Environmental Chemistry. A. K. De
16. Text Book on Law and Medicine. Chokhani and Ghormade. 2nd Edition. Hind Law House, Pune.
17. Essentials of Medical Pharmacology. K D Tripathi, Jaypee Brothers Medical publishers Pvt. ltd.
18. Practical organic chemistry, Vogel.

References (For Dyes)

1. Chemistry of Synthetic Dyes, Vol I – IV, Venkatraman K., Academic Press 1972
2. The Chemistry of Synthetic Dyes and Pigments, Lubs H.A., Robert E Krieger Publishing Company, NY ,1995
3. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications, 1973
4. Environmental Studies, Joseph Benny, Tata McGraw Hill Education, 2005
5. Fundamental Concepts of Environmental Chemistry,Sodhi. G. S., Alpha Science International, 2009
6. Planning Commission, Niti Aayog, FSSAI and FDA websites
7. Green Chemistry for Dyes Removal from Waste Water- Research Trends and Applications, Ed. Sharma S.K., Wiley, 2015
8. Environmental Pollution- Monitoring and Control, Khopkar S.M., New Age International (P) Ltd, New Delhi, 1982

Applied Components Practical

Course code:
UGSC6CHACP317
Title: - Applied components

Leaning Outcome: On successful completion of this course students will be able to:

1. Synthesise the simple drugs and dye intermediate
2. Separate the components of mixture by TLC
3. Describe the monograph of a drug in pharmacopeia

List of the experiments:

1.	O-Methylation of β-naphthol.
2.	Preparation of Paracetamol form p-aminophenol.
3.	Preparation of Fluorescein
4.	TLC of a mixture of dyes (safranine-T, Indigo carmine, methylene blue)
5.	Preparation of monograph of any one drug from syllabus by I.P. method. OR **Industrial visit Report.**

Student should complete all the experiments assigned for Semester-VI. Certified journal is a must to be eligible for appearing the semester end practical Examination.

EXAMINATION PATTERN

A) Continuous Internal Assessment (40 Marks):

Sr. No.	Particulars	Marks
1	One Assignment or Presentation or seminar.	20
2	One online/offline class test.	10
3	Active participation in routine class/practicals.	05
4	Overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	05

B) Semester End Examination (60 Marks):

Question Paper Pattern

1. These examinations shall be of Two Hours duration. Maximum marks 60.
2. There shall be Four questions each of **15 marks**. On each Unit -I , II & III there will be one question
3. The Fourth one will be based on entire syllabus with Six MCQs, six questions on match the column and three questions based on true/false with internal choice.
4. All questions shall be compulsory with internal choice within the questions. (Each question will be 25 **marks** with options.) but Fourth question has no internal choice.
5. Question may be subdivided into sub-questions a, b, c. d & e, the allocation of marks depends on the weightage of the topic.

Qn.	Sub-Qn	Particulars	Unit	Marks with options	Total Marks for sub-qn	Total Marks for qn
1	**A, B, C, D & E**	Answer the following (Attempt **any three out of five**)	**I**	25	15	15
2	**A, B, C, D & E**	Answer the following (Attempt **any three out of five**)	**II**	25	15	15
3	**A, B, C, D & E**	Answer the following (Attempt **any three out of five**)	**III**	25	15	15
4	**A**	Choose the Correct answer and rewrite the statement.	**I, II, III**	06	15	15
	B	Match the Columns		06		
	C	State whether the statement is true or false.		03		
		Total		**90**	60	**60**

C) Semester End Main Practical Examination (200 marks) and Applied Component Examination (100 marks):

Scheme of examination:

- There will be no internal assessment for practical.
- A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department/Institute to the effect that the candidate has

completed the practical course of that semester of T. Y. B.Sc. Chemistry as per the minimum requirement

- The duration of the practical examination will be Three hours thirty minutes for per paper.
- Students will be examined based on Paper I(Physical), II(Inorganic), III(Organic) and IV (Analytical) and Paper-V (Applied Component).
- The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for the skill and understanding of Chemistry.
- For semester end main Practical examination there will be two External Examiners and Two internal Examiners will be appointed.

Distribution of marks paper wise for term end practical examination

Sr. No.	**Particulars**	**Marks (50 marks)**
1	One Experiment	40
3	Viva voce	05
4	Certified journal	05
	Total Marks	**50**

Vocational Skill Course
Course code: UGSC6CHVS05
Title: - Experimental Chemistry

University of Mumbai

S. Z. S. P. Mandal's
SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA
SAWANTWADI
(An Autonomous College)
DIST: SINDHUDURG- 416 510, MAHARASHTRA
DEPARTMENT OF CHEMISTRY
Syllabus for Approval

Sr. No.	Heading	Particulars
1.	Title of the Course	S. Y. B. Sc.
2.	Eligibility for Admission	F. Y. B. Sc.
3.	Passing Marks	40%
4.	Ordinance/Regulations (if any)	
5.	No. of Years/Semesters	Two Semesters
6	Level	UG
7	Pattern	Semester (60:40)
8	Status	Revised
9	To be implemented from Academic Year	From Academic Year 2024-2025

Date:

Signature
HoD,
Dept. of Chemistry

SEMESTER-VI: Vocational Skill Course

Experimental Chemistry – V: UGSC6CHVS05 (Credit 02)

Chemistry Practicals:

One step preparation (1.0 g scale)

1. Bromobenzene to p-nitrobromobenzene
2. Anthracene to anthraquinone
3. Benzoin to benzil
4. p-Benzoquinone to 1,2,4-triacetoxybenzene
5. Ethyl acetoacetate to 3-methyl-phenylpyrazol-5-one
6. o-Phenylenediamine to 2-methylbenzimidazole
7. Preparation of Chalcone
8. Benzaldehyde to Benzoic Acid

(Minimum 06 experiments are expected)

(The learner is expected to write a balanced chemical reaction and stoichiometry.)

SEMESTER- V AND VI: FP/CEP/OJT
Course Code: UGSC5CHFP/CEP/OJT01
SEMESTER- VI: FP/CEP/OJT
Course Code: UGSC6CHFP/CEP/OJT02

Course Title: Field Project

Level: 5.5	Credits: 02	Number of Hrs. spend: 60	Semester- V or VI
Any project related to subject (field work): Report Submission			

Or

Course Title: Community Engagement Program

Level: 5.5	Credits: 02	Number of Hrs. spend: 60	Semester-V or VI
Any project related to subject (Social awareness work) : Report Submission			

Or

Course Title: On Job Training

Level: 5.5	Credits: 02	Number of Hrs. spend: 60	Semester-V or VI
Student acquire practical knowledge as well as in –plant training : Report Submission			

SEMESTER-V [Minor]
Course code: UGSC5CHT309
Title: - General Chemistry: Paper-I

Knowledge of Molecular Spectroscopy, Chemical Thermodynamics, Adsorption, Colloids, Nuclear Chemistry.

Course Objectives:

7. Generate novel approaches for data analysis and property determination in molecular spectroscopy and colligative properties.
8. Evaluate the appropriateness of selection rules, thermodynamic derivations and experimental methods used in spectroscopy and colligative properties.
9. Analyze the electrical properties of colloidal particles and models of electrical double layers to gain insights into colloid science.
10. Apply the knowledge gained in spectroscopy to analyze and interpret real-world data related to molecular structures, interatomic forces, and colligative properties.
11. Achieve a comprehensive understanding of the fundamental principles underlying molecular spectroscopy and colloid science, including the postulates of Langmuir adsorption isotherm and the quantum theory of Raman spectra.
12. Develop the ability to recall and describe key concepts, terminologies, mathematical expressions, and fundamental principles related to both molecular spectroscopy and colloid science.

Course Outcomes: After the completion of this course, learners will be able to:

7. Understand the fundamental principles of nuclear chemistry and measurement of radioactivity. They will also be able to understand the postulates of Langmuir adsorption isotherm and the quantum theory of Raman spectra.
8. Analyse the types of reactions in chemical kinetics, the electrical properties of colloidal particles and models of electrical double layers. They will be able to analyse colligative properties, such as vapor pressure lowering, boiling point elevation, and freezing point depression.
9. Evaluate the appropriateness of selection rules, thermodynamic derivations and experimental methods used in both spectroscopy and colligative properties. They will make informed judgements about the significance and practical applications of these techniques.
10. Remember the action of surfactants based on adsorption and flash photolysis in chemical kinetics. They will be able to describe key concepts, terminologies and mathematical expressions of chemical thermodynamics.
11. Apply their knowledge of spectroscopy for the interpretation of structure of a compound. They will be able to conduct quantitative analysis and draw meaningful conclusions.
12. Create a design of an experiment and execute the experiments for both molecular spectroscopy and the measurement of colligative properties. Learners will be adept at proposing innovative methodologies for data analysis and property determination in these fields.

Course Content

UNIT	Description	Lectures in Hours
I	**1.1 Spectroscopy** 1.1.1 Introduction: Electromagnetic spectrum, units of wavelength and frequency 1.2.1 UV – Visible spectroscopy: Basic theory, solvents, nature of UV- Visible spectrum, concept of chromophore, auxochrome, bathochromic and hypochromic shifts, hyperchromic and hypochromic effects, chromophore-chromophore and chromophore- auxochrome interactions.	**10**
II	**2.1 Natural Product** 2.1.1. Terpenoids: Introduction, Isoprene rule, special isoprene rule and the gem-dialkyl rule. 2.1.2 Citral: a) Structural determination of citral. b) Synthesis of citral from methyl heptenone c) Isomerism in citral. (cis and trans form). 2.1.2. Alkaloids Introduction and occurrence. 2.1.3 Nicotine: a) Structural determination of nicotine. (Pinner's work included) b) Harmful effects of nicotine.	**10**
	2.1 Agrochemicals (03L)	
	2.2.1 General introduction & scope, meaning & examples of insecticides, herbicides, fungicide, rodenticide, pesticides, plant growth regulators. 2.2.2 Advantages & disadvantages of agrochemicals 2.2.3 Bio pesticides – Neem oil & Karanj oil.	
III		**10**
	3.2 Atomic Spectroscopy: Flame Emission spectroscopy(FES) and Atomic Absorption Spectroscopy(AAS)(4L) 3.2.1 Introduction, Energy level diagrams, Atomic spectra, Absorption and Emission Spectra. 3.2.2 Flame Photometry – Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors) 3.2.3 Atomic Absorption Spectroscopy – Principle, Instrumentation (Source, Chopper, Flame and Electrothermal Atomiser) Quantification methods of FES and AAS – Calibration curve method, Standard addition method and Internal standard method.	
	References: **19)** Pearson education. Spectral identification of organic molecules by	

	Silverstein. **20)** Absorption spectroscopy of organic molecules by V.M.Parikh. **21)** Chemistry of natural products by Chatwal Anand – Vol I and Vol II **22)** Chemistry of natural products by O.P. Agarwal **23)** Chemistry of natural products by Meenakshi Sivakumar and Sujata Bhat. **24)** Organic chemistry by Morrision and Boyd,7th edition.	

EXAMINATION PATTERN

D) Continuous Internal Assessment (40 Marks):

Sr. No.	Particulars	Marks
1	One Assignment or Presentation or seminar.	20
2	One online/offline class test.	10
3	Active participation in routine class/practicals.	05
4	Overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	05

E) Semester End Examination (60 Marks):

Question Paper Pattern

1. These examinations shall be of Two Hours duration. Maximum marks 60.
2. There shall be Four questions each of **15 marks**. On each Unit -I , II & III there will be one question
3. The Fourth one will be based on entire syllabus with Six MCQs, six questions on match the column and three questions based on true/false with internal choice.
4. All questions shall be compulsory with internal choice within the questions. (Each question will be 25 **marks** with options.) but Fourth question has no internal choice.
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Qn.	Sub-Qn	Particulars	Unit	Marks with options	Total Marks for sub-qn	Total Marks for qn
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Scheme of examination:

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Distribution of marks paper wise for term end practical examination

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1	One Experiment	40
3	Viva voce	05
4	Certified journal	05
	Total Marks	**50**

Department of Chemistry

Board of Studies (BOS)

Sr.	Name	Category	Affiliation
1.	Dr. D. B. Shinde	Chairman BOS	
2.	Dr. U. C. Patil	Member	
3.	Dr. A. P. Nikum	Member	
4.	Dr. Y. A. Pawar	Member	
5.	Mr. D. K. Malik	Member	
6.	Mr. P. M. Dhuri	Member	
7.	Mr. P. P. Parab	Member	
8.	Mr. S. S. Kale	Member	
9.	Mr. S. S. Patil	Member	
10.	Prof. Gajanan S. Rashinkar	Subject Expert Nominated by AC other University	
11.	Prof. Shuresh S. Patil	Subject Expert Nominated by AC other University	
12.	Dr. Sagar T. Sankpal	Expert Nominated by VC	
13.	Mr. Bhargav S. Duse	Representative from Industry	
14.	Mr. Prashant T. Govekar	Post Graduate Meritorious Alumni	
15.	Dr. Shamrao T. Disale	Expert from outside the college	