HSNC Board's
Smt. Chandibai Himathmal Mansukhani College
(Autonomous)
(Affiliated to the University of Mumbai)
University College Code : 217-JD Office : T14
HYDERABAD (SIND) NATIONAL COLLEGIATE BOARD
Estd. 1965

Principal : Dr. Manju Lalwani Pathak

Ref No: CHM (A) AC/C/01/2025
Date: 18th June 2025

CIRCULAR

The immediate attention of all concerned is invited to this office Circular No. CHM (A) AC 05/2025 dated 19th May, 2025 regarding the Choice Based and Credit Based Syllabus (CBCS) for all subjects of F.Y.B.Sc. & T.Y.B.Sc. in Chemistry SEM - I & SEM – V respectively.

It is hereby communicated that the recommendations of the syllabus made by the Ad-hoc Board of Studies in Chemistry coordinated by the Dean, Faculty of Pure Sciences in the meeting of Academic Council held on 23rd May, 2025 vide item No. 5.2, have been accepted and subsequently passed.

In accordance, therewith, the syllabus as per the CBCS has been brought into force with effect from the academic year 2025 – 2026 and accordingly the same is attached for reference and is available on the College's website www.chmcollege.in

Ulhasnagar - 421 003
18th June, 2025

Dr. Manju Lalwani Pathak
Principal & Chairperson, Academic Council

Copy forwarded for information to:-

1) The Dean, Faculty of Humanities.
2) The Chairperson, Ad-hoc Board of Studies.
3) The Controller of Examination.
4) The Registrar

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar

(Autonomous)

Affiliated to the University of Mumbai

Bachelor of Science
(Chemistry)
(Aided Course)

Semester – V

Choice Based and Credit Based Syllabus
with effect from the
Academic Year 2025-2026

PREAMBLE

Present program is designed to provide a basic understanding of Chemistry keeping in view the student centric learning pedagogy, which is entirely outcome-oriented and emphasizing on skill enhancement. Curriculum of B.Sc (Chemistry) is framed to equip students with a basic theoretical foundation, practical skills, and critical thinking abilities necessary to address the challenges and opportunities in the diverse fields of the subject. There is continuous evaluation of students based on quizzes, class tests and assignments. Emphasis is given to conceptual understanding of theoretical concepts followed by inclusion of the same in practicals. In line with recent trends in the education section, this syllabus fosters implementation of modern pedagogical tools such as hybrid learning, e- learning platforms to understand basic concepts. The aims and objectives of the B.Sc (Chemistry) course are designed to provide students with a foundational understanding of the principles and applications of chemistry.

These aims and objectives align with broader educational goals, focusing on academic, practical, and professional development. The course certainly helps to apply acquired skills to entry-level positions in industries requiring a foundation in chemistry.

Present approach is intended to follow flexibility and innovation in design of the programme. The framework is intended to allow flexibility and innovation in programme design, syllabi development, teaching-learning process and quality assessment of students' learning levels.

PROGRAMME SPECIFIC OUTCOME (PSOs)

After successful completion of this Course (T.Y. B.Sc. Chemistry) students are able to....

PSO1: Develop the knowledge of progressive chemistry required to strengthen the basics of Chemistry learnt in previous levels of programme.

PSO2: Inculcate the skills useful in science laboratories for pursuing jobs in Industries.

PSO3: Identify, formulate and analyze scientific problem and reach to concrete solutions for societal benefits using various principles of chemical sciences.

PSO4: Develop awareness about significance of Green chemistry.

PSO5: Get a hold on higher educational opportunities like post-graduation

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester- V

Title: Chemistry I (Physical Chemistry)

With effect from
Academic Year 2025-2026

Title: Chemistry I (Physical Chemistry)
[Course Code: CHM(A)USCH501]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of Chemistry and their practical applications in the field of Chemical science. It begins with core concepts and the regulatory framework, including basics of chemistry practical framework. Students will learn to prepare and analyze chemical industrial issues and understand and evaluate it. The course also covers contemporary advancement in the field of chemistry. Theoretical concepts are reinforced with practical problem-solving and real-world applications.
2	**Vertical**	--
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	02
5	**Hours allotted**	48 Hours
6	**Marks allotted**	100 Marks
7	**Course Objectives:** 1. To enable learners to have comprehensive knowledge and understanding of the concepts in Molecular spectroscopy, Colligative properties and chemical kinetics, Nuclear and Phase equilibria, surface chemistry and colloids. 2. To develop the skill to solve the problems encountered in the field of Molecular spectroscopy, Colligative properties and effect of temperature on rate of reaction and surface chemistry. 3. To apply the basic knowledge of these topics to perform various tasks assigned to them at the workplace in industry and academia to meet the job requirements as per global standards.	
8	**Learning Outcomes**: Upon completion of the course, student will be able to .... **LO1** acquire knowledge about basics of spectroscopy, colligative properties of solutions, nuclear reaction and power generation by nuclear reactions, nuclear reactions of stellar bodies, three component phase system, adsorption phenomenon and colloidal science. **LO2** understand different types of spectroscopies, changes occurring in colligative properties due to solute, concept of artificial radioactivity, three types of three component phase system, types of adsorption curves concept of charge and electrolytic behavior of colloids. **LO3** apply various techniques learned in spectroscopy for structure interpretation, use of	

	radiotracers in carbon dating, power generation, various theories of chemical kinetics to optimize rate of reactions, knowledge of surface chemistry in catalysis. **LO4** solve and evaluate the spectra of various compounds, melting or boiling points of solutions due to addition of solutes, mechanism of reactions with help of radio tracers, rate of fast reactions, surface area of given material by adsorption phenomenon.
9	**Syllabus** **UNIT I: Spectroscopy** • **Introduction** Definition of Spectroscopy, Electromagnetic radiation, Inter-conversion of units, Electromagnetic Spectrum, Molecular energy levels. • **Rotational Spectroscopy** Dipole moment and Polarisation of bond, Permanent dipole moment and induced dipole moment. Definition and conditions of rotational spectra, Bond length of simple diatomic molecule (rigid rotor). Rotational spectrum of a diatomic molecule, Isotopic shift in rotational spectra, limitations of rotational spectra, applications of rotational spectra. (Numerical expected) • **Vibrational Spectrum** Definition and conditions of vibrational spectra, modes of vibrations, Hookes law, vibrational frequency, force constant, zero point energy, vibrational spectra of simple harmonic oscillator, vibrational spectra of simple unharmonic oscillator, hot band. Infrared spectra of simple molecules like H2O and CO2, Applications of vibrational spectroscopy.(Numerical expected) • **Raman Spectroscopy:** Raman phenomenon, Raman shift, quantum theory of Raman effect, rule of mutual exclusion, comparative study of IR and Raman spectra, Applications of Raman spectroscopy. (Numerical expected on Raman Shift) **UNIT II: Chemical Thermodynamics & Chemical Kinetics** • Colligative Properties: Vapour pressure and relative lowering of vapour pressure, Measurement of lowering of vapour pressure- Static and Dynamic method. (Numerical Expected) • **Solution of Solid in Liquid**: Elevation in boiling point of a solution, thermodynamic derivation relating elevation in boiling point of the solution and molar mass of non-volatile solute. (Numerical Expected). Depression in freezing point of a solution, thermodynamic derivation relating the depression in the freezing point of a solution and molar mass of the non- volatile solute, Rast Method. (Numerical expected) • **Osmotic Pressure**: Introduction, thermodynamic derivation of Vant Hoff factor, Measurement of Osmotic Pressure – Berkeley and Hartley's Method, Reverse Osmosis. • **Collision Theory of Reaction Rates:** Molecular Activation and Energy of Activation, Application of collision theory w.r.t. Bimolecular reaction (derivation not expected), Collision theory w.r.t. Unimolecular reaction (Lindeman theory) (derivation expected), Demerits of collision theory. • Classification of reaction as slow, fast and ultra-fast, Study of kinetics of fast reactions by Stop flow method and Flash photolysis.(derivation not expected) **UNIT III: Nuclear Chemistry** • **Detection and Measurement of Radioactivity**: Detection and measurement of nuclear radiations using G.M. Counter and Scintillation Counter.

- **Application of use of radioisotopes as Tracers:** Chemical reaction mechanism, age determination- dating by C^{14}.
- **Nuclear Transmutation:** Nuclear transmutation (one example for each projectile), artificial radioactivity, Q- value of nuclear reaction, threshold energy. (Numerical expected)
- **Fission Process:** Fissile and fertile material, chain reaction, factor controlling fission process, multiplication factor and critical size or mass of fissionable material, Nuclear reactor: Essential parts of nuclear reactor, power reactor
- **Fusion Process:** Thermonuclear reactions occurring on stellar bodies and earth
- **Phase Rule:** Introduction, Gibbs Phase rule and terms involved it, Condensed phase rule.
- **Three component System-** Introduction of three component system and explanation of phase diagram with example of Type I - Formation of one pair of partially miscible liquids. Type II- Formation of two pairs of partially miscible
- liquids Type III – Formation of three pairs of partially miscible liquids.

UNIT IV: Surface and Colloidal Chemistry

- **Adsorption**: Physical and Chemical Adsorption, types of adsorption isotherms, Langmuir's adsorption isotherm (Postulates and derivations expected). B.E.T. equation for multilayer adsorption, (derivation not expected), Determination of surface area of an adsorbent using B.E.T. equation **Introduction to colloids:** Dispersed phase and dispersion medium, types of colloids
- **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
- **Colloidal Electrolytes**: Introduction, micelle formation
- **Surfactants:** Classification and applications of surfactants in detergents and food industry.

10

Scheme of Examination and Assessment Pattern

Paper – 100 Marks

A. External Examination: Semester End External - 75 marks Time: 2.5 hours

Format of Question Paper

Attempt any 4 out of 6 questions.

Question No	Nature of Questions	Marks
Q1	Unit I (attempt any three out of 5)	15
Q2	Unit II (attempt any three out of 5)	15
Q3	Unit III (attempt any three out of 5)	15
Q4	Unit IV (attempt any three out of 5)	15
Q5	Unit I + II + III + IV (All compulsory)	15
		Total 75

B. Internal Examination: Continuous Evaluation - 25 marks

	Assessment / evaluation	Marks
1.	Quizzes, Class Tests, Presentations, Projects, Problem solving, etc	20
2.	Active participation in departmental activities,	05
	Total	25

11

REFERENCES:

1. Fundamental of Molecular Spectroscopy, 4thEdn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
2. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
3. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
4. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkata.
5. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]
6. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
7. Modern Electrochemistry, J.O.M Bockris& A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer
8. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
9. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
10. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
11. Essentials of Nuclear Chemistry, Arnikar, HariJeevan , New Age International (P) Ltd., Publishers, 2011.
12. Chemical Kinetics,K. Laidler, Pearson Education India, 1987.
13. Modern Nuclear Chemistry Hardcover by Walter D. Loveland (Author), David J. Morrissey, Glenn T. Seaborg, Wiley.
14. A Textbook of Physical Chemistry - Dynamics of Chemical Reactions, Statistical Thermodynamics, Macromolecules and Irreversible Processes| Volume 5 ,3rd Editionby K L Kapoor, McGraw Hill Education.

Title: Chemistry I Physical Chemistry Practical
[Course Code: CHM(A)USCHP01]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of Chemistry and their practical applications in the field of Chemical science. It begins with core concepts and the regulatory framework, including basics of chemistry practical framework. Students will learn to prepare and analyze chemical industrial issues and understand and evaluate it. The course also covers contemporary advancement in the field of chemistry. Theoretical concepts are reinforced with practical problem-solving and real-world applications.
2	**Vertical**	--
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credits**	2
5	**Hours allotted**	48 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** 1. To enable learners to have understanding of the theory concepts applied in practicals with instrument handling techniques. 2. To develop the skill to observe ,record and analyse the experimental results in systematic manner 3. To solve the numerical problems associated with experimental process using data and appropriate formulae 4. 4. To apply the basic knowledge of these topics to perform various tasks assigned to them at the workplace in industry and academia to meet the job requirements as per global standards.	

8

Learning Outcomes:

Upon completion of the course, student will be able to ....

LO1 acquire knowledge about alignment of theoretical concepts with experiments

LO2 To enhance instrument handling techniques and make appropriate use of those in various aspects of physical chemistry.

LO3 apply various techniques learned in spectroscopy for structure interpretation, use of radiotracers in carbon dating, power generation, various theories of chemical kinetics to optimize rate of reactions, knowledge of surface chemistry in catalysis,

LO4 demonstrate graphical representation and evaluate the spectra of various compounds

9

Syllabus

Non Instrumental Experiment

- **Phase Rule:** To study phase diagram of three component system water- chloroform or toluene / acetic acid by weight method.
- **Chemical Kinetic:** To interpret the order of reaction graphically from the given experimental data and calculate the specific rate constant
- **Surface phenomena:** To investigate the adsorption of acetic acid on activated charcoal and test the validity of Freundlich adsorption isotherm.

Instrumental Experiment

- **Potentiometry**: To determine the number of electrons in the redox reaction between ferrous ammonium sulphate and ceric sulphate potentiometrically
- **Conductometry**: To determine the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method.
- **pH-metry**:To determine acidic and basic dissociation constants of amino acid and hence to isoelectric point.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 50 marks Time: 3:30 hours

Format of Question Paper

Question No	Nature of Questions	Marks
Q1	Experiment	40
Q2	Journal	05
Q3	Viva	05
Total		**50**

11

REFERENCES

1. Practical Physical Chemistry 3rd edition A.M.James and F.E. Prichard , Longman publication
2. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata McGraw Hill
3. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
4. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
5. Experimental Physical Chemistry By V.D.Athawale.
6. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand and Co.. 2011

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester- V

Title: Chemistry II (Inorganic Chemistry)

With effect from
Academic Year 2025-2026

Title: Chemistry II (Inorganic Chemistry)
[Course Code: CHM(A)USCH502]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of Chemistry and their practical applications in the field of Chemical science. It begins with core concepts and the regulatory framework, including basics of chemistry practical framework. Students will learn to prepare and analyze chemical industrial issues and understand and evaluate it. The course also covers contemporary advancement in the field of chemistry. Theoretical concepts are reinforced with practical problem-solving and real-world applications.
2	**Vertical**	--
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	2
5	**Hours allotted**	48 Hours
6	**Marks allotted**	100 Marks
7	**Course Objectives**: The course aims to make the students well acquainted with… 1. Various symmetry operations and point group in solid compounds 2. General characteristics, Classification of solids and difference between amorphous and crystalline solids. 3. Applications of molecular orbital theory pertaining to polyatomic species 4. Effects of lanthanide contraction, method of separation of Lanthanide and advanced applications	
8	**Learning Outcomes**: Upon completion of the course, student will be able to **LO1** understand the concept of symmetry elements, symmetry operations and recognize the point groups of various Molecules. **LO2** illustrate effectively the various heteronuclear diatomic molecules with respect to molecular orbital diagrams and predict magnetic properties. **LO3** correlate the density of a substance with its unit cell properties. **LO4** classify crystalline solids, define crystal lattice and unit cell and solve associated numerical problems **LO5** gain knowledge of Superconducting material and their applications. Gain awareness of toxicity of metal ions and hazardous effects.	

9	**Syllabus** **UNIT I: Molecular Symmetry and Application of Molecular orbital Theory** • **Molecular Symmetry:** Introduction to Symmetry elements and Symmetry operations (illustrations with examples). Concept of a Point Groups with illustration • **Molecular Orbital Theory applicable to hetero nuclear diatomic molecules and polyatomic species:** Molecular orbital Theory w.r.t. Heteronuclear diatomic molecules like CO and NO Modified MO diagram for CO. Molecular orbital theory with respect to Polyatomic species H3, H3+ and AB2 molecules such as BeH2 (Correlation diagram expected). Applications of molecular orbital theory **UNIT II: Solid State Chemistry** • **Structures of Solids**: Explanation of terms viz. crystal lattice, lattice point, unit cell and lattice constants. 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. (Numerical problems expected) Stoichiometric Point defects in solids (discussion on Frenkel and Schottky defects expected). • **Superconductivity**: Discovery of superconductivity. Explanation of terms like superconductivity, transition temperature, Meissner effect. Different types of superconductors viz. conventional superconductors, alkalimetal fullerides, high temperature super conductors. Brief application of superconductors. **UNIT III: Chemistry of Lanthanides** • **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. • **Application of use of radioisotopes as Tracers:** Chemical reaction mechanism, age determination- dating by C^{14}. • Key Principles of extraction and separation of lanthanides by (i)Ion Exchange method(ii) Solvent extraction method using TBP . (Principles and technique). • Role of Lanthanides in solid state lasers **UNIT IV: Selected Topics** • **Chemistry of Non-aqueous Solvents**: General classification and Properties of non-aqueous solvents. Autoionization study of liquid ammonia, dinitrogen Tetroxide and Hydrogen fluoride as non-aqueous solvents with respect to: (i) acid-base reactions and (ii) redox reactions. • **Toxicity of metal ions and remediation:** Examples of metal toxicity and mechanism Hazardous effects of metal toxicity Remediation: Advanced Measures to reduce metal toxicity • **Comparative Chemistry of Group**: Electronic configuration, General characteristics, anomalous properties of fluorine, comparative study of acidity of oxoacids of chlorine w.r.t acidity, oxidizing properties Chemistry of inter halogens with reference to preparations, properties and structures (on the basis of VSEPR theory) .

10

Scheme of Examination and Assessment Pattern

Paper – 100 Marks

A. External Examination: Semester End External - 75 marks Time: 2.5 hours

Format of Question Paper

Attempt any 4 out of 6 questions.

Question No	Nature of Questions	Marks
Q1	Unit I (attempt any three out of 5)	15
Q2	Unit II (attempt any three out of 5)	15
Q3	Unit III (attempt any three out of 5)	15
Q4	Unit IV (attempt any three out of 5)	15
Q5	Unit I + II + III + IV (All compulsory)	15
		Total 75

B. Internal Examination: Continuous Evaluation - 25 marks

	Assessment / evaluation	Marks
1.	Quizzes, Class Tests, Presentations, Projects, Problem solving, etc	20
2.	Active participation in departmental activities	05
	Total	25

11

REFERENCES:

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. DerekW.Smith,Molecularorbitaltheoryininorganicchemistry Publisher: Cambridge University Press
4. C. J. Ballhausen, Carl Johan Ballhausen, Harry B. Gray Molecular Orbital Theory: AnIntroductoryLectureNoteandReprintVolumeFrontiersinchemistryPublisher W.A.Benjamin,1965
5. Jack Barrett and MounirAMalati, Fundamentals of, Affiliated East west Press Pvt. Ltd., New Delhi.
6. Satya Prakash, G.D.Tuli, R. D.Madan,, Advanced Inorganic Chemistry. S.Chand& Co Ltd.
7. E books: Molecular symmetry and spectroscopy by Philip Bunker, Molecular symmetrybyDavidWilock,Essentialsofcoordinationchemistrybyvashishtabhatt
8. LesleyE.Smart,ElaineA.MooreSolidStateChemistry:AnIntroduction,2nd Edition CRC Press,
9. C.N. R.Rao Advances in Solid State Chemistry
10. R.G. Sharma Superconductivity: Basics and Applications to Magnets
11. Michael Tinkham, Introduction to Superconductivity: VolI(Dover Bookson Physics)

	12. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India. 13. RichardHarwood, Chemistry Cambridge University Press, 14. Satya Prakash, G.D.Tuli, R.D.Madan,, Advanced Inorganic Chemistry. S. Chand & Co Ltd . 15. E books: Solid state chemistry by Elaine Moore, Smart5thedition,Sperconductivity by Paolo Mele, 16. Cotton,Wilkinson, Murillo and Bochmann, Advanced organicChemistry, 6^{th}Edition. 17. Greenwood, N.N.and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.

Title: Inorganic Chemistry Practical
[Course Code: CHM(A)USCHP02]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of Chemistry and their practical applications in the field of Chemical science. It begins with core concepts and the regulatory framework, including basics of chemistry practical framework. Students will learn to prepare and analyze chemical industrial issues and understand and evaluate it. The course also covers contemporary advancement in the field of chemistry. Theoretical concepts are reinforced with practical problem-solving and real-world applications.
2	**Vertical**	--
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credits**	2
5	**Hours allotted**	48 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** To make the students well acquainted with..... 1. alignment of theoretical concepts with experimental component 2. leverage the scientific temper to upgrade the practical skills	
8	**Learning Outcomes:** Upon completion of the course, student will be able to ... **LO1** demonstrate the practical approach on the basis of theoretical concepts **LO2** develop essential technical skills needed to explore applications of inorganic chemistry	
9	**Syllabus** • Preparation of bis(tetraethyl ammonium) tetrachloro nickelate(II) • Preparation of bis(ethylene diamine) copper sulphate. • Preparation of bis(acetylacetonato)copper(II) Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t added impurity cation and anion. Salts of selected transition metal ions viz.Co, Fe ,Ni,Zn. Quantitative analysis by titration method. (Complexometry for Co, Ni, Zn ions respectively and Fe ions by redox titration). Qualitative analysis by wet test method .Any THREE salts can be analysed	

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 50 marks Time: 3:30 hours

Format of Question Paper

Question No	Nature of Questions	Marks
Q1	Experiment	40
Q2	Journal	05
Q3	Viva	05
Total		**50**

11

REFERENCES:

1. Vogel Textbook of Quantitative Chemical Analysis G.H.Jeffery, J.Basset.
2. Advanced experiments in Inorganic Chemistry. ,G. N. Mukherjee.,1st Edn., 2010.,U.N.Dhur & Sons Pvt Ltd .
3. Vogel's.Textbook of .Macroand Semimicro qualitative inorganic analysis. Fifth edition.

Smt. Chandibai Himathmal Mansukhani College
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Third Year B. Sc.
(Chemistry)

Semester- V

Title: Chemistry III (Organic Chemistry)

With effect from
Academic Year 2025-2026

Title: Chemistry III (Organic Chemistry)
[Course Code: CHM(A)USCH503]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of Chemistry and their practical applications in the field of Chemical science. It begins with core concepts and the regulatory framework, including basics of chemistry practical framework. Students will learn to prepare and analyze chemical industrial issues and understand and evaluate it. The course also covers contemporary advancement in the field of chemistry. Theoretical concepts are reinforced with practical problem-solving and real-world applications.
2	**Vertical**	--
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	2
5	**Hours allotted**	48 Hours
6	**Marks allotted**	100 Marks
7	**Course Objectives:** 1. To provide students with a fundamental understanding of how organic reactions proceed, enabling them to predict stereo chemical outcomes, understand the role of intermediates, and develop problem-solving skills in organic chemistry. 2. To provide students with a fundamental to identify chiral centers, understand the concept of chirality, comprehensive understanding of specific chemicals which have their applications, impacts and management practices in agriculture 3. To provide students with a comprehensive understanding of the structure, synthesis, and reactivity of heterocyclic compounds, along with their diverse applications. 4. To equip the learners with the skills to assign the IUPAC names to spiro &bicyclo compounds, to familiarize the learners with the fundamentals of Green Chemistry and its application in organic synthesis. 5. To make the learners understand the fundamental principles of UV-Visible and Mass Spectroscopy and apply them for structural elucidation.	

8	**Learning Outcomes**: Upon completion of the course, student will be able to … **LO1** gain comprehensive understanding of basics of organic reaction mechanisms and get familiarized with specific reactions. **LO2** predict the pathways & product composition of organic reactions under thermal and photochemical conditions **LO3** understand basic requirement of Chirality & will get familiarize with concept of Molecular Chirality, check chirality of organic compounds using elements of symmetry, will be able to explain Molecular Chirality of Cumulenes & Biphenyls **LO4** get familiarize with different Agrochemicals and their applications in agriculture, get familiarize with advantages and harmful effect of Agrochemicals and (Monocyclic & Bicyclic) in terms of preparations and chemical reactivity. **LO5** assign IUPAC names to spiro & bicyclo compounds. Grasp the basics of Natural Product Chemistry including Terpenoids, Alkaloids & Hormones and understand the fundamental principles of UV- Visible and Mass Spectroscopy and apply them for structural elucidation
9	**Syllabus** **UNIT I: Mechanism of Organic Reactions & Photochemistry** **Mechanism of Organic Reactions:** • Basic terms & concepts: Electrophilicity vs. acidity & nucleophilicity vs basicity • Neighboring group participation in nucleophilic substitution reactions: Participationoflonepairof electrons,kineticsand stereochemical outcome. • Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalyzed esterification of carboxylic acids (AAC2) and base promoted hydrolysis of esters (BAC2). **Pericyclic reactions, classification and nomenclature:** • Electrocyclic reactions (ring opening and ring closing), conrotatory and disrotatory process. Woodward Hoffman rule.Cycloaddition, sigma tropic Rearrangement, group transfer reactions, cheletropic reaction (definition and one example of each type) • Pyrolytic elimination: Cope, Chugaev, pyrolysis of acetates. **Photochemistry:** • Introduction: Difference between thermal and photochemical reactions. Jablonski diagram, singlet and triplet states, allowed and forbidden transitions, fate of excited molecules, photosensitization. • Photochemical reactions of olefins: Photoisomerization, photochemical rearrangement of 1,4-dienes (di- π methane). • Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photo reduction (e.g. benzophenone to benzpinacol). **UNIT II: Stereochemistry I, Agrochemicals & Heterocyclic Chemistry:** **Stereochemistry I:** • Molecular chirality and Elements of symmetry: Basic concept, Examples of Elements of symmetry: Mirror plane symmetry, inversion center, rotation-reflection (alternating) axis •Chirality of compounds without a stereo genic center: Basic concept. Discussion of Molecular

chirality of Cumulenes and Biphenyls.

Agrochemicals:

- General information:

• Classification with examples: insecticides, herbicides, fungicide, rodenticide, pesticides, plant growth regulators
• Advantages & disadvantages of agrochemicals
• Synthesis & application of: IAA (Indole Acetic Acid) & Endosulphan
• Bio pesticides – Neem oil & Karanj oil.

Heterocyclic Chemistry:

• Nomenclature of Heterocyclic Compounds, Reactivity of pyridine-N-oxide, quinolone & isoquionoline.
• Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) iso-quinoline(Bischler- Napieralski synthesis).
• Reactions of pyridine-N-oxide: halogenation, nitration and reaction with NaNH2/liq.NH3, n-BuLi.
• Reactions of quinoline and isoquinoline: oxidation, reduction, nitration, halogenation and reaction with $NaNH_2$/liq.NH_3, n-BuLi.
• Applications of Heterocyclic compounds: Medicinal and Industrial.

UNIT III: IUPAC Nomenclature & Green Chemistry:

IUPAC Nomenclature:

• IUPAC Systematic nomenclature of the following classes of compounds (including compounds up to two substituents / functional groups).
• Bicyclic compounds: spiro, fused and bridged (up to 11 carbon atoms) – saturated and unsaturated compounds.
• Biphenyls
• Cumulenes

Green Chemistry:

• Introduction: Linear and convergent synthesis, criteria for an ideal synthesis, the concept of chemoselectivity and regioselectivity with examples and calculations of yields.
• Green Chemistry in Organic 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 CO2
iv) Green catalysts: Biocatalysts

• Green Methods of Organic Synthesis: Microwave-assistedOrganicSynthesis (Using organic solvents and in solid state). Ultrasound in Organic Synthesis, Phase transfer catalysis.

UNIT IV: Natural Products & Organic Spectroscopy:

Natural Products: Introduction and Classification of Natural Products:

- Terpenoids: Introduction, Isoprene rule, Special isoprene rule and Gem-dialkyl rule, Synthesis of Citral from Methyl heptanone, Isomerism in Citral (cis and trans forms)
- Alkaloids: Introduction and occurrence, Hofmann's exhaustive methylation and degradation in simple open chain and N-substituted monocyclic amines, Synthesis of Nicotine from Nicotinic acid, Harmful effects of Nicotine

- Hormones: Introduction, Example of Adrenaline, Synthesis of Adrenaline from Catechol & Ott's Synthesis

Organic Spectroscopy:

- Introduction to Organic Spectroscopy
- UV-Visible Spectroscopy: Electromagnetic spectrum, units of wavelength and frequency, Basic theory, solvents, nature of UV-Visible spectrum, concept of chromophore, auxochrome, bathochromic and hypsochromic shifts, hyperchromic and hypochromic effects, chromophore-chromophore and chromophore - auxochrome interactions.
- Mass Spectrometry: Basic theory, Nature of mass spectrum; Mass Spectrometer, Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula; General rules of fragmentation.

10

Scheme of Examination and Assessment Pattern

Paper – 100 Marks

A. External Examination: Semester End External - 75 marks Time: 2.5 hours

Format of Question Paper

Attempt any 4 out of 6 questions.

Question No	Nature of Questions	Marks
Q1	Unit I (attempt any three out of 5)	15
Q2	Unit II (attempt any three out of 5)	15
Q3	Unit III (attempt any three out of 5)	15
Q4	Unit IV (attempt any three out of 5)	15
Q5	Unit I + II + III + IV (All compulsory)	15
		Total 75

B. Internal Examination: Continuous Evaluation - 25 marks

	Assessment / evaluation	Marks
1.	Quizzes, Class Tests, Presentations, Projects, Problem solving, etc	20
2.	Active participation in departmental activities,	05
	Total	25

11

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2. Organic Reactions and their Mechanisms (Third revised edition), P. S. Kalsi, New Age International Publishers.
3. Advanced Organic Chemistry- Reactions Mechanism and Structure (Seventh

edition), J. March and M. B. Smith, Wiley Student Edition.
4. Organic Chemistry (Seventh Edition), R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.
5. Organic Chemistry (Eighth edition), John McMurry
6. Stereochemistry of Carbon Compounds, E. L. Eliel, Tata McGraw Hill.
7. Stereochemistry Conformation and Mechanism (Eleventh Edition), P. S. Kalsi, New Age International Publishers.
8. Stereochemistry of Organic Compounds: Principles and Applications (Fourth Edition), D. Nasipuri, New Age International Publishers.
9. Insecticides & pesticides: Saxena A. B., Anmol publication.
10. Growth regulators in Agriculture & Horticulture: Amarjit Basra, CRC press 2000.
11. Agrochemicals and Pesticides: A. Jadhav and T.V. Sathe Name Reactions in Heterocyclic Chemistry, Jie-Jack Li, Wiley-Interscience publications, 2005.
12. Handbook of Heterocyclic Chemistry (SecondEdition), Alan R. Katritzky and Alexander F. Pozharskii, Elsevier Science Ltd, 2000.
13. Heterocyclic Chemistry (ThirdEdition), Thomas L. Gilchrist, Pearson Education, 2007
14. Nomenclature of Organic Chemistry: IUPAC recommendations and preferred Names 2013, Henri A. Favre and Warren H. Powell- RSC publication.
15. IUPAC nomenclature (Second Edition), S. C. Pal, Narosa Publishing House pvt. Ltd
16. Green Chemistry an introductory text (Third Edition), Mike Lancaster, RSC Publication.
17. Green Chemistry, V. K. Ahluwalia, Narosa Publishing House pvt. ltd.
18. New trends in Green Chemistry, V. K. Ahluwalia, M. Kidwai, Klumer Academic publisher.
19. An Introduction to Green Chemistry, V. Kumar, Vishal Publishing Co.
20. Organic Chemistry (Tenth Edition), Francis Carey, Tata McGraw Hill.
21. Organic Chemistry (Fifth edition), Carey and Sundberg, Springer Organic Chemistry Natural Products, Vol I and Vol II (First edition), O. P. Agarwal, Krishna Publications.
22. Chemistry of Natural Products (First edition), S. V. Bhat, B. A. Nagasampagi, M. Sivakumar, Springer Narosa Publication.
23. Organic Chemistry (Seventhedition), R. T. Morrison, R. N. Boyd and S. K. Bhattacharjee, Pearson Education.
24. Organic Chemistry, Vol II, (Fifthedition), I. L. Finar, Pearson Education.
25. Natural Products Chemistry (First edition), K. Nakanishi, T. Goto, Academic Press
26. Organic Spectroscopy (Second edition), J. Mohan, Narosa Publication.
27. Introduction to Spectroscopy (Fifth edition), D. L. Pavia, G. M. Lampman, G. S. Kriz, J. A. Vyvyan, Cengage Learning Publication.
28. Elementary Organic Spectroscopy (Third edition), Y. R. Sharma, S. Chand Publication.
29. Organic Chemistry (Eighth edition), P. Y. Bruice, Pearson education.

Spectrometric Identification of Organic Compounds (Fifth edition), R.M. Silverstein,

31.A guidebook to mechanism in Organic Chemistry (Sixth edition), Peter Sykes, Pearson education, New Delhi.

Title: Organic Chemistry Practical
[Course Code: CHM(A)USCHP03]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of Chemistry and their practical applications in the field of Chemical science. It begins with core concepts and the regulatory framework, including basics of chemistry practical framework. Students will learn to prepare and analyze chemical industrial issues and understand and evaluate it. The course also covers contemporary advancement in the field of chemistry. Theoretical concepts are reinforced with practical problem-solving and real-world applications.
2	**Vertical**	--
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credits**	2
5	**Hours allotted**	48 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** To make the students well acquainted with..... 1. To develop a systematic approach for the qualitative analysis of binary organic mixtures 2. To enable the learners to understand the separation and identification of individual components based on their unique physical/chemical properties	
8	**Learning Outcomes:** Upon completion of the course, student will be able to ..... **LO1** learners will be able to determine chemical & physical type of organic mixture **LO2** learners will be able to separate mixture of organic compounds using chemical/physical properties	
9	**Syllabus** **Separation of Binary solid-solid mixture (2.0 g mixture to be given).** • Minimum Six mixtures to be completed by the students. • Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols (2-naphthol, 1-naphthol), water insoluble base (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.	

<table>
<tr><td></td><td>

Follow separation scheme with the bulk sample of binary mixture.
After separation into component A and component B, one component (decided by the examiner) is to be analyzed and identified with melting point

</td></tr>
<tr><td>10</td><td>
Scheme of Examination and Assessment Pattern
Paper – 50 Marks
A. External Examination: Semester End External - 50 marks Time: 3:30 hours
Format of Question Paper
<table>
<tr><th>Question No</th><th>Nature of Questions</th><th>Marks</th></tr>
<tr><td>Q1</td><td>Experiment</td><td>40</td></tr>
<tr><td>Q2</td><td>Journal</td><td>05</td></tr>
<tr><td>Q3</td><td>Viva</td><td>05</td></tr>
<tr><td>Total</td><td></td><td>50</td></tr>
</table>
</td></tr>
<tr><td>11</td><td>
REFERENCES

Practical Organic Chemistry – A. I. Vogel.
Practical Organic Chemistry – H. Middleton.
Practical Organic Chemistry – O. P. Agarwal

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</table>

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester- V

Title: Analytical Chemistry
Theory-2 Credits
Practicals-2 Credits

With effect from
Academic Year 2025-2026

Title: Chemistry IV (Analytical Chemistry)
[Course Code: CHM(A)USCH504]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of Chemistry and their practical applications in the field of Chemical science. It begins with core concepts and the regulatory framework, including basics of chemistry practical framework. Students will learn to prepare and analyze chemical industrial issues and understand and evaluate it. The course also covers contemporary advancement in the field of chemistry. Theoretical concepts are reinforced with practical problem-solving and real-world applications.
2	**Vertical**	--
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	2
5	**Hours allotted**	48 Hours
6	**Marks allotted**	100 Marks
7	**Course Objectives:** The course aims to make the students well acquainted with... 1. The concept of Quality in Analytical Chemistry, and the processes and practices to ensure validation of analytical data. 2. Modern analytical techniques for Quantitative analysis. 3. Modern separation techniques	

8	**Learning Outcomes**: Upon completion of the course, student will be able to .... **LO1** differentiate between the processes of QA and QC. **LO2** understand the role of regulatory bodies and Good Laboratory Practices in ensuring Quality. **LO3** collect and prepare samples for analysis **LO4** use classical titration techniques for quantitative estimations **LO5** understand the principles and working of advance spectroscopic instruments for estimation.
9	**Syllabus** **UNIT I: Quality in Analytical Chemistry, Chemical Calculations & Sampling** • **Quality in Analytical Chemistry** : Concepts of Quality, Quality Control and Quality Assurance, Importance of Quality concepts in Industry, GLP -Principle, Objective, OECD guidelines, Regulatory affairs – Objectives , Regulatory authorities (NABL , FSSAI , CDSCO) Importance TQM - Definition, Principles, Importance and benefits. Philosophy of implementation of TQM Process steps, Advantages and Limitations i) Kaizen -Six steps ii) Six Sigma approach iii) 5S and 5S audit check for laboratories. • **Chemical Calculations (Numericals and word problems are expected):** Molarity, Normality (recap) Ppm, ppb, mole fraction Inter conversion of various concentration units. (Conversion of concentration from one unit to another unit with examples) • **Sampling:** Sampling of liquids: Homogeneous and heterogeneous, Static and flowing liquids. Sampling of gases: Ambient and stack sampling: Apparatus and methods for sampling of gases. Collection, preservation and dissolution of the sample. **UNIT II: Titrimetric Estimations** • **Neutralization Titrations**: Calculation of pH in the beginning, at equivalence point and after the equivalence point in neutralization titration between strong base and i) Strong Acid ii) Weak acid • **Redox Titration**: •Introduction, Construction of the titration curves and calculation of Esystem in aqueous medium in case of One electron system. Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators. • **Complexometric Titrations:** 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 of EDTA as a titrant with examples. Advantages and limitations of EDTA as a titrant. Types of EDTA titrations. Metallochromic indicators, theory, examples and applications **UNIT III: Spectroscopy** • **Flame Emission spectroscopy (FES):** Introduction, Absorption and Emission Spectra Flame Photometry – Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors) • **Atomic Absorption Spectroscopy** – Principle, Instrumentation (Source, Chopper, Flame and Electrothermal Atomiser) • **Qualitative and Quantitative analysis** with respect to FES and AAS – Calibration curve method, Standard addition method and Internal standard method. Comparison between FES and AAS Applications, Advantages and Limitations • **Molecular Fluorescence and Phosphorescence Spectroscopy:** Introduction and Principle; Relationship of Fluorescence intensity with concentration; Factors affecting

Fluorescence and Phosphorescence; Instrumentation and applications Comparison of Fluorimetry and Phosphorimetry Comparison with Absorption methods

- **Turbidimetry and Nephelometry:** Introduction and Principle; Factors affecting scattering of Radiation, Concentration, particle size, wavelength and refractive index; Instrumentation and Applications

UNIT IV: Separation Techniques

- **Solvent Extraction**: Factors affecting extraction: Role of complexing agents in solvent extraction Chelation, Ion pair formation and Solvation; Graph of percent extraction versus pH.; Concept of $[pH]_{1/2}$ and its significance (derivation not expected)
- **Craig's counter current extraction**: Principle,apparatusand applications
- **Solid phase extraction**: Principle, process and applications with special reference to water and industrial effluent analysis.
- Comparison of solid phase extraction and solvent extraction.
- **Gas Chromatography:** Introduction, Principle, Theory and terms involved
- Instrumentation: Block diagram and components, types of columns, stationary phases in GSC and GLC,
- Detectors: TCD, FID, ECD Qualitative, Quantitative analysis and applications Comparison between GSC and GLC

10

Scheme of Examination and Assessment Pattern

Paper – 100 Marks

A. External Examination: Semester End External - 75 marks Time: 2:30 hours

Format of Question Paper

Attempt any 4 out of 6 questions.

Question No	Nature of Questions	Marks
Q1	Unit I (attempt any three out of 5)	15
Q2	Unit II (attempt any three out of 5)	15
Q3	Unit III (attempt any three out of 5)	15
Q4	Unit IV (attempt any three out of 5)	15
Q5	Unit I + II + III + IV (All compulsory)	15
		Total 75

B. Internal Examination: Continuous Evaluation - 25 marks

	Assessment / evaluation	Marks
1.	Quizzes, Class Tests, Presentations, Projects, Problem solving, etc	20
2.	Active participation in departmental activities,	05
	Total	25

11	**REFERENCES:** 1. OECD Principles of Good Laboratory Practice (as revised in 1997)". OECD Environmental Health and Safety Publications. OECD. 1. 1998 2. Total Quality Management - Bester field - Pearson Education, Ch:5 3. Quality in the Analytical Laboratory, Elizabeth Pichard, Wiley India, Ch: 5, Ch: 6 &Ch: 7. 4. Quality Management, Donna C S Summers, Prentice-Hall of India, Ch:3. 5. A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002), 6. 3000 solved problems in Chemistry, David E. Goldberg,PhD.,Schaums Outline 7. A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001) 8. Analytical Chemistry, Skoog, West ,Holler,7th Edition 9. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd 10. Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication 11. Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International (p) Limited 12. Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969. 13. Fundamentals of Analytical Chemistry by Skoog and West , 8th Edition 14. Analytical Chemistry, Gary.DChristan, 5th edition 15. Instrumental methods of Analysis, by DrSupriya S Mahajan, Popular Prakashan Ltd 16. Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House 17. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969

Title: Chemistry IV (Analytical Chemistry) Practical
[Course Code: CHM(A)USCHP504]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of Chemistry and their practical applications in the field of Chemical science. It begins with core concepts and the regulatory framework, including basics of chemistry practical framework. Students will learn to prepare and analyze chemical industrial issues and understand and evaluate it. The course also covers contemporary advancement in the field of chemistry. Theoretical concepts are reinforced with practical problem-solving and real-world applications.
2	**Vertical**	--
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credits**	2
5	**Hours allotted**	48 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** 1. To train learners to prepare standard solutions of known concentration 2. To introduce the learner to various classical and instrumental methods of analysis to real life and commercial samples. 3. To train learners to handle and standardize analytical instruments for its optimum use	
8	**Learning Outcomes:** Upon completion of this course, student will be able to **LO1** outline the basic principles, instrumentation of these advanced separation techniques and electroanalytical methods **LO2** assess advantages and limitations of these techniques. **LO3** correlate these techniques with industrial applications. **LO4** relate the applications of analytical methods in day-to-day life.	
9	**Syllabus** **Non-Instrumental Experiments** • To determine the amount of persulphate in the given sample solution by back titration with standard Fe (II) ammonium sulphate solution. • To determine the amount of Iron present in iron sample by redox titration using	

potassium dichromate with diphenyl amine as an indicator.

- To estimate the amount of Al in the given sample complexometrically, by back titration with $ZnSO_4$.

Instrumental Experiments

- To determine potassium content of a Fertilizer by Flame Photometry (Calibration curve Method)
- Estimation of Cu spectrophotometrically, by standard addition method.
- Estimation of Chromium in water sample spectrophotometrically by using Diphenyl
- Carbazide.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 50 marks Time: 3:30 hours

Format of Question Paper

Question No	Nature of Questions	Marks
Q1	Experiment	40
Q2	Journal	05
Q3	Viva	05
Total		**50**

11

REFERENCES

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

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester- V

Title: Chemistry V (Applied Component)
Drugs and Dyes

With effect from
Academic Year 2025-2026

Title: Chemistry V (Applied Component)
[Course Code: CHM(A)USACDD501]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the applications of Chemistry in the field of Drugs and Dyes. It begins with role of chemical compounds in Drug formulations. It encompasses the reactions underlying drug synthesis process. Students will learn to prepare and analyze simple formulations. The course also covers contemporary advancement in the field of dyes chemistry. Role of natural and synthetic pigments and processes underlying dyes manufacturing is covered under the course.
2	**Vertical**	--
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	2
5	**Hours allotted**	48 Hours
6	**Marks allotted**	100 Marks
7	**Course Objectives**: The course aims to make the students … 1. Understand the classification of drugs and dyes, basic terms used in medicinal and dye stuff chemistry, and routes of drug administration. 2. To understand the various pharmacodynamic agents with respect to chemical structure, therapeutic action and uses. 3. Understand the processes involved in the synthesis of dyes/drugs and their intermediate. 4. To understand the correlation between the colour of a compound and the structure, the origin, mode of application, classification of dyes, pigments and fluorescent brighteners and the science behind dye fibre attachment.	

8	**Course Outcomes**: Upon completion of the course, student will be able to **LO1** define various terms used in medicinal chemistry and color chemistry **LO2** reproduce the synthesis of drugs and dyes **LO3** predict the use of the drug **LO4** identify, predict, classify commercially available dyes based on terminology/nomenclature, the nature of dye-fibre attachment and the fastness of dyes
9	**Syllabus** **UNIT I: General Introduction to Drugs** • Definition of a drug, sources of drugs, requirements of an ideal drug, classification of drugs (based on therapeutic action), • Nomenclature of drugs: Generic name, Brand name,Systematic name • Definition of the following medicinal terms: Pharmacon, Pharmacology, Pharmacophore, Prodrug, Half – life efficiency, LD_{50}, ED_{50}, GI_{50} Therapeutic Index. • 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. **Routes of Drug Administration and Dosage Forms** • Oral and Parenteral routes with advantages and disadvantages. • Formulations& combination formulation, Different dosage forms(including Patches& Adhesives, emphasis on sustained release Formulations and enter tablets). **Pharmacodynamic agents:** A brief introduction of the following pharmaco dynamic agents and the study with respect to their chemical • structure, chemical class, therapeutic uses, and side effects **CNSDrugs** Classification based on pharmacological actions: CNS Depressants & CNS Stimulants. Concept of sedation and hypnosis, anaesthesia. • Phenytoin (Hydantoin) • Trimethadione (Oxazolidinedione)(**Synthesis from acetone)** • Alprazolam (Benzodiazepines) • Levetiracetam (Pyrrolidines) • Amphetamine(Phenethylamine)(**Asymmetric synthesis from phenyl acetic acid)** • Chlorpromazine (Phenothiazines) • . **UNIT II: Classification of Drugs:** **Analgesics, Antipyretics and Anti-inflammatory Drugs** • Morphine (Phenanthrenealkaloids) • Tramadol(Cyclohexanols)(**Synthesis from salicylicacid)** • Paracetamol(p-Amino phenols)Aspirin (Salicylates) Paracetamol(p-Amino phenols) Mechanism of inflammation and various inflammatory conditions. • Steroids:Prednisolone, Betamethasone Sodium Diclofenac, Aceclo fenac(N-Arylanthranilic acids) **(Synthesis from 2,6-**

dichlorodiphenyl amine)

Antihistaminic Drugs

- Diphenhydramine(Ethanolamines)
- Cetrizene (Piperazine)

(Synthesis from 4-Chlorobenzhydryl chloride)

- Chlorpheniramine maleate (Ethylamines) Pantoprazole (Benzimidazoles)

Cardiovascular drugs

Classification based on pharmacological action

- Iso sorbidedinitrate (Nitrates)
- Valsartan(Aminoacids)(structurenotexpected)
- Atenolol(Aryloxy propanol amines) **(Synthesisfrom 3-Hydroxy phenyl acetamide)**
- Amlodipine(Pyridines)

Frusemide/Furosemide(Sulfamoyl benzoic acid) Rosuvastatin (Pyrimidine)

AntidiabeticAgents

Generalideaand typesof diabetes; Insulin therapy

- Glibenclamide(Sulphonylureas)
- Metformin(Biguanides)
- Dapagliflozin(Pyranose) Pioglitazone(Thiazolidinediones)**(Synthesisfrom2-(5-ethylpyridin-2-yl) ethanol)**

Anti-Parkinsonism Drugs

IdeaofParkinson'sdisease.

- Procyclidinehydrochloride (Pyrrolidines)
- Ethopropazinehydrochloride(Phenothiazines)
  Levodopa(Amino acids) **(Synthesisfrom Vanillin) Drugs for Respiratory System**

General idea of: Expectorants;Mucolytes;Bronchodilators; Decongestants; Antitussives

- Ambroxol(Cyclohexanol)**(Synthesis from paracetamol)**

Salbutamol(Phenyl ethylamines) Oxymetazoline (Imidazolines)

UNIT III: Introduction to the dye-stuff Industry

- Dyes Definition of dyes, requirements of a good dye i.e. Colour, Chromophore, Auxochrome,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.
- Natural and Synthetic Dyes
- Natural Dyes:Definition and limitations of naturaldyes.

Examples and uses of natural dyes w.r.t Heena, Turmeric, Saffron, Indigo, Madder, Chlorophyll with namesof the chief dyeing material/s in each natural dye.

[structures not expected],

- Synthetic dyes: Definition of synthetic dyes, primaries andintermediates.

Important milestones inthe development ofsyntheticdyes– Emphasis on Name of the Scientist, dyes and the year of the discovery is required. (structure is not

- expected)

Substrates for Dyes: Types of fibres

- Natural fibres: cellulosic and proteinaceous fibres,
- Structural features of wool, silk andcotton and names of dyes applied on each of them. Semi-synthetic fibres:definition andexamples[structuresnot expected]
- Synthetic fibres:Nylon,PolyestersandPolyamidesstructuresandnamesof dyes applied on each of them
- Blendedfabrics: definition andexamples [structures not expected]

Classification of dyes based on applications and dyeing methods

Dyeing methods Basic Operations involved in dyeing process:

i. Preparation of fibres ii.Preparation of dyebath

iii. Application of dyes iv. Finishing Dyeing

Method of Cotton Fibres:

(i)Direct dyeing (ii) Vat dyeing

(iii) Mordant dyeing (iv) Disperse dyei

(a) **Classification based on applicability on substrates(examples** AcidDyes-OrangeII,

(b) BasicDyes-Methylviolet,

(c) DirectcottonDyes-Benzo fastYellow 5GL

(d) AzoicDyes–Diazo components;Fastyellow G, Fastorange R.

Coupling components.Naphthol AS,NaphtholASG

(e) Mordant Dyes-Eriochrome Black A,Alizarin.

(f) Vat Dyes –Indanthrene brown RRD,

(g) Sulphur Dyes- Sulphur BlackT (no structure)

(h) DisperseDyes-CellitonFastbrown3R, Reactive Dyes- Procion Brilliant HB

Optical Brighteners

General idea, important characteristics of optical brighteners and their classes [Stilbene, Coumarin, Heterocyclic vinylene derivatives, diaryl pyrazolines, Naphthylamide derivatives]G e n e r a ltructure of each class.

UNIT IV: Colour and Chemical Constitution of Dyes

- Absorption of visible light, Colour of wavelength absorbed, Complementary colour.
- Relation between colour and chemical constitution.

(i) Armstrong theory(quinonoidtheory)and its limitations.

(ii) Witt's Theory: Chromophore, Auxochrome, Bathochromic &Hypsochromic Shift, Hypochromic &Hyperchromic effect

- Valence Bond theory, comparative study and relation of colour in the following classes of compounds/dyes: Benzene

Nitrobenzene, Nitroanilines,Nitrophenols,Benzoquinones,Triphenyl methane, Anthraquinones.

- (iv) Molecular Orbital Theory.With reference to Ethylene; 1, 3- butadiene & β- carotene

Unit process and Dye Intermediates

brief idea of Unit Processes

Introductionto primariesand intermediates
Unitprocesses: definition and brief ideas of following unit processes:(a) Nitration(b) Sulphonation(c) Halogenation
(d) Diazotization:(Direct & Reverse Method)
Ammonolysis.
NB: Definition ,Reagents, Examples of each unit processes mentioned above with reaction conditions (mechanism is not expected)

Preparation of the Following Intermediates

Benzenederivatives: Benzenesulphonicacid;1,3-Benzenedisulphonic acid; Resorcinol; sulphanilic acid; o-, m-, p-chloronitrobenzenes;
o-,m-,p-nitroanilines; o-,m-,p-phenylenediamines;NaphtholASG **Naphthalene Derivative**:Schaefferacid;Tobiasacid;Naphthionicacid;N.W.acid;H- acid ;NaphtholAS.

Anthracene Derivative:
Anthraquinone;1-Aminoanthraquinone; Benzanthrone

10

Scheme of Examination and Assessment Pattern

Paper – 100 Marks

A. External Examination: Semester End External - 75 marks Time: 2:30 hours

Format of Question Paper

Attempt any 4 out of 6 questions.

Question No	Nature of Questions	Marks
Q1	Unit I (attempt any three out of 5)	15
Q2	Unit II (attempt any three out of 5)	15
Q3	Unit III (attempt any three out of 5)	15
Q4	Unit IV (attempt any three out of 5)	15
Q5	Unit I + II + III + IV (All compulsory)	15
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B. Internal Examination: Continuous Evaluation - 25 marks

	Assessment / evaluation	Marks
1.	Quizzes, Class Tests, Presentations, Projects, Problem solving, etc	20
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1. OECD Principles of Good Laboratory Practice (as revised in 1997)". OECD Environmental Health and Safety Publications. OECD. 1. 1998
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7. A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001)
8. Analytical Chemistry, Skoog, West ,Holler,7th Edition
9. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd
10. Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication
11. Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International (p) Limited
12. Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969.
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15. Instrumental methods of Analysis, by DrSupriya S Mahajan, Popular Prakashan Ltd
16. Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House
17. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman
18. Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969

Title: Applied Component Practical
[Course Code: CHM(A)USACDD5P1]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of Chemistry and their practical applications in the field of Chemical science. It begins with core concepts and the regulatory framework, including basics of chemistry practical framework. Students will learn to prepare and analyze chemical industrial issues and understand and evaluate it. The course also covers contemporary advancement in the field of chemistry. Theoretical concepts are reinforced with practical problem-solving and real-world applications.
2	**Vertical**	--
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credits**	2
5	**Hours allotted**	48 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** 1. To make students involved in actual drug and dye synthesis, and learn applications. 2. To study drug-receptor interactions, mode of action, and the importance of intermediates in drug synthesis. 3. To learn application in textiles, and the relationship between chemical structure and color.	
8	**Learning Outcomes:** Upon completion of the course, student will be able **LO1** Gain knowledge of the synthesis of various drug intermediates and drugs, including those used as analgesics, antipyretics, antidiabetic, and anti-inflammatory agents. **LO2** Study the mode of action of drugs, including the concept of receptors and drug-receptor interactions. **LO3** Understand the properties and nomenclature of dyes, including natural and synthetic dyes. **LO4** Learn about different types of fibers, how dyes are applied to them, and the principles of dye-fiber attachment.	
9	**Syllabus** **Estimation of Ibuprofen (back titration method)** • Estimation of Acid neutralizing capacity of a drug • Preparation of Aspirin from salicylic acid. • 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
10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **External Examination: Semester End External - 50 marks Time: 3:30 hours** Format of Question Paper

Question No	Nature of Questions	Marks
Q1	Experiment	40
Q2	Journal	05
Q3	Viva	05
Total		**50**

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REFERENCES:

1. Chemistry of Synthetic Dyes,VolI –VIII,VenkatramanK.,Academic Press 1972
2. TheChemistryofSyntheticDyesandPigments,LubsH.A.,RobertEKriegerPublishing Company, NY ,1995
3. Chemistryof Dyes and Principles of Dyeing, Shenai V.A., SevakPublications, 1973
4. Dyes: Overview, Shrikrishna D. Tupare, Lulu publications, 2021
5. Synthetic organic Chemistry, Gurdeep R. Chatwal, Himalaya Publishing House, 2001

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