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/02/2025
Date: 01st December, 2025

CIRCULAR

The immediate attention of all concerned is invited to this office Circular No. CHM (A) AC 08/2025 dated 31st October, 2025 regarding the Choice Based and Credit Based Syllabus (CBCS) for all subjects of F.Y.B.Sc, S.Y.B.Sc & T.Y.B.Sc. in Chemistry SEM-II SEM-IV & SEM-VI 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 20th November, 2025 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
01st December, 2025

Dr. Manju Lalwani Pathak
Principal & Chairperson, Academi

Copy forwarded for information to:-
1. The Dean, Faculty of Pure Sciences.
2. The Chairperson, Ad-hoc Board of Studies.
3. The Controller of Examination cell.
4. The Registrar

P.B. No.17, Opp. Railway Station, Smt. Chandibai Himathmal Mansukhani Road, Ulhasnagar - 421 003, Dist. Thane. (Maharashtra)
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HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar

(Autonomous)

Affiliated to the University of Mumbai

Bachelor of Science
(Chemistry)
(Aided Course)

Semester – VI

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- VI

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: Electrochemistry** • **Introduction Activity and Activity Coefficient:** Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye Huckel limiting law (No derivation) (Numerical expected) • **Classifications of cells:** Chemical cells and Concentration cells. Chemical cells, Electrode concentration cells, Liquid junction potential, Electrolyte concentration cells with and without transference • **Applied Electrochemistry** • **Polarization :** Concentration polarization and its elimination **Decomposition Potential and Overvoltage:** Introduction, experimental determination of decomposition potential, Factors affecting decomposition potential. • **Over Voltage:** Experimental determination of over-voltage. Hydrogen over voltage, Tafel's equation for hydrogen overvoltage. (Numerical expected) **UNIT II: Polymer Chemistry** • **Recapitulations:** Basic terms of polymer • **Classification of polymer:** Classification based on Source, Thermal response, physical properties • **Method of determination molar masses of polymer:** by Ultra- Centrifuge method (limiting velocity method), Viscosity method using Ostwald Viscometer (derivation and numerical expected), • **Light Emitting Polymer**: Introduction, Characteristics, Method of preparation and applications. • **Antioxidants and Stabilizer:** Antioxidants, Ultraviolet stabilizers, Colorants, Antistatic agent. **UNIT III: Quantum Chemistry** • **Classical mechanics**: Introduction, limitation of classical mechanics, Black body radiation, photoelectric effect, Compton Effect. • **Quantum mechanics**: Introduction, Planck's theory of quantization, wave particle duality, de-Broglie's equation, Heisenberg's uncertainty principle. (Numerical expected) • **Progressive and standing waves –** Introduction, boundary conditions, Schrodinger's time independent wave equation (No derivation expected), interpretation and properties of wave

function.

- **Quantum mechanics:** State function and its significance, Concept of operators – definition, addition, subtraction and multiplication of operators, commutative and non-commutative operators, linear operator, Hamiltonian operators, Eigen function and Eigen value. (Numerical expected)

UNIT IV: NMR -Nuclear Magnetic Resonance Spectroscopy

- Principle : Nuclear spin, magnetic moment, nuclear ' g ' factor, energy levels, Larmor precession, Relaxation processes in NMR (spin-spin relaxation and spin- lattice relaxation)
- **Instrumentation :** NMR Spectrometer

ESR-Electron Spin Resonance Spectroscopy

- **Principle:** Fundamental equation, g-value- dimensionless constant or electron g – factor, hyperfine splitting.

Instrumentation: ESR spectrometer, ESR spectrum of hydrogen and deuterium.

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

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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 (objective)	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. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer.
2. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
3. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.
4. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition, John Wiley & Sons, Inc [part 1]
5. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
6. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
7. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
8. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
9. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal Publishing Company, 2008.
10. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.
11. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.
12. S. Glasstone, Thermodynamics for Chemists, Affiliated East- West Press, New Delhi, 1964.
13. D. N. Bajpai, Advanced Physical Chemistry, S. Chand 1st Edn. 1992.

Quantum Chemistry Paperback by Donald A. McQuarrie.

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 students to plot mathematical functions such as linear, exponential, and trigonometric using appropriate tools and techniques. 2. To understand the principles of polymer solution viscosity and its relationship with molecular weight. 3. To develop a clear understanding of potentiometric titration techniques and their application in the quantitative analysis. 4. To introduce the principles of static methods for estimating the concentration of metal ions, in coordination complexes formed with ligands.	

8

Learning Outcomes:

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

LO1 Accurately plot and interpret linear, exponential, and trigonometric functions using graphing tools, and evaluate the acceptability of these functions based on mathematical and contextual criteria.

LO2 Explain the principles governing the viscosity of polymer solutions and determine the molecular weight of polyvinyl alcohol (PVA) through viscosity measurements and relevant calculations.

LO4 Perform potentiometric titrations for the quantitative determination of

LO5 Utilize static (equilibrium-based) methods to estimate the concentration of coordination complexes, and understand the role of ligands like salicylic acid in complex formation.

9

Syllabus

Non Instrumental Experiment

- Graph Plotting of mathematical functions –linear, exponential and trigonometry and identify whether functions are acceptable or non-acceptable?
- To determine the molecular weight of high polymer polyvinyl alcohol (PVA) by viscosity measurement

Instrumental Experiment

- To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate.
- To determine the Solubility product and solubility of AgCl potentiometrically using chemical cell.

  To titrate a mixture of weak acid and strong acid against strong base and estimate the amount of each acid in the mixture conductometrically.
- To estimate the amount of Fe (III) in the complex formation with salicylic acid by Static method..

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- VI

Title: Chemistry II (Inorganic Chemistry)

With effect from
Academic Year 2025-2026

Title: Chemistry II (Inorganic Chemistry)
[Course Code: CHM(A)USCH602]

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 theories proposed to understand molecular orbital formations 2. Significance of metals in organic compounds and synthetic methods of preparation of organometallic compounds 3. Catalysis concept and metallurgical operations such as extraction of metals.. 4. Important properties and compounds of noble gases like Xenon 5. Biological importance of metal ions	
8	**Learning Outcomes**: Upon completion of the course, student will be able to **LO1** understand the concept of Crystal field theory, Molecular orbital Theory for coordination compounds **LO2** elaborate synthetic methods of preparation of organometallic compounds and important chemical reactions of organometallic compounds **LO3** comprehend the basic mechanism in catalysis **LO4** gain knowledge of metallurgical aspects in industries **LO5** understand biological importance of certain metal ions	
9	**Syllabus** **UNIT I: Tenets of Crystal Field Theory** • Limitations of Valence Bond Theory. Fundamentals of Crystal Field Theory	

Phenomenon of Crystal field Splitting and its effects :octahedral, and tetrahedral complexes.

- Distortions from the octahedral geometry : (i) effect of ligand field (ii) Jahn-Teller distortions.
- Crystal field splitting parameter 10Dq(Δ) ,factors affecting 10 Dq, spectrochemical series.
- Crystal field stabilization energy(CFSE), calculation of CFSE for octahedral complexes with d^0 to d^{10} metal ion configurations.
- Consequences of crystal field splitting on properties such as ionic radii and hydration energy of formation of metal complexes of the first transition series.

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UNIT II: Molecular orbital Theory and properties of coordination compounds

- Identification of the central metal orbitals and their symmetry suitable for formation of σ bonds with ligand orbitals.
- Construction of ligand group orbitals.

Construction of molecular orbitals for ML_6 complex.:

Examples like $[FeF_6]^{-4}$, $[Fe(CN)_6]^{-4}$, $[CoF_6]^{-3}$ $[Co(NH_3)_6]^{+3}$

UNIT III: Organometallic chemistry

1Organometallic Compounds of main group metal

- General characteristics of various types of organometallic compounds, viz. ionic, σ-bonded and electron deficient compounds.
- General synthetic methods of organometallic compounds : (i)Oxidative-addition, (ii)Metal-metal exchange(trans-metallation), (iii) Carbanion-halide exchange,(iv) Metal-hydrogen exchange(metallation) and (v) Methylene-insertion reactions.

Some chemical reactions of organometallic compounds: (i) Reactions with oxygen and halogens, (ii) Alkylation and arylation reactions (iii) Reactions with protic reagents

Metallocenes

- Introduction, Ferrocene : Synthesis, properties, structure and bonding on the basis of VBT.

Role of transition metals in Catalysis

- Comparison between homogeneous and heterogeneous catalysis
- Basic steps involved in homogeneous catalysis
- Mechanism of Wilkinson's catalyst in hydrogenation of alkenes.

UNIT IV: Selected Topics

- **Metallurgy**
  - Types of metallurgies,
  - General steps of metallurgy; Concentration of ore, calcinations, roasting, reduction and refining.
  - Metallurgy of copper: occurrence, physicochemical
- principles, Extraction of copper from pyrites & refining by electrolysis.

- **Chemistry of Group 18**
    - Historical perspectives
    - General characteristics and trends in physical and chemicalproperties
    - Isolation of noble gases

Compounds of Xenon fluorides (XeF_2, XeF_4, XeF_6) with respect to preparation and structure (VSEPR)

Applications of noble gases

Introduction to Bioinorganic Chemistry

- Essential and non essential elements in biological systems.

Biological importance of metal ions such as Na^+,K^+,Fe^{+2}/Fe^{+3}

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

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 (objective)	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.Geoffrey A. Lawrance Introduction to Coordination Chemistry John Wiley & Sons. 2.R. K. Sharma Text Book of Coordination Chemistry Discovery Publishing House 3.R. Gopalan , V. Ramalingam Concise Coordination Chemistry , Vikas PublishingHouse; 4.Shukla P R, Advance Coordination Chemistry , Himalaya Publishing House E books:, E book: Crystal Field Theory ,Libre Texts chemistry23.6 5.Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley &Sons, NY, 6.Twigg ,Mechanisms of Inorganic and Organometallic Reactions Publisher: Springer 7.R.K. Sharma Inorganic Reaction Mechanisms Discovery Publishing House 8.M. L. Tobe Inorganic Reaction Mechanisms Publisher Nelson, 1972. 9.Coordination chemistry- Fred Basolo Ronald Johnson Ebook: Coordination chemistry, Sandhya Pimpalpure, Rahmi Jain 10.Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.. 11.H.W. Porterfield, Inorganic Chemistry, Second Edition, Academic Press, 2005 12.Robert H. Crabtree ,The Organometallic Chemistry of the Transition metals 13.B D Gupta & Anil J Elias Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University press 14.Ram Charan Mehrotra, Organometallic Chemistry: A Unified Approach, New Age International. E books: Organometallic chemistry, edited by Hiroshi Nakazawa, Royal society of Chemistry 15.R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India. 16.D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, OxfordUniversity Press 17.Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition. 18.Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993. 19.Lippard, S.J. & Berg, J.M. Princhemistryciples of Bioinorganic Chemistry PanimaPublishing Company 1994. 20.Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand& Co Ltd E books: Extractive metallurgy of copper by Mark Schlesinger Manual of Metallurgy by William Greenwood

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** **I. Inorganic preparations** 1. Preparation of Tris(acetylacetonato) iron(III) 2.Green synthesis of bis(dimethylglyoximato) nickel(II) complex using nickel carbonate and sodium salt of dmg . 3.Preparation of potassium trioxalato chromate(III) • 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. Mg, Ba, Sr,Ca. Quantitative analysis by titration method. (Complexometry 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.

Title: Chemistry III (Organic Chemistry)
[Course Code: CHM(A)USCH603]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This B.Sc. Chemistry course, designed for the Third-Year students (effective 2025-26), provides a robust foundation in Molecular rearrangements, Catalysts and Reagents. The curriculum extensively covers stereochemistry including Chirality, Selectivity, Specificity, Topicity and further explores the chemistry of natural products like Carbohydrates. It delves into advanced topics like spectroscopy for structure determination and crucial aspects of polymers (recycling, biodegradability, biomedical uses), concluding with the structure and functions of vital biomolecules like Proteins and Nucleic acids.
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 enable the learners to understand specific terms related with stereochemical outcome of organic reactions. 2. To make learners aware with basic biomolecules with reference to structural aspects, physical and chemical properties 3. To familiarize the learners with different catalysts and reagents useful in the field of organic synthesis along with basic information on Polymers. 4. To equip the learners with the skills to predict the products of selected rearrangement and named reactions used extensively in synthetic organic chemistry. 5. To provide the learners, a comprehensive understanding of Carbohydrates, their stereochemistry and various chemical reactions. 6. To make the learners understand the fundamental principles of Infrared, ^{1}H-NMR and ^{13}C-NMR Spectroscopic techniques and apply them for structural elucidation of organic compounds.	

8	**Learning Outcomes**: Upon completion of the course, student will be able to … **LO1** explain course of organic reactions and explain stereochemistry of product **LO2** understand the biological processes occurring into the body of living being **LO3** to do selection of catalysts or reagents to develop organic synthesis, also will get familiarized with industrial aspects of Organic Chemistry **LO4** get familiarized with selected rearrangement and named reactions used extensively in the synthetic organic chemistry to synthesize the commodity chemicals and compounds of industrial/ commercial importance/ applications. **LO5** gain comprehensive understanding of Carbohydrates, their stereochemistry and various chemical reactions. **LO6** understand the fundamental principles of Infrared, ^{1}H-NMR and ^{13}C-NMR Spectroscopic techniques and apply them for structural elucidation of organic compounds.
9	**Syllabus** **UNIT I: Stereochemistry & Chemistry of Biomolecules: (15 L)** • **Stereoselectivity and stereospecificity:** Idea of enantioselectivity (ee) and Diastereoselectivity (de), Topicity: Enantiotopic and Diastereotopic atoms, groups and faces. • **Stereochemistry of –** i) Substitution reactions: SNi (reaction of alcohol with thionyl chloride) ii) Elimination reactions: E2–Base induced dehydrohalogenation of 1-bromo-1,2-diphenyl propane. iii) Addition reactions to olefins: a) Bromination (electrophilic anti addition) b) Syn hydroxylation with OsO_4 and $KMnO_4$ c) Epoxidation followed by hydrolysis • **Amino acids, Proteins & Nucleic acids:** **(i) 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. **(ii) Polypeptides and Proteins:** Nature of peptide bond. Nomenclature and representation of polypeptides (di-and tri-peptides) with examples, Merrifield solid phase polypeptide synthesis. **(iii) Proteins:** General idea of primary, secondary, tertiary & quaternary structure **(iv) Nucleic Acids:** 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.

UNIT II: Polymers and Catalysts & Reagents (15 L)

Polymers: (7 L)

- **Introduction**: Terms monomer, polymer, homopolymer, copolymer, thermo plastics and thermosets.
- **Addition polymers**: Polyethylene, polypropylene, Teflon, polystyrene, PVC, Uses.
- **Condensation polymers**: Polyesters, polyamides, polyurethanes, polycarbonates, phenol formaldehyde resins and uses of each one of these.
- **Stereochemistry of polymers**: Tacticity, mechanism of stereochemical control of polymerization using Ziegler Natta catalysts
- **Natural and synthetic rubbers**: Polymerization of isoprene: 1,2 and 1,4 addition (cis and trans), Styrene butadiene copolymer.
- **Additives to polymers**: Plasticizers, stabilizers and fillers.
- **Biodegradable polymers**: Classification and uses. polylactic acid structure, propertiesand 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)

- **Catalysts and Reagents**: Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism)
- **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

- **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. m-CPBA (epoxidation of C=C)
e. NBS (allylic and benzylic bromination)

UNIT III: Molecular Rearrangements & Carbohydrates:

Molecular Rearrangements:

Mechanism of the following rearrangements with examples and stereochemistry wherever applicable.

- **Migration to the electron deficient carbon:** Pinacol - Pinacolone rearrangement
- **Migration to the electron deficient nitrogen:** Beckmann rearrangement
- **Migration involving a carbanion:** Favorskii rearrangement
- **Name reactions:** Michael addition, Wittig reaction

Carbohydrates:

	• **Introduction:** Classification, Characteristics, Nutritional value, reducing & non-reducing sugars, DL notation. • **Structures of monosaccharides:** Fischer projection (4-6 carbon monosaccharides) and Haworth formula (furanose and pyranose forms of pentoses and hexoses). • **Stereoisomers of D-glucose:** Enantiomer, diastereomers, anomers, epimers. • **Mutarotation:** Introduction & Mechanism of Mutarotation in D-glucose • **Chain lengthening & shortening reactions:** Modified Kiliani-Fischer synthesis (D-arabinose to D-glucose and D-mannose), Wohl method (D-glucose to D-arabinose). • **Reactions of D-glucose and D-fructose:** Osazone formation, Reduction using H_2/Ni, & $NaBH_4$, Oxidation using Bromine water, HNO_3 & HIO_4, Acetylation, Methylation. • **Glycosides:** Introduction & General structure. **UNIT IV: Organic Spectroscopy II** • **IR Spectroscopy:** Basic Theory, Nature of IR spectrum, selection rule, finger print region. • **^{1}H-NMR Spectroscopy:** Basic theory of ^{1}H-NMR, nature of ^{1}H-NMR spectrum, chemical shift (δ unit), standard for ^{1}H-NMR, solvents used. Factors affecting chemical shift: Inductive effect, 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 ^{1}H-NMR in structure determination. • **^{13}C-NMR Spectroscopy:** Basic theory of ^{13}C-NMR, nature of ^{13}C-NMR spectrum, chemical shift (δ unit), standard for ^{13}C-NMR, solvents used, application of ^{13}C-NMR in structure determination. • **IR & ^{1}H-NMR spectral characteristics of following classes of organic compounds:** Alkanes, Alkenes, Alkynes, Haloalkanes, Alcohols, Carbonyl compounds, Ethers, Amines, Monosubstituted & Disubstituted benzenes. (broad regions characteristic of different groups are expected). • Problems on structural elucidation of simple organic compounds using individual or combined use of UV-Vis, IR, Mass, ^{1}H-NMR and ^{13}C-NMR spectroscopic techniques are expected. (Index of hydrogen deficiency should be the first step in solving the problems).

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

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 (Objective)	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. Stereochemistry of Carbon Compounds, E. L. Eliel, Tata McGraw Hill.
2. Stereochemistry Conformation and Mechanism (Eleventh Edition), P. S. Kalsi, New Age International.
3. Stereochemistry of Organic Compounds: Principles and Applications (Fourth Edition), D. Nasipuri, New Age International
4. Biochemistry (Eighth Edition), J. M. Berg, J. L. Tymoczko, G. J. Gatto, Jr. L. Stryer, W.H. Freeman Publicat
5. Principles of Biochemistry (Seventh Edition), D. L. Nelson and M. M. Cox, Lehninger, W. H. Freeman Publication.
6. Organic Chemistry (Sixth edition), R. T. Morrison and R. N. Boyd, Pearson education.
7. Organic Chemistry (Fourth edition), S. H. Pine, Tata McGraw Hill.
8. Polymer Chemistry, M. G. Arora, K. Singh, Anmol Publications Pvt. Ltd.
9. Polymer Science, V. K. Ahluwalia and A. Mishra, Ane books.
10. Polymer Chemistry An Introduction, v.12, (Third edition), R. B. Seymour, C.E. Carraher, Marcel Dekker.
11. Organic Chemistry (Eighth edition), Francis A. Carey, R. M. Giuliano, McGraw Hill Education.
12. Advanced Organic Chemistry (Part A & B- Fifth edition), Francis A. Carey and Richard J. Sundberg, Springe
13. Name Reactions (Fourth Edition), J. J. Li, Springer Publication.
14. Organic Spectroscopy (Second edition), Jag Mohan, Narosa publication.
15. Introduction to Spectroscopy (Fifth edition), D. L. Pavia, G. M. Lampman, G. A. Kriz, J. R. Vyvyan, Cengag Learning.
16. Elementary Organic Spectroscopy (Third edition), Y. R. Sharma, S. Chand publication.
17. Organic Chemistry, Paula Y. Bruice, Pearson education.
18. Spectrometric Identification of Organic Compounds (Paperback – Illustrated, 29 Sept. 2014 English edition) Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, Wiley.
19. Absorption Spectroscopy of Organic Molecules, V. M. Parikh, Addison Wesley Publishing Company.
20. A guidebook to mechanism in Organic Chemistry (Sixth edition), Peter Sykes, Pearson education, New Delh

21. Organic Reaction Mechanism (Fourth edition), V. K. Ahluwalia, R. K. Parashar, Narosa Publication.
22. Organic Reactions and their mechanisms (Third revised edition), P. S. Kalsi, New Age International Publish
23. Advanced Organic Chemistry- Reactions, Mechanism and Structure (Seventh edition), J. March and M. B. S Wiley Student Edition.
24. Organic Chemistry (Fourth edition), G. Marc Loudon, Oxford University press.
25. Introduction to Organic Chemistry (Fourth edition), Andrew Streitwieser, Jr. Clayton H. Heathcock, Macmil publishing, New York.
26. Organic Chemistry (Sixth edition), Morrison and Boyd, Pearson Education.
27. Introduction to Organic Chemistry, John Mc Murry, Cengage Publisher.
28. Organic Chemistry, Volume- 1 & 2 (Fifth and sixth edition), I. L. Finar, Pearson Education.

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 learners 1. To develop a systematic approach for the qualitative analysis of binary liquid-liquid and liquid -solid organic mixtures. 2. To understand the separation and identification of individual liquid/ solid 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 the physical type of organic mixture **LO2** learners will be able to separate mixture of liquid-liquid and liquid-solid organic compounds using simple distillation as characterize using the chemical/physical properties	
9	**Syllabus** **Separation of Binary liquid-solid and liquid-liquid mixture:** • 8.0 - 10 mL mixture to be given. 6.0 - 8.0 mL of volatile liquid, 4.0-5.0 mL of non-volatile liquid & 1.5 g – 2.0 g of solid compound can be provided to the students. • Minimum Six mixtures to be completed by the students out of which 03 can be liquid-solid & 03 liquid-liquid mixtures. • Components of the mixture should include volatile liquids (Acetone, Ethyl acetate) & non-volatile liquids (Aniline, Acetophenone), water insoluble carboxylic acids (Benzoic acid,	

Cinnamic acid), water insoluble phenols (2-naphthol, 1-naphthol), water insoluble base (nitroanilines), water insoluble neutral compounds (anilides, amides, m-DNB, hydrocarbons).

- After correct determination of physical type which can either be Volatile Liquid + Solid or Volatile liquid + Non-volatile liquid, the students should separate the components by simple distillation.
- 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 or boiling point.
- In liquid-liquid mixtures, characterization can be given for volatile or non-volatile liquid.

10

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

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

11

REFERENCES

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

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester- VI

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 validation of analytical data. 2. Modern analytical techniques for Quantitative and qualitative analysis. 3. Modern separation techniques 4. Chemistry of Food and Cosmetics.	

8	Learning Outcomes: Upon completion of the course, students will be able to …. **LO1** Use Electroanalytical, Thermal and spectroscopic techniques for qualitative and quantitative analysis. **LO2** Use advance chromatographic techniques for separation process'. **LO3** Analyse common food products for the presence of adulterants. **LO4** Know the chemical constituents of common cosmetics. **LO5** Identify the factors for method validation **.**
9	**Syllabus** • **UNIT I: ELECTRO ANALYTICAL TECHNIQUES** • **Polarography** (**Numerical and word problems are expected)** • Difference between potentiometry and voltammetry, Polarizable and non-polarizable electrodes • Basic principle of polarography • Hshapedpolarographiccell,DME(construction,working, advantages and limitations) • 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 $E_{1/2}$, Factors affecting $E_{1/2}$ • Quantitative aspects of polarography: Ilkovic equations: various terms involved in it (No derivation) • Quantification • Wave height – Concentration plots (working plots/calibration) • Internal standard (pilot ion) method • Standard addition method • Applications advantages and limitations • **Amperometric Titrations** • Principle, Rotating Platinum Electrode(Construction, advantages and limitations) • Titration curves with example • Advantages and limitations **UNIT II : METHODS OF SEPARATION - II** • **Gas Chromatography** (**Numerical and word problems are expected**) • 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. • **Ion Exchange Chromatography** • Introduction, Principle.

- Types of Ion Exchangers, Ideal properties of resin.
- Ion Exchange equilibria and mechanism, selectivity coefficient and separation factor
- Factors affecting the separation of ions
- Ion exchange capacity and its determination for cation and anion exchangers.
- Applications of Ion Exchange Chromatography with reference to preparation of demineralised water, Separation of amino acids.

UNIT III:FOOD AND COSMETICS ANALYSIS

- **Introduction to food chemistry**
- Food processing and preservation:
- Introduction, need, chemical methods, action of chemicals(sulphur dioxide, boric acid, sodium benzoate, acetic acid, sodium chloride and sugar) and pH control
- Physical methods (Pasteurization and Irradiation)
- Study and analysis of food products and detection of adulterants
- **Milk:**
- Composition & nutrients, types of milk (fat free, organic and lactose milk)
- Analysis of milk for lactose by Lane Eynon's Method
- **Honey:**
- Composition
- Analysis of reducing sugars in honey by Coles Ferricyanide method
- **Tea**:
- Composition, types (green tea and mixed tea)
- Analysis of Tannin by Lowenthal's method
- **Coffee:**
- Constituents and composition, Role of Chicory
- Analysis of caffeine by Bailey Andrew method
    - **Cosmetics**
    - Introduction and sensory properties
- Study of cosmetic products –
- **Face powder:**
- Composition
- Estimation of calcium and magnesium by complexometric titration

- **Lipstick:**
- Constituents
- Ash analysis for water soluble salts: borates, carbonates and zinc oxide

- **Deodorants and Antiperspirants:**
- Constituents, properties
- Estimation of zinc by gravimetry

UNIT IV: QUALITATIVE ANALYSIS (THERMAL METHODS and IR) AND ANALYTICAL METHOD VALIDATION

- **Thermal Methods**
- Introduction to thermal methods -TGA and DTA
- **Thermogravimetric Analysis(TGA)**
- Instrumentation-block diagram,thermobalance (Basic components: balance, furnace, temperature measurement and control, recorder)
- Thermogram (TG curve)for$CaC_2O_4..H_2O$ and $CuSO_4.5H_2O$
- Factors affecting thermogram-Instrumental factors and Sample characteristics
- Applications:
- Determination of drying and ignition temperature range
- Determination of percent composition of binary mixtures (Estimation of Calcium and Magnesium oxalate)
- **Differential Thermal Analysis (DTA):**
- Principle**,** Instrumentation, and Reference material used
- Differential thermogram (DTA curve) $CaC_2O_4 .H_2O$ and $CuSO_4.5H_2O$
- Applications
- Comparison between TGA and DTA.

- **Introduction to IR Spectroscopy(only Dispersive) :**
- Principle – vibrational excitation, molecular fingerprint
- Instrumentation- Components of IR spectrophotometer –sources, detectors (Thermal)
- Sample preparation techniques
- Applications, Advantages and Disadvantages.

- **Analytical Method Validation**
- Introduction and need for validation of a method
- Validation Parameters: Specificity, Selectivity, Precision, Linearity,
- Accuracy and Robustness

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. An Advance Dairy chemistry, V 3, P. F. Fox, P. L. H. McSweeney Springer
2. Analysis of food and Beverages, George Charalanbous, Academic press 1978
3. Analytical Chemistry of Open Learning(ACOL),James W. Dodd & Kenneth H. Tonge
4. Analytical chemistry David Harvey The ,McGraw Hill Companies, Inc.
5. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd
6. Analytical Chemistry, Gary.D Christan, 5th edition
7. Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969
8. Food Analysis, Edited by S. Suzanne Nielsen, Springer
9. Food Analysis: Theory and practice, YeshajahuPomeranz, Clifton E. Meloan, Springer
10. Formulation and Function of cosmetics, Sa Jellineck
11. Modern cosmetics, E. Thomessen Wiley Inter science
12. Fundamentals of Analytical Chemistry, D .A. Skoog and D. M. West and F. J. Holler Holt., Saunders 6th Edition (1992)
13. Government of India publications of food drug cosmetic act and rules.
14. Harry's Cosmetology, Longman scientific co.
15. High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributer
16. Introduction to Polarography and Allied Techniques, By Kamala Zutshi, New Age International, 2006
17. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman
18. Principles of Polarography by Jaroslav Heyrovský , Jaroslav Kůta, 1st Edition, Academic Press, eBook ISBN: 978148326478

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:** • Estimation of reducing sugar in honey by Willstatter method.	

- Estimation of Mg^{+2} & Zn^{+2} by using an anion exchange resin.
- Interpretation of the given IR spectrum (functional groups and possible structure)

Instrumental Experiments:

- Estimation of acetic acid in commercial Vinegar sample by using Quinhydrone electrode, potentiometrically.
- Determination of phosphoric acid in cola sample , pH metrically.

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

Title: Chemistry VI (Applied Component)
[Course Code: CHM(A)USACDD601]

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:** • **Drug Discovery, Design and Development:** Discovery of a Lead compound: Screening, drug metabolism studies and clinical observation, Lipinski's rule of 5 • Medicinal properties of compounds from Natural Sources: Anti-infective and anticancer properties of Turmeric (Curcumin) • Development of drug: The Pharmacophore identification, modification of structure or functional group, Structure activity relationship (Sulphonamides). • Structure modification to increase potency: Homologation, Chain branching and Extension of the structure. Computer assisted drug design. • **Drug Metabolism:** Introduction, Absorption, Distribution, Bio- transformation, Excretion Different types of chemical transformation of drugs with specific examples. • **Chemotherapeutic Agents:** Study of the following chemotherapeutic agents with respect to their chemical structure, chemical class, therapeutic uses, side effects and introduction to MDR wherever applicable **Antibiotics and antivirals:** Definition, Amoxicillin (β-lactum antibiotics), Cefpodoxime (Cephalosporins) Doxycycline (Tetracyclines), Levofloxacin (Quinolones) (Synthesis from 2, 3, 4 -Trifluoro -1- nitrobenzene) Aciclovir/Acyclovir (Purines) **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) Following combination to be discussed: Atremether-Lumefantrine (no structure) **Anthelmintics and Anti-Fungal agents** Drugs effective in the treatment of Nematodes and Cestodes infestations., Diethyl carbamazine (Piperazines), Albendazole (Benzimidazoles) (Synthesis from 2- Nitroaniline), Clotrimazole (Imidazole), Fluconazole (Triazole) (Synthesis from 1- Bromo – 2, 4- di-fluorobenzene) **UNIT II:** • **Antiamoebic Drugs:** Types of Amoebiasis, Metronidazole, Ornidazole, Tinidazole Types of Amoebiasis, Metronidazole, Ornidazole, Tinidazole (Imidazole) (Synthesisof Metronidazolefromglyoxal, By Debus- Radziszewski imidazole synthesis route) • **Antitubercular and Antileprotic Drugs:** Types of Tuberculosis; Symptoms and diagnosis of Tuberculosis. Types of Leprosy. General idea of Antibiotics used in their treatment. PAS (Amino salicylates), Isoniazide (Hydrazides), Pyrazinamide (Pyrazines), (+) Ethambutol (Aliphatic diamines) (Synthesis from 1-Nitropropane), Dapsone (Sulphonamides) (Synthesis from 4- Chloronitrobenzene) Clofazimine (Phenazines), Bedaquiline (Quinoline) Following combination therapy to be discussed: Rifampin + Ethambutol + Pyrazinamide, Rifampin + Isoniazide + Pyrazinamide **Anti-Neoplastic Drugs:** Idea of malignancy; Causes of cancer, Brief idea of Immuno

- Stimulants & Immuno depressants, Lomoustine (Nitrosoureas), Anastrozole (Triazoles) (Synthesis from 3, 5-bis (bromo methyl) toluene), Cisplatin (Chloro Platinum), Vincristine, Vinblastine, Vindesine) (Vinca alkaloids) (structure not expected)
- **Anti-HIV Drugs:** Idea of HIV pathogenicity, Symptoms of AIDS, AZT/Zidovudine, Lamivudine, DDI (Purines)
- **Vitamin Therapy:** Therapeutic uses and Hypervitaminosis with respect to water Insoluble Vitamins (A, D, E, & K) and water-soluble Vitamins (B_{12} and C)
- **Nano particles in Medicinal Chemistry:** Introduction; Carbon nano particles (structures) and Carbon nano tubes: Functionalization for Pharmaceutical applications, Targeted drug delivery, In vaccine (Foot and mouth disease), Use in Bio-physical treatment, Gold nano particles in treatment of Cancer; Parkinsonism and Alzheimer, Silver nano particles for its Antimicrobial activity.
- **Drugs and Environmental Aspects:** Impact of Pharma-industry on environment, International regulation for human, Experimentation with reference to"The Nuremberg Code" and "The Helsinki Declaration"

UNIT III:

- **Classification of Dyes based on Chemical Constitution: i) Nitro dyes**: Naphthol Yellow S, **ii) Nitroso dyes**: Gambine Y **, iii) Azo dye:** Mono azo dyes: Orange IV, Eriochrome Black T; Dis azo dyes: Congo red; Tris azo dyes: Direct Deep Black EW **iv) Diphenyl methane Dyes:** Auramine O **v) Triphenyl methane dyes:** diamino Derivatives: Acid Magenta; Tri amino Derivatives: Malachite Green; Phenolic Derivatives: Rosolic Acid **vi) Heterocyclic dyes** Thiazine dyes (Methylene Blue), Azine dyes (Safranin T), Xanthene Dyes (Eosin), Oxazine Dyes (Capri Blue), Acridine Dyes (Acriflavine) **vii) Quinone Dyes**: Naphthaquinone (Naphthazarin) Anthraquinone Dyes (Indanthrene Blue) **viii) Indigoid Dyes**: Indigo **ix) Phthalocyanine Dyes**: Monastral Fast Blue B
- **Synthesis of Selected Dyes:** Synthesis of the following dyes i) Oange IV from sulphanilic acid ii) Eriochrome Black T from β- naphthol iii) Congo red, from Nitrobenzene iv) Direct deep black from benzidine v) Auramine O from benzaldehyde vi) Malachite Green, vii) Safranine T from o-toluidine viii) Indanthrene Blue from anthraquinone ix) Indigo from aniline & mono chloro acetic acid
- **Health and Environmental Hazards of Synthetic Dyes and their Remediation Processes:** Impact of the textile and leather dye Industry on the environment with special emphasis on water pollution Toxicity of dyes w.r.t food colours (Health hazards).

UNIT IV:

- **Non-textile uses of dyes: Biomedical uses of dyes:** Dyes used in formulations - (Tablets, capsules, syrups etc) Indigo carmine, Sunset yellow, Ta rtrazine. Biological staining agents - Methylene blue, Crystal violet and Safranine T, DNA markers, Bromophenol blue, Orange G, Cresol red. Dyes as therapeutics - Mercurochrome, Acriflavine, Crystal Violet, Prontosil. **Dyes used in food and cosmetics:** Properties of dyes used in food and cosmetics, Introduction to FDA and FSSAI Commonly used food colours and their limits, **Paper and leather dyes:** Structural features of paper and leather, Dyes applicable to paper and leather, **Miscellaneous dyes:** Hair dyes, Laser dyes, Indicators, Security inks, Coloured smokes and camouflage colours
- **Pigments:** Introduction, Definition of pigments with examples, Properties of pigments, Difference between dyes and pigments, Definition of Lakes and Toners, Requirement of Pigments, Types of Pigments, Extraction method of Pigments.

Dyestuff Industry - Indian Perspective:

Growth and development of the Indian

	dyestuff

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

- Industry, Strengths, Weaknesses, Opportunities and Challenges of the Dyestuff industry in India, Make in India - Future Prospects of the Dye Industry

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<tr><td>10</td><td>

Scheme of Examination and Assessment Pattern

Paper – 100 Marks

A. External Examination: Semester End External - 75 marks Time: 2:30 hours
Attempt any 4 out of 5 questions.

Format of Question Paper

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

B. Internal Examination: Continuous Evaluation - 25 marks

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11	**REFERENCES:** 1. Foye's principles of medicinal chemistry. 6th Edition, 2008, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippmcolt Williams & Wilkins. 2. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition, 2007. 3. The Art of Drug synthesis. Johnson and Li. Wiley, 2007. 4. The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press, 2014. 5. Nanoparticle and technology for drug delivery (Drugs and pharmaceutical sciences) Ram B. Gupta & Uday B. Kompella, volume 159, Taylor and Francis group. 2006. 6. Chemistry of Synthetic Dyes, Vol I – IV, Venkatraman K., Academic Press 1972 7. The Chemistry of Synthetic Dyes and Pigments, Lubs H.A., Robert E Krieger Publishing Company, NY ,1995 8. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications Lubs H.A., Robert E Krieger Publishing Company, NY ,1995 9. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications, 1973 10.Green Chemistry for Dyes Removal from Waste Water- Research Trends and Applications, Ed. Sharma S.K., Wiley, 2015 11.Environmental Pollution- Monitoring and Control, Khopkar S.M., New Age International (P) Ltd, New Delhi, 1982. 12.Dyes: Overview, Shrikrishna D. Tupare, Lulu publications, 2021 Synthetic organic Chemistry, Gurdeep R. Chatwal, Himalaya Publishing

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

11	**REFERENCES:**

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.	

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- 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

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Scheme of Examination and Assessment Pattern
Paper – 50 Marks
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 colspan="2">Total</td><td>50</td></tr>
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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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Board of Studies (Sem – VI)

Sr No	Name of the Faculty	Designation and College	Signature
1.	Dr. Yogini Bambardekar	Head, Associate Professor Smt.CHM College, Ulhasnagar Bambardekar.yogini@gmail.com	
2.	Dr. Sarika Chhabria Talreja	Associate Professor Smt.CHM College, Ulhasnagar sarikachhabriatalreja@gmail.com	
3.	Dr. Nagesh Sutar	Associate Professor Smt.CHM College, Ulhasnagar Nageshr.sutar@gmail.com	
4.	Dr. Neena Anand	Associate Professor Smt.CHM College, Ulhasnagar dr.neenanand@gmail.com	
5.	Dr. Sandeep Kotwal	Associate Professor Smt.CHM College, Ulhasnagar sandeepbkotwal@gmail.com	
6.	Dr. Prashant Thorat	Assistant Professor Smt.CHM College, Ulhasnagar drthoratprashant@gmail.com	
7.	Dr. Gayatree Shinde	Assistant Professor Smt.CHM College, Ulhasnagar Gayatree.g@gmail.com	
8.	Dr. Prajakta More	Assistant Professor Smt.CHM College, Ulhasnagar prajaktasandeep@gmail.com	
9.	Dr. Nilanjana Kar	Assistant Professor Smt.CHM College, Ulhasnagar Nilkar.nilanjanakar@gmail.com	
10.	Mr. Dnyaneshwar Gholap.	Assistant Professor Smt.CHM College, Ulhasnagar Gholapdnyaneshwar.chmc.chem@gmail.com	
11.	Dr.Pradeep Shimpi	VC NOMINEE BNN College,Bhiwandi	
12	Dr.Smita Thosar	Representative from Industry Associate Director, Cipla	
13	Dr.Mukund Deshpande	Alumni Member	
14	Dr.Rajesh Samant	Subject Expert outside the parent University	

Name & Signature of the BoS Chairperson: Dr. Yogini Bambardekar

Name & Signature of the Dean: Dr. Neena Anand