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

Principal : Dr. Manju Lalwani Pathak

Ref. No: CHM (A) AC/02/2026-27
Date: 27th June, 2026

CIRCULAR

The immediate attention of all concerned is invited to this Office Circular No. CHM (A) AC 11/2026 dated 19th June, 2026 regarding Choice Based and Credit Based Syllabus (CBCS), of Smt. CHM College (Autonomous), under the guidelines of University of Mumbai, as per Academic Framework of NEP 2020, for all subjects of T.Y.B.Sc in Chemistry SEM-V and SEM-VI.

This is in continuation with curriculum approved by Academic Council for all the subjects of F.Y.B.Sc in Chemistry (SEM-I), S.Y.B.Sc in Chemistry (SEM-III) and F.Y.B.Sc in Chemistry (SEM-II) & S.Y.B.Sc in Chemistry (SEM – IV) vide Circular Reference Numbers CHM (A) AC/C/01/2025 dated 18th June, 2025, CHM (A) AC/C/01A/2025 dated 21st July 2025 and CHM (A) AC/C/02/2025 dated 20th November, 2025 respectively.

It is hereby communicated that the recommendations of the curriculum designed 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 June, 2026 have been approved.

In accordance, therewith, the syllabus as per the CBCS, has been brought into force with effect from the Academic Year 2026-27 for T.Y.B.Sc in Chemistry, in continuation with syllabus of F.Y. B.Sc in Chemistry and S.Y.B.Sc in Chemistry of 2025-2026 (updated), and accordingly the same is attached for reference and is available on the College's website www.chmcollege.in

Ulhasnagar – 421003
27th June 2026

Dr. Manju Lalwani Pathak
Principal & Chairperson, Academic Council

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

P.B. No.17, Opp. Railway Station, Smt. Chandibai Himathmal Mansukhani Road, Ulhasnagar - 421 003, Dist. Thane. (Maharashtra)
Tel. : +91 251 273 4940 Fax : + 91251 273 1869 E-mail : principal.chmc@gmail.com website : chmcollege.in

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Affiliated to the University of Mumbai

Bachelors of Science
(Chemistry)
(Aided)

(as per NEP 2020 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, Practicum 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 Practicum. 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, Practicum, 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 program. The framework is intended to allow flexibility and innovation in program design, syllabi development, teaching-learning process and quality assessment of students' learning levels mix of academic knowledge, Practicum skills, and industry exposure.

Faculty of Pure Sciences

Programme Outcomes

Upon completion of Bachelor of Science , learner will be able to :

.

PO1: **Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the chosen discipline, their concepts, theories, methods, and its interdisciplinary applications

PO2: **Critical Thinking and Analytical Reasoning:** Analyse issues critically, apply logical reasoning, and develop appropriate solutions

PO3: **Problem Solving and Scientific Skills:** Apply scientific methods to investigate and solve real life problems.

PO4: **Research Competence:** Formulate research questions, design and conduct investigations, collect and interpret data, apply appropriate statistical methods and communicate research findings effectively.

PO5: **Digital literacy:** Effectively use ICT, digital resources, computational tools, bioinformatics, artificial intelligence applications, and statistical software for scientific learning, research, and decision-making.

PO6: **Communication Skills:** Communicate effectively through written reports, oral presentations, scientific publications, visual media, and interpersonal interactions with diverse audiences.

PO7: **Environmental Sustainability and Community Engagement:** Demonstrate empathy, appreciate cultural diversity, engage in community service, and promote environmental sustainability.

PO8: **Ethics and Professional Values:** Demonstrate integrity, ethical conduct, biosafety, academic honesty, respect for intellectual property, and professional responsibility in scientific practice and research.

PO9: **Leadership and Teamwork:** Work collaboratively in diverse teams, demonstrate leadership qualities, and contribute effectively to achieving common goals.

PO10: **Lifelong Education :** Engage in self-directed lifelong education for continuous personal and professional development.

PO11: **Employability and Entrepreneurship:** Apply scientific knowledge, creativity, and entrepreneurial skills for employment and entrepreneurship.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Comprehend knowledge of advanced concepts in Physical, Organic, Inorganic, and Analytical Chemistry and apply them to solve chemical problems in academic, industrial, and research settings.

PSO2: Design, execute, and interpret laboratory experiments, chemical syntheses, and research-based investigations while adhering to laboratory safety, ethical practices, and quality assurance protocols.

PSO3: Apply chemical principles to interdisciplinary areas such as pharmaceuticals, materials science, environmental monitoring, metallurgy, polymers, and industrial processes, environmental sustainability, and get acquainted with sophisticated analytical equipments thereby enhancing employability and entrepreneurship potential.

PSO4: Develop critical thinking, scientific communication, data analysis, and problem-solving skills, research pursuits, and professional growth in chemistry and allied fields.

PSO5: Appreciate the contributions of the Indian Knowledge System and sustainable chemical practices, and apply scientific knowledge responsibly for societal and environmental well-being

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Affiliated to the University of Mumbai

Bachelors of Science

(Chemistry)

(Aided)

Semester – I

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Chemistry)

Semester- I

Title: **Basics in Physical, Inorganic and Organic Chemistry - I**

Vertical – 1
(MAJOR)

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Title: Basics in Physical, Inorganic and Organic Chemistry-I
[Course Code: CHMCHI1]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of chemistry and their Practicum applications in in the field of chemistry. It begins with developing and understanding of major concepts in all disciplines of chemistry. The course enhances knowledge of basic analytical tools. The course helps to solve the problem and also think methodically, independently and draw a logical conclusion. Students can employ critical thinking and the scientific knowledge to design, carryout, record and analyze the results of chemical reactions. The course can help to create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1**: To understand the basic concept of viscosity, preparation of solutions, kinetics, rate laws and determination of orders of reactions. **CO(A)2**: To understand basic concepts of electrochemistry, thermodynamics and surface tension **CO(A)3**: To comprehend the history of atomic structure, periodicity and properties of elements. **CO(A)4**: To distinguish the qualitative methods for identification of inorganic compounds; types of chemical bonds in molecule/ compounds and theories. **CO(A)5**: To develop critical thinking about different types of organic compounds and about stereochemical approach of organic compounds	
8	**Course Outcomes**: Upon completion of the course, student will be able to **CO1:** Explain the properties of states of matter, concentration expressions, and rate laws.	

	CO2: Describe and interpret the principles of electrochemistry, thermodynamics, and surface tension. **CO3:** Classify elements using periodic theories and analyze the historical evolution of atomic structure. **CO4:** Compare qualitative analysis methods and chemical bonding theories. **CO5:** Apply nomenclature and stereochemical concepts to identify and classify organic compounds.
9	**Syllabus** **UNIT I: Physical Chemistry (10 Hours)** • **Liquid State**: Introduction, coefficient of viscosity, relative viscosity, specific viscosity, reduced viscosity, determination of viscosity by Ostwald viscometer. • **Chemical Calculations**: Mole concept, molar mass & Percentage composition, Methods of expressing concentration of solutions: Normality, Molarity, Molality, Mole fractions, ppm, ppb. Preparation of solutions (Dilution). (Numerical problems expected wherever necessary) • **Chemical Kinetics:** Rate of reaction, rate constant, measurement of reaction rates, order and molecularity of reaction, Integrated rate equation of first order and Second order reactions (with equal initial concentration of reactants) . Determination of order of reaction by a) Integration method b) Graphical method c) Ostwald's isolation method d) Half time method (Numerical problems expected wherever necessary). **UNIT II: Inorganic Chemistry (10 Hours)** • **Atomic Structure:** Historical perspectives of the atomic structure; J.J. Thomson Model, Rutherford's Atomic Model- alpha particle scattering experiment, Bohr's theory, Aufbau principle, Hund's rule of maximum multiplicity and Pauli exclusion principle, Applications of Atomic Structure in Modern Science • **Periodic Table and Periodicity:** Classification for elements as main group, transition and inner transition elements. Atomic and ionic size, electron gain enthalpy, ionization enthalpy, effective nuclear charge (Slater's rule), electronegativity, Pauling and Mulliken methods. (Numerical problems expected, wherever applicable.) **UNIT III: Organic Chemistry (10 Hours)** • **Classification and Nomenclature of Organic Compounds:** Nomenclature of mono and bi-functional aliphatic compounds on the basis of priority order of the following classes of Basic Principles of compounds: haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids. • **Stereochemistry:** Flying Wedge projection, Fischer Projection, Newman and Sawhorse Projection formulae (erythro, threo isomers of tartaric acid and 2,3 - dichlorobutane) and their interconversions; R/S nomenclature, E/Z notations with C.I.P rules. Conformational analysis of n-butane; Relative stability with energy profile diagrams, Introduction to Optical activity. Basic concepts of Chirality (dissymmetry), enantiomers, diastereomers and meso isomers (with examples like Lactic acid (1C), glyceraldehyde(1C), Tartaric acid (2C))

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Theory Examination: Semester End Total Marks - 30 Time- 1.0 hour

Format of Question Paper

Question No	Nature of Questions	Marks
Q1	A) Objective questions 4 out of 6	4
	B) Subjective questions2 out of 3	6
Q2	A) Objective questions 4 out of 6	4
	B) Subjective questions2 out of 3	6
Q3	A) Objective questions 4 out of 6	4
	B) Subjective questions2 out of 3	6
	Total 30	

Note:

1. Each question will carry 10 marks.
2. All questions shall be compulsory with internal choice within the questions.
3. Use of simple calculator is allowed in the examination.

B. Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Objective Question Tests	10
2.	Active participation/ Viva/ Real time Assignments	10
	Total 20	

11

REFERENCES:

1. Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch (2006)
2. Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Hollers'. Crouch (2009)
3. Modern Analytical Chemistry by David Harvey, McGraw-Hill Higher Education (1999)
4. S.M. Khopkar, "Basic Concepts of Analytical Chemistry", IInd Edition New Age International Publisher (2004)
5. Principles of Instrumental Analysis, D. A. Skoog, F. James Holler, Stanley R. Crouch (2007)
6. Vogel's Textbook of Quantitative Chemical Analysis, 5th edition (1989)
7. Instrumental method of analysis, B.K. Sharma, Goel publishing house. Miscellaneous methods (2005)

Title: Practicum in Chemistry- I
[Course Code: CHMCHI2]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of chemistry and their Practicum applications in in the field of chemistry. It begins with developing and understanding of major concepts in all disciplines of chemistry. The course enhances knowledge of basic analytical tools. The course helps to solve the problem and also think methodically, independently and draw a logical conclusion. Students can employ critical thinking and the scientific knowledge to design, carryout, record and analyze the results of chemical reactions. The course can help to create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** The course objectives focus on building a strong foundation for advanced studies and Practicum applications in chemistry. **CO(A)2:** To enable students to develop critical thinking, efficient experimental skills in all chemistry disciplines, scientific temper and research-based skills. **CO(A)3:** To provide knowledge of basic branches of chemistry and leverage it to develop interest in contemporary chemistry aspects	
8	**Course Outcomes**: Upon completion of the course, student will be able to **CO1:** Describe solutions of different concentrations and standardize the given solutions. **CO2:** Explain rate constant of a reaction and understand effect of time on rate of reaction. **CO3:** Perform quantitative commercial analysis of compounds by volumetric titration method. **CO4:** Calculate the percent purity of samples by gravimetric method. **CO5:** Purify various organic compounds by recrystallization technique and calibrate thermometer and determine physical constants; M.P. and B.P.	

9

Syllabus

Physical Chemistry

- To prepare 0.1 N succinic acid and standardize the NaOH solution of different concentrations.
- To standardize Sodium thiosulphate solution.
- To determine the rate constant for the hydrolysis of ester using HCl as catalyst.
- Introduction to instruments: pH meter, Potentiometer, Colorimeter and Conduct meter (Demonstration only)

Inorganic Chemistry

- To determine the strength of commercial acid sample (HCl) by volumetric analysis.
- To estimate the content of Na_2CO_3 and $NaHCO_3$ in the given sample using double indicator by volumetric analysis.
- To determine the percent purity of sample of $BaSO_4$ containing NH_4Cl gravimetrically.

Organic Chemistry

- Purification of organic compounds by recrystallization selecting suitable solvent (minimum 2 Organic compounds to be given, Students are expected to report **a)** Solvent for recrystallization **b)** Percentage Yield and the melting points of the purified compound.)
- Basic principles involved in characterization of Organic compound (minimum 4 Solid Organic compounds, Students should perform Preliminary Tests, Solubility Test, obtain melting point and recrystallize the compound with given solvent)

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. **External Examination: Semester End - 30 Marks Time: 2 hours**

Exam Pattern	Maximum Marks
One Experiment (25 marks for Experiment and 5 Marks for Journal)	30
Total	**30**

B. **Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Viva/ Real time Assignments/ Objective Question Tests	15
2.	Active participation	05
		Total 20

11	**REFERENCES:** 1. Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch (2006) 2. Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Hollers'. Crouch (2009) 3. Modern Analytical Chemistry by David Harvey, McGraw-Hill Higher Education (1999) 4. S.M. Khopkar, "Basic Concepts of Analytical Chemistry", IInd Edition New Age International Publisher (2004) 5. Principles of Instrumental Analysis, D. A. Skoog, F. James Holler, Stanley R. Crouch (2007) 6. Vogel's Textbook of Quantitative Chemical Analysis, 5th edition (1989) 7. Instrumental method of analysis, B.K. Sharma, Goel publishing house. Miscellaneous methods (2005)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Chemistry)

Semester- I

Vertical – 2
(MINOR)
Not Applicable

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.

Semester- I

OPEN ELECTIVE

Vertical – 3

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Faculty of Interdisciplinary

Vertical 3: List of Open Elective Skill Based Courses for First Year: Semester - I

Sr. No.	Nomenclature of the Paper
1	Basic Computer Skills for Digital Age
2	Visual Design and Digital Tools : A Foundation For Animation
3	Basic Tools of AI for Economics and Education
4	Communicative English
5	Urbanization and Real Estate: Concepts and Contemporary Scenarios
6	Business of Travel and Tours
7	Managing Family Wealth Through Family Office
8	Web Designing Essentials: HTMLI and CSS Styling Techniques
9	Basics of Nutrition
10	Lessons of Reel Making
11	Performing Arts
12	Data Analysis with Excel
13	Political Communication and Media Skills
14	Stress Management-I
15	Social Media and Communication
16	Mushroom Cultivation: Training and Trading
17	Yoga and Fitness
18	Basic Perfumeries Course (Level-I)
19	Soft Skills for Corporate Readiness
20	Beautician : Strategic Business Planning
21	Current Trends of Fashion Design: Financial Perspective
22	Basics of Accounting-I
23	Digital Marketing
24	Online Trading in Stock Market
25	Event Management Course in Sindhi

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar (Autonomous)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Chemistry)

Semester- I

Title:

VSC: Calibration of glassware and instruments

Vertical - 4

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Title: Calibration of Glassware and Instruments
[Course Code: CHMCHI4]

Sr. No.	Heading	Particulars
1	**Description of the course:**	The aim of Vocational Skill Courses (VSC) designed to provide experiential learning for students, which help to develop their technical skill through hands-on training and also developing abilities of critical thinking, Analytical skill, collaboration, teamwork, problem-solving and communication which mold their careers.
2	**Vertical:**	4
3	**Type:**	Practicum
4	**Credits:**	2 Credit
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** **CO(A)1:** Explain the functions and applications of common laboratory glassware and analytical instruments used in chemistry laboratories. **CO(A)2:** Demonstrate the principles and procedures for calibrating laboratory glassware and instruments to ensure precision and accuracy in analytical measurements. **CO(A)3:** Apply laboratory safety practices and standard protocols for the safe handling, storage, and disposal of chemicals. **CO(A)4:** Apply appropriate analytical techniques for the qualitative and quantitative analysis of samples and interpret the analytical results.	
8	**Course Outcomes:** After Completion of the course, the Learner will be able to; **CO1:** Calibrate laboratory glassware and analytical instruments according to standard laboratory procedures. **CO2:** Analyze sources of experimental errors and implement appropriate measures to improve the precision and accuracy of analytical results. **CO3:** Demonstrate safe handling, storage, and disposal of chemicals by following established laboratory safety guidelines. **CO4:** Select and apply appropriate analytical techniques for sample analysis and interpret the obtained results.	
9	**Practicum Syllabus** • Calibration of Laboratory Glasswaress • Calibration of Burette • Calibration of Pipette • Calibration of Standard Measuring Flask • Calibration of Thermometer(Demonstration) • Calibration of Laboratory Instruments	

- Calibration of pH meter
- Calibration of Conductometer
- Calibration of Colorimeter
- Calibration of Potentiometer (Demonstration)
- To standardize given NaOH solution by using secondary standard by titration method.
- To find out strength of weak acid using titration method.
- To study the effect of dilution on the absorbance of potassium permanganate solution by visual observation technique
- To separate the mixture of volatile and non-volatile solid compounds by using sublimation method.
- To understand principle of separation of two organic liquids by distillation. (demonstration)

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. **External Examination: Semester End - 30 Marks Time: 2 hours**

Nature	Marks
One Experiment (25 marks for Experiment and 5 Marks for Journal = 30 Marks)	30

B. **Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Quizzes, Class Tests, Presentations, Projects, Role Plays, Creative Writing, Assignments etc.	15
2.	Active participation	05
		Total 20

11

REFERENCES:

1. Instrumental Analysis by Douglas A.Skoog, F.J ames Holler, StanleyR.Crouch (2006)
2. Fundamental of Analytical Chemistry by Douglas A.Skoog, West, F .JamesHollers'. Crouch (2009)
3. Modern Analytical Chemistry by David Harvey,McGraw-Hill HigherEducation (1999)
4. S.M.Khopkar,"BasicConceptsofAnalyticalChemistry",IIndEditionNewAgeInternational
5. Publisher (2004)
6. Principles of InstrumentalAnalysis, D.A.Skoog, F.JamesHoller, StanleyR.Crouch (2007)
7. Vogel's Textbook of Quantitative Chemical Analysis, 5th edition (1989)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Chemistry)

Semester- I

Title:
SEC: Basic statistical tools in Chemistry

Vertical - 4

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Title: Basic Statistical Tools in Chemistry

[Course Code: CHMCHI5]

Sr. No.	Heading	Particulars
1	**Description the Course**	The aim of Skill Enhancemen Courses (SECs) is to introduce the students with various numerical skills and available statistical tools applications in solving and analyzing experimental data.
2	**Vertical**	4
3	**Type**	Practicum
4	**Credits**	2 Credits
5	**Hours Allotted**	60 Hours
6	**Marks Allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** Explain the significance of data and classify different types of datasets used in scientific investigations. **CO(A)2:** Apply appropriate statistical methods to evaluate the precision and accuracy of experimental data. **CO(A)3:** Analyze data dispersion and variability using suitable statistical measures and interpret the results for scientific decision-making.	
8	**Course Outcomes**: Upon successful completion of the course, students will be able to: **CO1:** Classify different types of datasets and explain their relevance in scientific data analysis. **CO2:** Calculate and interpret measures of precision and accuracy to evaluate the quality and reliability of experimental data. **CO3:** Analyze data dispersion using appropriate statistical measures and interpret the variability of datasets for informed conclusions.	
9	**Practicum Syllabus** • To collect primary data and secondary data and understanding difference between them. • To study different types of errors in chemical analysis and understand their practical applications in analytical chemistry • To study and understand the difference between accuracy and precision using repeated analytical measurements. • Determination of mean, median and mode of titre values of acid base titration (Minimum number titre values = 10 using secondary data)	

- Determination of standard deviation and variance of titre values of any complexometric titration (Minimum number titre values = 10 using secondary data)
- Determination of acetic acid in vinegar by titration method and calculate absolute and relative error
- Determination of Absolute deviation, average deviation and relative average deviation from the given data of any experiments of Chemistry.
- Determination of absolute and relative error in standardization of $Na_2S_2O_3$ by using 0.05N $K_2Cr_2O_7$. (The readings should based on secondary data)

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. **External Examination: Semester End - 30 Marks Time: 2 hours**

Nature	Marks
One Experiment (25 marks for Experiment and 5 Marks for Journal = 30 Marks)	30

B. **Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Quizzes, Class Tests, Presentations, Projects, Role Plays, Creative Writing, Assignments etc.	15
2.	Active participation	05
		Total 20

11

REFERENCES:

1. Analytical Chemistry by Cary D. Christian, John Wiley and sons
2. Basic concepts of Analytical Chemistry by S.M. Khopkar, NewAge International Publishers
3. Vogel's Textbook of Quantitative Chemical Analysis by J.Menham, R.C.Denney, J.D. Barnes and
4. M.J.K. Thomas, 6th Edn, Low Price Edition, Pearson Education Ltd, New Delhi (2000)

Board of Studies (Sem – I)

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.	Dr. Dnyaneshwar Gholap.	Assistant Professor Smt.CHM College, Ulhasnagar Gholapdnyaneshwar.chmc.chem@gmail.com	
11.	Dr.Pradeep Shimpi	VC NOMINEE BNN College,Bhiwandi	Outside Memb
12	Dr.Smita Thosar	Representative from Industry Associate Director, Cipla	Outside Mem
13	Dr.Mukund Deshpande	Alumni Member	Outside Mem
14	Dr.Rajesh Samant	Subject Expert outside the parent University	Outside Mem

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

me & Signature of the Dean: Dr. Neena Anand

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B.Sc.

Semester- I

Vertical – 5

Ability Enhancement Course (English)

2 Credits

with effect from
Academic Year 2025-2026

Title: Introduction to Communication Skills in English
Course Code: CHMBSCAECI

Sr. No.	Heading	Particulars
1	**Description the Course:**	Effective communication is the cornerstone of academic and professional success. This course introduces learners to foundational skills in English communication, with a focus on both oral and written competencies essential in academic, social, and workplace contexts. It aims to equip learners with the ability to read critically, write precisely, speak confidently, and listen actively. Emphasis is placed on building clarity, coherence, and conciseness in communication, along with an understanding of audience, purpose, and tone. The course integrates grammar reinforcement, vocabulary building, reading comprehension, and practice-oriented modules such as email etiquette, group discussion, and formal writing. Through dynamic classroom interactions and practical assessments, learners will gain confidence in using English effectively and purposefully**.**
2	**Vertical 4**	Ability Enhancement Course
3	**Type** Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: CO(A)1: To introduce learners to the fundamentals of effective communication and its components. CO(A)2: To enhance learners' reading comprehension through exposure to multiple genres and contexts. CO(A)3: To develop grammatical accuracy and lexical resourcefulness for academic and professional communication. CO(A)4: To strengthen verbal and non-verbal presentation skills and promote interactive speaking abilities.	

	CO(A)5: To build competence in real-world writing tasks such as email drafting, bio-data preparation, and descriptive writing.
8	**Course Outcomes**: Student will be able to CO-1: Understand and apply key principles of effective communication in varied contexts. CO-2: Comprehend and analyze written texts using appropriate reading strategies. CO-3: Recognize and correct common grammatical and lexical errors. CO-4: Engage in clear, confident, and context-appropriate spoken interactions. CO-5: Produce structured, coherent, and grammatically correct written content for academic and workplace use.

9	**Syllabus**

UNIT I: Foundations of English Communication

A) Core Concepts of Communication

- Principles of Effective Communication: The 7 Cs
- Verbal and Non-verbal Communication with Examples
- Cross-cultural Communication in the Globalized World
- Technology in Communication: Email, Messaging, Video Conferencing
- Listening for Detail and Intent: Barriers to Listening and Strategies

B) Reading Comprehension

- Understanding the Main Idea and Supporting Details
- Interpreting Tone, Purpose, and Bias
- Using Context Clues for Vocabulary Building
- Reading Visual Texts: Graphs, Charts, and Infographics
  Sample readings will include excerpts from news articles, reports, editorials, and educational essays (200–250 words).

C) Grammar and Vocabulary

- Subject-Verb Agreement
- Sentence Structures
- Punctuation and Capitalization
- Commonly Confused Words
- Editing and Proofreading Practice

A remedial and functional approach will be followed with contextual exercises.

UNIT II: Applied Communication Skills

A) Speaking and Listening Skills

- Introducing Oneself in Academic/Professional Settings
- Participating in Group Discussions and Expressing Opinions
- Delivering a Short Speech (2–3 minutes) on Familiar Topics
- Understanding and Responding to Instructions
- Listening Comprehension Practice through Audio/Video Clips

B) Functional Writing Skills

- Formal Email Writing with Subject and Tone Sensitivity
- Descriptive Paragraph Writing (People, Places, Processes)
- Bio-data and Resume Writing
- Drafting Job Applications (Solicited and Unsolicited)
- Writing a Statement of Purpose

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 1:00 hour

Format of Question Paper

Question No	Nature of Questions	Marks
Q. 1	**Short Notes** (Attempt any 3 out of 5) - **Unit 1** **OR** **Essay-Type Question** (Attempt any 1 out of 2)- **Unit 1**	15
Q. 2	**Short Notes** (Attempt any 3 out of 5) - **Unit 2** **OR** **Essay-Type Question** (Attempt any 1 out of 2)- **Unit 2**	15
	Total	**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Students are required to draft a job application letter along with a resume using the following AI assistance: Canva Resume Builder, Resume.oi, Zety, Novopresume, Rezi etc **OR** Draft an SoP with the help of the following AI assistance: Quillbot, Yocket, Writesonic, Jasper AI	15
2.		05
	Total	**20**

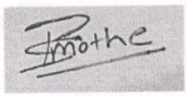
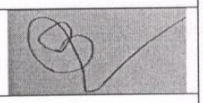
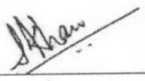
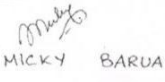
11

REFERENCES:

1. Adler, Ronald B., et al. *Understanding Human Communication*. 15th ed., Oxford UP, 2021.
2. Bailey, Stephen. *Academic Writing: A Handbook for International Students*. 5th ed., Routledge, 2018.
3. Barrass, Robert. *Students Must Write: A Guide to Better Writing in Coursework and Examinations*. Routledge, 2005.
4. Brown, Gillian, and George Yule. *Teaching the Spoken Language: An Approach Based on the Analysis of Conversational English*. Cambridge UP, 1983.
5. Carnegie, Dale. *The Quick and Easy Way to Effective Speaking*. Pocket Books, 2006.
6. Chaney, Lillian, and Jeanette Martin. *Intercultural Business Communication*. 6th ed., Pearson, 2014.
7. Cullen, Pauline, et al. *English Grammar in Use Supplementary Exercises*. Cambridge UP, 2019.
8. Eastwood, John. *Oxford Guide to English Grammar*. Oxford UP, 2005.

9. Gerson, Sharon J., and Steven M. Gerson. *Technical Communication: Process and Product*. 9th ed., Pearson, 2021.
10. Hewings, Martin. *Advanced Grammar in Use: A Self-study Reference and Practice Book for Advanced Learners of English*. 3rd ed., Cambridge UP, 2013.
11. Jones, Leo. *Functions of English: Communication Practice in English*. Cambridge UP, 1981.
12. Kumar, Sanjay, and Pushp Lata. *Communication Skills*. 2nd ed., Oxford UP, 2018.
13. Lynch, Tony. *Listening in Language Learning*. Longman, 1988.
14. McCarthy, Michael, and Felicity O'Dell. *Academic Vocabulary in Use*. Cambridge UP, 2008.
15. Nordquist, Richard. *The Essentials of English Grammar*. McGraw-Hill Education, 2016.
16. Quirk, Randolph, et al. *A Comprehensive Grammar of the English Language*. Longman, 1985.
17. Seely, John. *The Oxford Guide to Writing and Speaking*. Oxford UP, 2005.
18. Straus, Jane, et al. *The Blue Book of Grammar and Punctuation*. 12th ed., Jossey-Bass, 2021.
19. Wallace, Catherine. *Reading*. Oxford UP, 1992.
20. Zinsser, William. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Perennial, 2016.

Syllabus Committee:

Sr. No	Name of the Faculty	Designation and College	Signature
1.	Prof. (Dr.) Kailas Aute	Professor & Head, Dept. of English, Smt. CHM College	
2.	Prof. (Dr.) B. R. Hiramani,	(VC Nominee, University of Mumbai) Pancham Khemraj College, Sawantwadi	
3.	Prof. (Dr.) Vikas Raskar	(Subject Expert outside University) Hutatma Rajguru Mahavidyalay, Rajguru Nagar, Khed, (Affiliated to Savitribai Phule University)	
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University	
5.	Mr. Ananda Pandhare	Asst. Professor, Dept. of English, Smt. CHM College	
6.	Ms. Sana Khan	Asst. Professor, Dept. of English, Smt. CHM College	
7.	Dr. Micky Barua	Faculty Vidyalankar Institute of technology, Alumni Member	 MICKY BARUA
8.	Ms. Sofy Verghese	Accenture, Industry Representative	

Name & Signature of the Ad-hoc BoS Chairperson: Prof. (Dr). Kailas Aute 

Name & Signature of the Dean: Prof. (Dr). Nitin Arekar 

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar

(Autonomous)

Affiliated to the University of Mumbai

Bachelor of Commerce/ Arts/Science/ SFC (Sindhi)

(AEC – Ability Enhancement Course)

(Aided Course)

Semester – I

Choice Based and Credit Based syllabus as per NEP 2020 with effect from the Academic Year 2025-2026

PREAMBLE

The Bachelor of Commerce (B.Com.) in Sindhi is a comprehensive program designed to develop Sindhi language. Language is the soul of Literature. Sindhi is medium of Communication, Education and Cultural exchange. Curriculum is designed specially in digital age.

Language enriches literature. This curriculum is prepared according to Social, Cultural and Academic needs. The B.Com. Sindhi subject offers students a unique opportunity to explore and widened Sindhi Culture through a wide range of literary programs. The curriculum not only emphasizes literary appreciation and analysis but also fosters ethical awareness, intercultural sensitivity and social responsibility.

The program is committed to developing critical thinking, ethical reasoning and inclusive perspectives. It encourages students to reflect and engage with communication in Sindhi, expertise in Business and Employment Creative work, meditation and listening, use of visual tails, expertise of asking questions, knowledge of different languages through communication.

Language allows us to share our ideas, thoughts, feelings and emotions with others through communication. There is a special contribution of the ideal citizen in nation building. It plays crucial role in creating civilized society.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO-1 Students will understand the communication skills and role of language in communication.

PSO-2 Students will be able to talk effectively in Sindhi language with friends, relatives and Business customers.

PSO-3 Students will understand aspects of language.

PSO-4 Students will be able to understand the Importance of communication, and they will communicate in different ways i.e. verbal, non-verbal, written and Digital methods.

Smt

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year

Semester- I

Title: Communication Skills in Sindhi

Vertical - 5
Ability Enhancement Course
2 Credit

with effect from
Academic Year 2025-2026

Title: Communication Skills in Sindhi
COURSE CODE: CHMSINIAEC

Sr. No.	Heading	Particulars
1	**Description the Course:**	Communication is the core component of commerce and trade. In communication, language plays very significant role. If a student has mastered the skills of language, undoubtedly, he or she would be able to communicate in the best manner. In this course basic part of Sindhi language would be taught based on the NEP 2020. Innovative approaches like critical thinking, creative mind, and use of technology will lead to communicating and participating with different groups. The vocabulary section would be given prominence. The course would be in the Devanagari script so that it can attract majority of the students. Even non-Sindhi students shall have opportunity to adopt this course.
2	**Vertical 1**	AEC – Ability Enhancement Course
3	**Type**	Theory + Practicum (Teaching Method: Lecture/ Discussion/Reading)
4	**Credit**	2 credits (1 credit = 15 hours for theory or 30 hours of Practical work in a semester)
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50Marks
7	**Course Objectives**: After successful completion of this course: **CO(A) 1:** The learner will get understanding of communication skills. **CO(A) 2:** The learner will understand how to accurate the pronunciation of special words in Sindhi **CO(A) 3:** The learner will improve the conversation skill in Sindhi. **CO(A) 4:** The learner will become best communicator in Sindhi language	
8	**Course Outcomes**: Student will be able to **CO1**: Know the basic special features of Sindhi language. **CO2**: Understand communication skills. **CO3**: Knowing the conversation with businessmen and customers **CO4**: Know the etiquettes with parents, relatives, friends and others in effective way	

9	**Syllabus**

UNIT I: Fundamental of Sindhi Communication

- Introduction of Communication skills through Pictorial Presentation
- Importance of Language
- Basic aspects of language:
  i) Types of Language, ii) Role of Language, iii) Changes in Language iv) Non-violent aspects of language v) Language & New generation vi) Language & Modern technology
- New Education Policy (NEP) & Importance of language
- Sindhi language: (Special features of spoken Sindhi language with pronunciation through audio visual presentation

UNIT II: Functional Communication

- Importance of Communication
- Types of Communication (Presentation through video clips):
  i) Verbal, ii) non-verbal, iii) Written iv) Digital Communication
- Characteristics of Communication
- Obstacles in Communication of Sindhi Language
- Methods of Best Communication through role plays
- Spoken Sindhi in Business
- Conversation with customers and proprietors

****

Syllabus

यूनिट १: सिंधी राबते जो बुनियाद

- संचारी भाषा: वाक्फियत
- भाषा जी अहिमियत
- भाषा जा बुनियादी पहलू

  १) किस्म, २) भाषा जो किरदार, ३) भाषा मे तबदीलियूं, ४) भाषा जा अहिसासाती पहलू ५) बोली ऐ नई पीड़ी ६) बोली ऐ जदीद टेकनालाजी
- नई तैलीमी नीति ऐं बोलियुन जी अहमियत
- असां जी सिंधी बोली

यूनिट २: अमली राबतो (असराइतो गालाइण जो तरीको)

- राबते जी अहमियत
- राबते जा किस्म

  १) जिबानी राबतो, २) गैर जिबानी राबतो, ३) लिख्त राबतो ४) डिजीटल राबतो राबते मां फायदा
- रााबते में रंडकुं
- बेहतर राबते जा तरीका
- ग्राहकन सां सिंधी बोलीअ मे गुफ्तगू
- कारोबार में सिंधी गालाइण

****

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 1:00 hour

Format of Question Paper

Question No	Nature of Questions	Marks
Q1.A)	Objective Type Questions (Unit- I)	05
Q1.B)	Attempt ANY 2 out of 4- (5 marks each) (Unit-I)	10
Q2.A)	Objective Type Questions (Unit- II)	05
Q2.B)	Attempt ANY 2 out of 4- (5 marks each) (Unit-II)	10
Total		**30**
		Total 30

Internal Examination: Continuous Evolution - 20 marks

	Assessment / evaluation	Marks
1.	**Written assignment on any one of the following topics** 1) Draft a Notice and Report writing in Sindhi 2) Simulate dialogues such as interview, daily conversation and public speaking in Sindhi (Students are required to use AI assistance in the preparation of their drafts. Eg: Microsoft Copilot, Google Gemini, Google voice Typing tool)	15
2.	Class Attendance and Participation	05
	Total	**20**

11

REFERENCE BOOKS:

1. Sanchari Basha – By Dr. Pushpa Kodwani
2. Sindhi Pahakaa – Dr. Jetly M.K.
3. Sindhi Muhavahra – By Hardwani Lachhman
4. Sindhi Adhyat mak Shabdhkesh – By Hardwani Lachhman
5. Acho Sindhi Sikhu – By Hardwani Lachhman

Syllabus Committee:

Sr No	Name of the Faculty	Designation and College	Signature
1.	Mrs. Kajal Ramchandani	**H.O.D. of Jai Hind College**	
2.	Mrs. Komal Totani	**Assistant Teacher, Smt. CHM College**	

Name & Signature of the BoS Chairperson: (Mrs. Kajal Ramchandani)_____

Name & Signature of the Dean: (Dr. Nitin Arekar) _____

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year

Semester - I

Title: Indian Knowledge System

Vertical - 5
IKS Subject - 2 Credits

With effect from
Academic Year 2025-2026

Title: Indian Knowledge System
Course Code: CHMIKSI

Sr. No.	Heading	Particulars
1	**Description the Course:**	This course introduces students to the Indian Knowledge System (IKS), emphasizing its historical depth, cultural relevance, and interdisciplinary value. Rooted in the context of Indian civilization, it explores the holistic development of knowledge from ancient to pre-modern times, including contributions in medicine, mathematics, logic, linguistics, governance, arts, and sciences. By revisiting the traditional education systems and intellectual heritage of India, the course encourages learners to connect ancient insights with contemporary disciplines. It aims to enhance awareness, foster appreciation of indigenous wisdom, and reveal the interconnectedness of various streams of knowledge, aligning with the goals of the NEP 2020.
2	**Vertical 5**	IKS
3	**Type & Teaching Methods**	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To sensitize the students about context in which they are embedded i.e. Indian culture and civilization including its Knowledge System and Tradition. **CO(A)2:** To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system. **CO(A)3:** To help to study the enriched scientific Indian heritage. **CO(A)4:** To introduce the contribution from Ancient Indian system & tradition to modern science & Technology.	
8	**Course Outcomes**: Student will be able to **CO1:** Understand and appreciate the rich Indian Knowledge Tradition. **CO2:** Understand the contribution of Indians in various fields. **CO3:** Experience increase subject-awareness and self-esteem. **CO4:** Develop a comprehensive understanding of how all knowledge is ultimately intertwined.	

9	**Syllabus** **UNIT I: Introduction** • **Introduction to IKS** (What is knowledge System, Characteristic Features of Indian Knowledge System) • **Why IKS?** (Macaulay's Education Policy and its impact, Need of revisiting Ancient Indian Traditions) • **Scope of IKS** (The Universality of IKS (from Micro to Macro), development form Earliest times to 18th Century CE) • **Tradition of IKS** (Ancient Indian Education System: Home, Gurukul, Pathashala, Universities and ancient educational centres) • **Relevant sites in the vicinity of the Institute** (Water Management System at Kanheri, Temple Management of Ambernath, etc.) **UNIT II** • Medicine (Ayurveda) • Alchemy • Mathematics • Logic • Art of Governance (Arthashastra) **UNIT III (Select Any FIVE out of the following)** • Aesthetics • Town Planning • Strategic Studies • Krishi Shastra • Vyakaran & Lexicography • Natyashastra • Ancient Sports • Astronomy • Yoga and Wellbeing • Linguistics • Chitrasutra • Architecture • Taxation • Banking • Trade and Commerce

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 1:00 hours

Format of Question Paper

Attempt all questions.

Question No	Nature of Questions	Marks
Q1	Attempt any two out of five	06
Q2	Attempt any three out of five	12
Q3	Attempt any three out of fifteen	12
TOTAL		**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Class test during lectures (MCQ / Short notes / Match the pairs / Puzzles)	10
2.	Participation in Workshop / Conference / Seminar / Case Study / Field Visit / Certificate Course / Project presentation / Viva	10
TOTAL		**20**

11

REFERENCES:

1. Concise history of science in India- D.M. Bose, S.N Sen, B.V. Subbarayappa.
2. Positive sciences of the Ancient Hindus- Brajendranatha seal, Motilal Banrasidas, Delhi 1958.
3. History of Chemistry in Ancient India & Medieval India, P. Ray- Indian Chemicals Society, Calcutta 1956.
4. Charaka Samhita- a scientific synopsis, P. Ray & H.N Gupta National Institute of Sciences of India, New Delhi 1965.
5. MacDonnell A.A- History of Sanskrit literature.
6. Winternitz M- History of Indian Literature Vol. I, II.
7. Dasgupta S.N & De S.K- History of Sanskrit literature Vol' I.
8. Ramkrishna Mission- cultural heritage of India Vol' I, II.
9. Majumdar R. C & Pushalkar A.D- History & culture of the Indian people, Vol. I, II & III.
10. Keith A.B- History of Sanskrit literature.

Name & Signature of the Dean &Adhoc BoS Chairperson(Interdisplinary):

(Dr. Nitin Arekar)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year

Semester- I

Title: Cocurricular Course I

Vertical - 6
Cocurricular Course - 2 Credits

with effect from
Academic Year 2025-2026

Title: Cocurricular Course - I

Course Code: CHMCCI6

Sr. No.	Heading	Particulars
1	**Description the Course:**	This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year. Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting. This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.
2	**Vertical 6**	Cocurricular Course (Mandatory)
3	**Type** **Teaching Methods**	Non Theory Participation, Report Writing, Presentation etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities. 2. To enhance personal and interpersonal skills through real-life experiences and teamwork. 3. To foster a sense of responsibility, leadership, and community engagement among students. 4. To develop self-confidence and emotional well-being through creative expression and collaboration. 5. To integrate classroom learning with experiential learning for holistic growth.	
8	**Learning Outcomes**: By the end of the course, students will be able to: **LO1:** Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences. **LO2:** Demonstrate improved communication, leadership, and teamwork skills. **LO3:** Exhibit increased awareness of social responsibility and civic engagement. **LO4:** Build confidence through creative, cultural, and intellectual expressions. **LO5:** Maintain a portfolio or activity log to track participation and personal development.	

9	**Syllabus** **Unit I - Suggested Areas of Participation in the activities:** • **Cultural Events:** Drama, dance, music, literary events, debates, etc. • **Social Outreach:** Blood donation, awareness campaigns, cleanliness drives. • **Clubs & Societies:** Photography, quiz, environment club, shram club, etc. • **Sports & Fitness:** College tournaments, yoga, marathons, fitness challenges. • **Institutional Events:** Foundation Day, Annual Day, College Festivals, Intercollegiate events. • **National Festivals:** Independence Day, Republic Day etc. **Unit II - Program Specific Topics** • **Workshops/Seminars:** Report Writing, Personality Development, Soft Skills, Leadership Talks. • **Speak, Show, Shine:** Presentation / Poster Presentation / Viva and Learning Experience **Mode of Evaluation:** • **Faculty Coordinator:** To guide and evaluate student progress. • **Participation Proof:** Certificates, photos, attendance records. • **Reflective Journal:** Minimum 2–3 pages summarizing experiences, learning, and growth. • **Final Viva/Presentation:** 5-minute talk on poster presentation and on overall learning.
10	**Scheme of Examination and Assessment Pattern** **Based on 3 approved Activities** **Semester End External - 30 marks**

Activity No	Nature of Activities	Marks
1.	Title of Approved Activity - 1	10
2.	Title of Approved Activity - 2	10
3.	Title of Approved Activity - 3	10
	Total	**30**

Internal Examination: Continuous Evaluation – 20 marks

	Assessment / Evaluation	Marks
1.	Reflective journal	10
2.	Presentation/ poster presentation/viva	10
	Total	**20**

Suggested Readings:

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

Dr. Manju Lalwani Pathak

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Affiliated to the University of Mumbai

Bachelors of Science

(Chemistry)

(Aided)

Semester – II

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Chemistry)

Semester- II

Title: **Basics in Physical, Inorganic and Organic Chemistry -II**

Vertical – 1
(MAJOR)

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Title: Basics in Physical, Inorganic and Organic Chemistry-II
[Course Code: CHMCHII1]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course provides a comprehensive foundation in Physical, Inorganic, and Organic Chemistry. It covers essential physical chemistry concepts such as surface tension, gas laws, electrochemistry, and thermodynamics, with a strong focus on numerical problem-solving and conceptual understanding. Inorganic chemistry topics include qualitative analysis using reagent papers, precipitation equilibria, and bonding theories like Fajan's Rule and VSEPR. The organic chemistry section introduces reaction mechanisms, types and stability of reactive intermediates, and the role of hybridization and orbital overlap in molecular structure. Through an integrated approach, the course enables students to understand chemical principles, analyze reactions, predict molecular behavior, and apply theoretical knowledge to practical scenarios.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** Explain the principles of surface tension, gaseous state behavior, electrochemistry, and thermodynamics, and solve related numerical problems. **CO(A)2:** Apply thermodynamic laws, gas equations, and conductance concepts to analyze physicochemical processes and perform quantitative calculations. **CO(A)3:** Analyze qualitative analysis procedures, and factors affecting chemical bonding and molecular geometry. **CO(A)4:** Interpret the nature of reactive intermediates, reaction mechanisms, and stereochemical features of organic compounds. **CO(A)5:** Evaluate the stability, reactivity, and mechanisms of aromatic electrophilic substitution reactions and predict reaction outcomes.	
8	**Course Outcomes**: Upon completion of the course, student will be able to **CO1:** Describe the concepts of surface tension, kinetic theory of gases, real and ideal gases, and electrochemical conductance. **CO2:** Calculate thermodynamic parameters, conductance values, surface tension, and gas properties using appropriate equations.	

	CO3: Differentiate between ionic and covalent bonding, explain molecular shapes using VSEPR theory. **CO4:** Classify reactive intermediates such as carbocations, carbanions, and free radicals based on their structure and stability, and explain organic reaction mechanisms. **CO5:** Examine cycloalkane conformations and elucidate the mechanism of aromatic electrophilic substitution reactions, including nitration of benzene.
9	**Syllabus** **UNIT I: Physical Chemistry (10 Hours)** • **Surface tension:** Introduction, methods of determination of surface tension by Drop number method (Numericals expected) • **Gaseous State:** Kinetic theory of gases, Maxwell-Boltzmann's distribution of velocities (Qualitative discussion), Ideal gas laws, Deviation from ideal gas laws, Ideal and real gases, Reasons for deviation from ideal gas laws, Compressibility factor, Boyle's temperature, van der Waals equation of state (Derivation). (Numericals expected) • **Electrochemistry:** Conductance, specific conductance, equivalent conductance, molar conductance, Variation of molar conductance with concentration of strong and weak electrolyte. (Numericals expected) • **Chemical Thermodynamics:** • Thermodynamic Terms: System, surrounding, boundaries, types of system, Intensive and Extensive properties, Thermodynamic processes. • First law of thermodynamics: Concept of heat (q), work (w), internal energy (U), enthalpy, heat capacity, relation between heat capacities, sign conventions, calculations of heat, work, internal energy and enthalpy (H) (Numerical problems expected) **UNIT II: Inorganic Chemistry (10 Hours)** • **Concept of Qualitative Analysis:** Testing of Gaseous Evolutes, Role of Papers impregnated with Reagents in qualitative analysis (with reference to papers impregnated with starch iodide, potassium dichromate, lead acetate, dimethylglyoxime and oxine reagents). Formation of precipitates like AgCl, AgBr, AgI and $BaSO_4$ effect of common ions, uncommon ions, oxidation states, buffer action. • **Chemical Bond and Reactivity:** Types of chemical bond, comparison between ionic and covalent bonds, polarizability (Fajan's Rule), shapes of molecules, Lewis dot structure, Sidgwick Powell Theory, basic VSEPR theory for AB_n type molecules with and without lone pair of electrons, applications and limitations of VSEPR theory. **UNIT III: Organic Chemistry (10 Hours)** • **Fundamentals of Organic Reaction Mechanism:** **Basic terms and concepts**: Homolytic and Heterolytic fission with curly arrows with suitable examples. Electrophiles and Nucleophiles. **Types (primary, secondary, tertiary, allyl, benzyl), shape and their relative stability of the following reactive intermediates**: i. Carbocations ii. Carbanions and iii. Free radicals • **Stereochemistry of cycloalkanes:** **Strains:** Angle, pitzer, steric and transannular strain with examples. **Conformations of cyclohexane:** Chair, Boat, Twist boat and Half chair conformations of

cyclohexane and their relative stability

- **Aromatic electrophilic substitution reaction:**
  General mechanism with generation of electrophile, attack of electrophile, resonance, stability. Nitration of Benzene in detail.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Theory Examination: Semester End Total Marks - 30 Time- 1.0 hour

Format of Question Paper

Question No	Nature of Questions	Marks
Q1	A)Objective questions 4 out of 6	4
	B)Subjective questions2 out of 3	6
Q2	A)Objective questions 4 out of 6	4
	B)Subjectivequestions2 out of 3	6
Q3	A)Objective questions 4 out of 6	4
	B)Subjectivequestions2 out of 3	6
	Total 30	

Note:

1. Each questions will carry 10 marks.
2. All questions shall be compulsory with internal choice within the questions.
3. Use of simple calculator is allowed in the examination.

B. Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Viva/ Real time Assignments/ Objective Question Tests	10
2.	Active participation	10
	Total 20	

11

REFERENCES:

1. Concise Graduate Chemistry – I, II, III & IV, University Text Book of Chemistry, University of Mumbai.
2. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014).
3. Advanced Inorganic Chemistry, 17th Edition, by Satyaprakash, G.D.Tuli and R. D. Madan, 2022.
4. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
5. Organic Chemistry: A problem solving approach by Lakshmi Ravishankar and Gomathi Shridhar, Narosa Publisher, 2023.
6. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.

Title: Practicum in Chemistry -II
[Course Code: CHMCHII2]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of chemistry and their Practicum applications in in the field of chemistry. It begins with developing and understanding of major concepts in all disciplines of chemistry. The course enhances knowledge of basic analytical tools. The course helps to solve the problem and also think methodically, independently and draw a logical conclusion. Students can employ critical thinking and the scientific knowledge to design, carryout, record and analyze the results of chemical reactions. The course can help to create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** The course objectives focus on building a strong foundation for advanced studies and Practicum applications in chemistry. **CO(A)2:** To enable students to develop critical thinking, efficient experimental skills in all chemistry disciplines, scientific temper and research-based skills. **CO(A)3:** To provide knowledge of basic branches of chemistry and leverage it to develop interest in contemporary chemistry aspects	

8	**Course Outcomes**: Upon completion of the course, student will be able to **CO1:** Understand the concept of neutralization by conductometric titration. **CO2:** Explain concept of buffer action. **CO3:** Perform quantitative commercial analysis of compounds by volumetric titration method. **CO4:** Describe concept of qualitative analysis using semi micro technique. **CO5:** Identify various organic compounds by using qualitative techniques.
9	**Syllabus** **Physical Chemistry** • To determine the amount of strong acid in the given solution by titrating against strong base conductometrically. • To determine the dissociation constant of weak acid (Ka) using Henderson's equation and the method of incomplete titration pH metrically. • To determine enthalpy of dissolution of salt (KNO_3) • To standardize commercial sample of HCl using borax and to write material safety data of the chemicals involved. **Inorganic Chemistry** **Qualitative analysis of simple salts: (4 mixtures to be analyzed)** Semi-micro inorganic qualitative analysis of a sample containing two cations and two anions (from amongst): *Cations (from amongst):* Pb^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Mg^{2+}, K^+, $NH4^+$ *Anions (from amongst):* CO_3^{2-}, SO^{2-}, NO_2^-, NO_3^-, Cl^-, Br^-, I^-, SO_4^{2-}, PO_4 (Scheme of analysis should avoid use of sulphide ion in any form for precipitation/ separation of cations.) Below are the representative mixture combinations, besides these any other combination will also be taken. **Probable mixture combination**: 1) $MgSO_4$ + KCl 2) $CaCl_2$ + KNO_3 3) $CaCO_3$ + $Mg(NO_3)_2$ 4) $BaSO_4$ + NH_4Cl **Organic Chemistry** • Characterization of organic compounds containing C, H, (O), N, S, X elements (6 solid/liquid Organic compounds) (Preliminary Tests, Solubility/Miscibility Test, Detection of Elements, Detection of Functional group and determination of Physical constant)

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. **External Examination: Semester End - 30 Marks Time: 2 hours**

Exam Pattern	Maximum Marks
One Experiment (25 marks for Experiment and 5 Marks for Journal)	30
Total	**30**

B. **Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Viva/ Real time Assignments/ Objective Question Tests	15
2.	Active participation	05
	Total 20	

11

REFERENCES:

Physical Chemistry

1. Concise Graduate Chemistry – I, II, III & IV, University Text Book of Chemistry, University of Mumbai.
2. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014).
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
4. Keith J. Laidler & John H. Meiser, Physical Chemistry, 2nd Ed. (2004)
5. Puri B. R., Sharma L. R. & Pathania M. S. Principles of Physical Chemistry, Vishal Publishing Company, 2008
6. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
7. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
8. Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
9. McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
10. Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).
11. Laboratory Experiments in Chemistry I & II, University Practical Book of Chemistry, University of Mumbai.
12. Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).
13. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
14. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
15. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

Inorganic Chemistry

1. Concise Graduate Chemistry – I, II, III & IV, University Text Book of Chemistry, University of Mumbai.

2. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
3. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry, Oxford, 1970
4. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
5. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India.
6. Laboratory Experiments in Chemistry I & II, University Practical Book of Chemistry, University of Mumbai.
7. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
8. Advanced Inorganic Chemistry, 17th Edition, by Satyaprakash, G.D.Tuli and R. D. Madan, 2022.

Organic Chemistry

1. Concise Graduate Chemistry – I, II, III & IV, University Text Book of Chemistry, University of Mumbai.
2. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education), 2012.
3. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
4. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
5. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
6. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
7. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
8. Paula Y Bruice, Organic Chemistry, 7th Ed, Pearson education, Asia.2014.
9. Graham Solomon, Fryhle, Dnyder, Organic Chemistry, Wiley publication. 12 th Ed, 2016.
10. Bahl and Bahl, Advanced Organic chemistry by S. Chand publication, 2010.
11. Peter Sykes. Guidebook to the mechanism in Organic chemistry, 6th edition.
12. D. Nasipuri. Stereochemistry of Organic Compounds, Principles and Applications, Second Edition.
13. Organic Chemistry: A problem solving approach by Lakshmi Ravishankar and Gomathi Shridhar, Narosa Publisher, 2023.
14. Laboratory Experiments in Chemistry I & II, University Practical Book of Chemistry, University of Mumbai.
15. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
16. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).
17. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Chemistry)

Semester- II

NOT APPLICABLE

Vertical – 2
(MINOR)

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Chemistry)

Semester- II

OPEN ELECTIVE

Vertical – 3

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Faculty of Interdisciplinary

Vertical 3: List of Open Elective Skill Based Courses for First Year: Semester – II

Sr. No.	Nomenclature of the Paper
1	Cyber and Digital Safety
2	Audio -Video Editing Foundation for Graphics Design and Basics of Animation II
3	Basic Tools of AI for Economics and Education - II
4	English for Professional and Corporate World
5	Urbanisation and Real Estate
6	Business of Travel and Tours-II
7	Managing Family Wealth through Family Office
8	Interactive Web Design using Java Script
9	Basics of Nutrition II
10	Reels Production and Creator Branding
11	Performing Art
12	Data Analysis with Advanced Excel
13	Advanced Political Communication and Media Skills
14	Stress Management
15	Social Media and Society Identity, Power and Digital Citizenship
16	Mushroom Cultivation Training and Trading Level
17	Yoga and Fitness II
18	Basic Perfumery Course (Level-II)
19	Soft Skills II-Personal and Interpersonal Effectiveness
20	Beautician - Strategic Business Planning-II
21	Current Trends of Fashion Designing- Financial Perspective Level-II
22	Basic Accounting-II
23	Digital Marketing II
24	Online Trading and Stock Market-II
25	Event Management Course in Sindhi

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar (Autonomous)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Chemistry)

Semester- II

Title:

VSC- Commercial Analysis of Food Samples

Vertical - 4

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Title: Commercial Analysis of Food Samples
[Course Code: CHMCHII4]

Sr.No.	Heading	Particulars
1	**Description the course:**	The aim of Vocational Skill Courses (VSC) designed to provide experiential learning for students, which help to develop their technical skill through hands-on training and also developing abilities of critical thinking, Analytical skill, collaboration, teamwork, problem-solving and communication which mold their careers.
2	**Vertical:**	4
3	**Type:**	Practicum
4	**Credits:**	2 Credit
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** **CO(A)1**: To develop fundamental knowledge and practical skills in food analysis techniques for evaluating the nutritional composition, quality, and safety of food samples. **CO(A)2:** To perform qualitative and quantitative estimation of important nutrients and food constituents such as pH, Vitamin C, proteins, carbohydrates, calcium, iron, starch, and artificial colors using standard laboratory methods. **CO(A)3:** To interpret analytical results accurately and understand their significance in food quality control, contamination detection, and nutritional assessment.	
8	**Course Outcomes:** After Completion of the course, the Learner will be able to: **CO1:** Apply standard laboratory techniques for qualitative and quantitative analysis of nutrients and food constituents in different food samples. **CO2**: Determine and interpret physicochemical properties of foods, including pH, vitamin, mineral, protein, and carbohydrate content using appropriate analytical methods. **CO3**: Identify food adulterants and contaminants such as starch and artificial colors through suitable detection tests.	
9	**Practicum Syllabus** • To understand Importance of Food Analysis and Nutrients. • Measure the pH of given food sample (acidic/basic) using pH meter. • Estimation of Vitamin C (Ascorbic Acid) in lemon squash sample by using 2,4 Dichlorophenol indicator • Qualitative analysis of macronutrients (two samples each) proteins (Biuret test) Carbohydrates (Benedict's Test) • Estimation of Calcium in milk powder by complexometric titration • Detection of starch as contamination in the given milk sample	

- Detection of artificial colors in the given samples of turmeric powder.
- Estimation of Iron in the given food sample by colorimetry using KSCN

10 **Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. **External Examination: Semester End - 30 Marks Time: 2 hours**

Nature	Marks
One Experiment (25 marks for Experiment and 5 Marks for Journal = 30 Marks)	30

B. **Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Quizzes, Class Tests, Presentations, Projects, Role Plays, Creative Writing, Assignments etc.	15
2.	Active participation	05
		Total 20

11 **REFERENCES:**

1. Instrumental Analysis by Douglas A.Skoog,F.J ames Holler, StanleyR.Crouch (2006)
2. Fundamental of Analytical Chemistry by Douglas A.Skoog, West,F .JamesHollers'. Crouch (2009)
3. Modern Analytical Chemistry by David Harvey,McGraw-Hill HigherEducation (1999)
4. S.M.Khopkar,"BasicConceptsof Analytical Chemistry",IIndEditionNewAgeInternational Publisher (2004)
5. Principles of Instrumental Analysis,D.A.Skoog,F.JamesHoller,StanleyR.Crouch (2007)
6. Vogel'sTextbookofQuantitativeChemicalAnalysis,5th edition (1989)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Chemistry)

Semester- II

Title:
SEC- Data Analysis in Chemistry

Vertical - 4

(as per NEP 2020 with effect from the Academic Year 2025-2026)

Title: Data Analysis in Chemistry

[Course Code: CHMCHII5]

Sr. No.	Heading	Particulars
1	**Description the Course**	The aim of Skill Enhancemen tCourses (SECs) is to introduce the students with opportunities to develop Required skills in Chemistry
2	**Vertical**	4
3	**Type**	Practicum
4	**Credits**	2 Credits
5	**Hours Allotted**	60 Hours
6	**Marks Allotted**	50 Marks

7	**Course Objectives** **CO(A)1:** To develop understanding of SI units, measurement techniques, and accuracy in chemical experiments and data recording. **CO(A)2**: To apply statistical tools such as significant figures, rounding off, Q-test, confidence limits, and confidence intervals in the analysis of experimental chemical data. **CO(A)3:** To perform volumetric and gravimetric analyses using standard analytical methods including redox titration, acid-base titration, and gravimetric estimation. **CO(A)4:** To enhance practical skills in measurement of physicochemical parameters such as density and pH, and to interpret analytical results with precision and reliability.
8	**Course Outcomes:** After Completion of the course, the Learner will be able to **CO1:** Apply SI units, measurement principles, and laboratory techniques accurately in chemical experiments. **CO2:** Analyze experimental data statistically using significant figures, rounding off rules, Q-test, confidence limits, and confidence intervals. **CO3:** Determine physicochemical properties such as density and pH of samples and interpret the results scientifically. **CO4:** Demonstrate accuracy, precision, and good laboratory practices while recording, analyzing, and presenting experimental data
9	**Practicum Syllabus** • To measure physical quantities using SI units and understand their applications in chemistry. • To determine density of liquid and analyze data statistically. • Application of 2.5d rule for a Redox Titration of Ferrous sulphate against K2Cr2O7. • Application of 4.0d rule for standardization of NaOH by using succinic acid as primary standard. • Application of Q-Test for the provided data in the gravimetric estimation Ni+2 as Ni-DMG. • Determination of confidence limit and confidence interval from the given secondary data.

- Determination of significant figures from the given data of any experiments of Chemistry.
- To measure pH of different solutions and analyze recorded data using rounding off and significant figures

10 **Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. **External Examination: Semester End - 30 Marks Time: 2 hours**

Nature	Marks
One Experiment (25 marks for Experiment and 5 Marks for Journal = 30 Marks)	30

B. **Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Quizzes, Class Tests, Presentations, Projects, Role Plays, Creative Writing, Assignments etc.	15
2.	Active participation	05
		Total 20

11 **REFERENCES:**

1. Analytical Chemistry by Cary D. Christian, John Wiley and sons
2. Basic concepts of Analytical Chemistry by S.M. Khopkar, New Age International Publishers
3. Vogel's Textbook of Quantitative Chemical Analysis by J.Menham, R.C.Denney, J.D. Barnes and M.J.K. Thomas, 6th Edn, Low Price Edition, Pearson Education Ltd, New Delhi (2000)

Board of Studies (Sem – II)

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	Outside membe
12	Dr.Smita Thosar	Representative from Industry Associate Director, Cipla	Outside Mem
13	Dr.Mukund Deshpande	Alumni Member	Outside Mem
14	Dr.Rajesh Samant	Subject Expert outside the parent University	Outside Mem

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

me & Signature of the Dean: Dr. Neena Anand

Date of BOS Meeting – 17 /6/2026

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B.Sc.

Semester- II

Vertical – 5

Ability Enhancement Course (English)

2 Credits

with effect from
Academic Year 2025-2026

Title: Advanced English for Workplace and Academic Communication
Course Code: CHMBSCAECII

Sr. No.	Heading	Particulars
1	**Description of the Course:**	In an increasingly competitive academic and professional landscape, learners require advanced communication skills that enable clarity, precision, critical thinking, and professionalism. This course focuses on practical, real-world communication abilities needed for college-level academic work, job applications, workplace collaboration, and digital interactions. Through hands-on tasks, real-world assignments, and communication practice, learners become adept in using English confidently and appropriately in diverse settings.
2	**Vertical 5**	**AEC: Advanced English for Workplace and Academic Communication**
3	**Type** Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: CO(A)1: To develop advanced communication skills required for academic and professional success. CO(A)2: To train learners in report writing, summary writing, and formal documentation. CO(A)3: To enhance proficiency in digital and virtual communication platforms. CO(A)4: To strengthen presentation, interview, and workplace communication skills. CO(A)5: To build confidence in expressing ideas clearly to varied audiences.	
8	**Course Outcomes**: After completing this course, learners will be able to: **CO-1:** Demonstrate clarity, precision, and professionalism in communication. **CO-2:** Interpret and summarize written texts, visuals, and data accurately. **CO-3:** Prepare well-structured reports, emails, and professional documents.	

CO-4: Use digital tools and virtual communication etiquette effectively.

CO-5: Communicate confidently in interviews, presentations, and teamwork situations

9

Syllabus

UNIT I: Communication for Academic & Professional Settings (15 Hours)

A. Communication in Academic & Workplace Contexts

1. Features of formal communication
2. Audience-centered communication
3. Ethics in communication: integrity, attribution, clarity
4. Explaining concepts in simple and clear language
5. Interpreting graphs, charts, tables, and infographics
6. Summarizing data concisely

B. Grammar & Style for Professional Writing

1. Tone: formal, neutral, objective
2. Avoiding redundancy and ambiguity
3. Active vs. passive structures
4. Editing, revising, and proofreading techniques

UNIT II: Practical Documentation & Employability Skills (15 Hours)

1. Report writing (academic/field-based/observational)
2. Project summary reports
3. Preparing short presentations
4. Creating informational posters or digital slides
5. Writing a formal complaint or request email
6. Creating a short informational or awareness write-up

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 1:00 hour

Format of Question Paper

All questions are compulsory:

Question No	Nature of Questions	Marks
Q. 1	**Short Notes** (Attempt any 3 out of 5) - **Unit 1** **OR** Attempt **Essay Type** question. (1 out of 2) - **Unit 1**	15
Q. 2	**Short Notes** (Attempt any 3 out of 5) - Unit 2 **OR**	15

	Attempt **Essay Type** question. (1 out of 2) - Unit 2	
	Total	**30**

Internal Examination: Continuous Evaluation - 20 marks

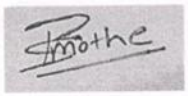
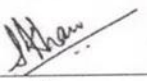
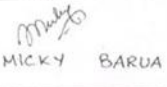
	Assessment / evaluation	**Marks**
1.	Assignments on **any one** of the following topics: Academic/Scientific Report/ Informational Poster / Digital Infographic (Students are required to use AI assistance in the preparation of their drafts. Eg: Notion AI, Otter.ai, Grammarly, Google Gemini, Canva, Piktochart, etc)	15
2.	Class Attendance and Participation	05
	Total	**20**

11

References:

1. Adler, Ronald B., et al. *Understanding Human Communication*. 15th ed., Oxford UP, 2021.
2. Bailey, Stephen. *Academic Writing: A Handbook for International Students*. 5th ed., Routledge, 2018.
3. Cargill, Margaret, and Patrick O'Connor. *Writing Scientific Research Articles*. Wiley-Blackwell, 2013.
4. Eastwood, John. *Oxford Guide to English Grammar*. Oxford UP, 2005.
5. Gerson, Sharon J., and Steven M. Gerson. *Technical Communication: Process and Product*. 9th ed., Pearson, 2021.
6. Hewings, Martin. *Advanced Grammar in Use*. Cambridge UP, 2013.
7. Kumar, Sanjay, and Pushp Lata. *Communication Skills*. 2nd ed., Oxford UP, 2018.
8. McCarthy, Michael, and Felicity O'Dell. *Academic Vocabulary in Use*. Cambridge UP, 2008.
9. Nordquist, Richard. *The Essentials of English Grammar*. McGraw-Hill Education, 2016.
10. Seely, John. *The Oxford Guide to Writing and Speaking*. Oxford UP, 2005.
11. Zinsser, William. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Perennial, 2016.

Syllabus Committee:

Sr. No	Name of the Faculty	Designation and College	Signature
1.	Prof. (Dr.) Kailas Aute	Professor & Head, Dept. of English, Smt. CHM College	
2.	Prof. (Dr.) B. R. Hiramani,	(VC Nominee, University of Mumbai) Pancham Khemraj College, Sawantwadi	
3.	Prof. (Dr.) Vikas Raskar	(Subject Expert outside University) Hutatma Rajguru Mahavidyalay, Rajguru Nagar, Khed, (Affiliated to Savitribai Phule University)	
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University	
5.	Mr. Ananda Pandhare	Asst. Professor, Dept. of English, Smt. CHM College	
6.	Ms. Sana Khan	Asst. Professor, Dept. of English, Smt. CHM College	
7.	Dr. Micky Barua	Faculty Vidyalankar Institute of technology, Alumni Member	
8.	Ms. Sofy Verghese	Accenture, Industry Representative	

Name & Signature of the Ad-hoc BoS Chairperson: Prof. (Dr). Kailas Aute

Name & Signature of the Dean: Prof. (Dr). Nitin Arekar

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar

(Autonomous)

Affiliated to the University of Mumbai

Bachelor of Commerce/ Arts/Science/ SFC (Sindhi)

(AEC – Ability Enhancement Course)

(Aided Course)

Semester – II

Choice Based and Credit Based syllabus as per NEP 2020 with effect from the Academic Year 2025-2026

PREAMBLE

The Bachelor of Commerce (B.Com.) in Sindhi is a comprehensive program designed to develop Sindhi language. Language is the soul of Literature. Sindhi is medium of Communication, Education and Cultural exchange. Curriculum is designed specially in digital age.

Language enriches literature. This curriculum is prepared according to Social, Cultural and Academic needs. The B.Com. Sindhi subject offers students a unique opportunity to explore and widened Sindhi Culture through a wide range of literary programs. The curriculum not only emphasizes literary appreciation and analysis but also fosters ethical awareness, intercultural sensitivity and social responsibility.

The program is committed to developing critical thinking, ethical reasoning and inclusive perspectives. It encourages students to reflect and engage with communication in Sindhi, expertise in Business and Employment Creative work, meditation and listening, use of visual tails, expertise of asking questions, knowledge of different languages through communication.

Language allows us to share our ideas, thoughts, feelings and emotions with others through communication. There is a special contribution of the ideal citizen in nation building. It plays crucial role in creating civilized society.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO-1 Students will understand the communication skills and role of language in communication.

PSO-2 Students will be able to talk effectively in Sindhi language with friends, relatives and Business customers.

PSO-3 Students will understand aspects of language.

PSO-4 Students will be able to understand the Importance of communication, and they will communicate in different ways i.e. verbal, non-verbal, written and Digital methods.

Smt

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year

Semester- II

Title: Communication Skills in Sindhi

Vertical - 5
Ability Enhancement Course
2 Credit

with effect from
Academic Year 2025-2026

Title: Communication Skills in Sindhi
COURSE CODE: CHMSINIIAEC

Sr. No.	Heading	Particulars
1	**Description the Course:**	Communication is the core component of commerce and trade. In communication, language plays very significant role. If a student has mastered the skills of language, undoubtedly, he or she would be able to communicate in the best manner. In this course basic part of Sindhi language would be taught based on the NEP 2020. Innovative approaches like critical thinking, creative mind, and use of technology will lead to communicating and participating with different groups. The vocabulary section would be given prominence. The course would be in the Devanagari script so that it can attract majority of the students. Even non-Sindhi students shall have opportunity to adopt this course.
2	**Vertical 1**	AEC – Ability Enhancement Course
3	**Type**	Theory + Practicum (Teaching Method: Lecture/ Discussion/Reading)
4	**Credit**	2 credits (1 credit = 15 hours for theory or 30 hours of Practical work in a semester)
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50Marks
7	**Course Objectives**: After successful completion of this course: **CO(A) 1:** The learner will get understanding of communication skills. **CO(A) 2:** The learner will understand how to accurate the pronunciation of special words in Sindhi **CO(A) 3:** The learner will improve the conversation skill in Sindhi. **CO(A) 4:** The learner will become best communicator in Sindhi language	
8	**Course Outcomes**: Student will be able to **CO1**: Know the basic special features of Sindhi language. **CO2**: Understand communication skills. **CO3**: Knowing the conversation with businessmen and customers **CO4**: Know the etiquettes with parents, relatives, friends and others in effective way	

9	**Syllabus** **Communication Skills in Sindhi** **UNIT I: Everyday & Professional Communication in Sindhi** ● Daily Life Conversation Skills: Greetings and introductions, asking for information, making requests/giving instructions, small talk in simple Sindhi ● Workplace & Business Communication: Customer interaction, Office enquiries, permissions, complaints, Bank/shop/travel conversation, Basic telephone conversation, Short Event Reports **UNIT II: Digital & Modern Communication in Sindhi** ● Email & Message Writing: Professional emails, WhatsApp/SMS etiquette, Announcements, reminders ● Product and Promotive Communication: Short ads, Taglines & slogans, Simple product description, Pitch Presentation, Interview / Communication for Market **********

Syllabus

Communication Skills in Sindhi

यूनिट १: रोज़मरह जी जिंदगी में गुफ्तगू (सिंधीअ में):

- वाकुफ़ियत डियण ऐ जाण हासुल करण, वेंती मोकिलण, अर्ज करण, हिदायतूं डियण, सौली सिंधीअ में गालाईण.
- कम करण वारी जगह ते राबतो ऐ कारोबारी राबतोः ग्राहकनि सा गुफ्तगू, ऑफिस में पूछताछ, परमीशन, शिकायत पत्र, बैंक जे करमचारियुनि सा गुफ्तगू, ग्राहकनि सा गालिहाइणि, बेसिक टेलीफोनिक संवादु, नंडे जशन जी रिपोर्ट.

यूनिट २: डिजिटल ऐ आधुनिक संवादु (सिंधी में):

- ईमेल ऐ मैसेज लिखण, पेशेवर ईमेल, वाट्सप ऐ समसे (Message) जा शिष्टाचार (Etiquettes), घोषणा याद डियारण वारो नोट (Reminders),
- उत्पाद ऐ प्रचार प्रसार संवादु, नंडो विज्ञापन (Small Ads), टैगलाइन ऐ स्लोगन सौलो उत्पाद वर्णन.
- पिच प्रिन्टेशन, इंटरव्यू, मार्केट रिसर्च जे लाइ संवादु.

****

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 1:00 hour

Format of Question Paper

Question No	Nature of Questions	Marks
Q1.A)	Objective Type Questions (Unit- I)	05
Q1. B)	Attempt ANY 2 out of 4- (5 marks each) (Unit-I)	10
Q2.A)	Objective Type Questions (Unit- II)	05
Q2. B)	Attempt ANY 2 out of 4- (5 marks each) (Unit-II)	10
	Total	**30**

Internal Examination: Continuous Evolution - 20 marks **Total 30**

	Assessment / evaluation	Marks
1.	**Written assignment on any one of the following topics** 1) Draft a formal letter and formal E_mail in Sindhi 2) Write a conversation between Customer and Shopkeeper, Nurse and patient. (Students are required to use AI assistance in the preparation of their drafts. Eg: Notion AI, Powtoon, Elicit)	15
2.	Class Attendance and Participation	05
	Total	**20**

11

REFERENCE BOOKS:

1. Sanchari Basha – By Dr. Pushpa Kodwani
2. Sindhi Pahakaa – Dr. Jetly M.K.
3. Sindhi Muhavahra – By Hardwani Lachhman
4. Sindhi Adhyat mak Shabdhkesh – By Hardwani Lachhman
5. Acho Sindhi Sikhu – By Hardwani Lachhman

Name & Signature of the BoS Chairperson: (Mrs. Kajal Ramchandani) _____

Name & Signature of the Dean: (Dr. Nitin Arekar) _____

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year

Semester- II

Title: Cocurricular Course I

Vertical - 6
Cocurricular Course - 2 Credits

with effect from
Academic Year 2025-2026

Title: Cocurricular Course - I

Course Code: CHMCCI6

Sr. No.	Heading	Particulars
1	**Description the Course:**	This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year. Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting. This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.
2	**Vertical 6**	Cocurricular Course (Mandatory)
3	**Type** **Teaching Methods**	Non Theory Participation, Report Writing, Presentation etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities. 2. To enhance personal and interpersonal skills through real-life experiences and teamwork. 3. To foster a sense of responsibility, leadership, and community engagement among students. 4. To develop self-confidence and emotional well-being through creative expression and collaboration. 5. To integrate classroom learning with experiential learning for holistic growth.	
8	**Learning Outcomes**: By the end of the course, students will be able to: **LO1:** Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences. **LO2:** Demonstrate improved communication, leadership, and teamwork skills. **LO3:** Exhibit increased awareness of social responsibility and civic engagement. **LO4:** Build confidence through creative, cultural, and intellectual expressions. **LO5:** Maintain a portfolio or activity log to track participation and personal development.	

9	**Syllabus** **Unit I - Suggested Areas of Participation in the activities:** • **Cultural Events:** Drama, dance, music, literary events, debates, etc. • **Social Outreach:** Blood donation, awareness campaigns, cleanliness drives. • **Clubs & Societies:** Photography, quiz, environment club, shram club, etc. • **Sports & Fitness:** College tournaments, yoga, marathons, fitness challenges. • **Institutional Events:** Foundation Day, Annual Day, College Festivals, Intercollegiate events. • **National Festivals:** Independence Day, Republic Day etc. **Unit II - Program Specific Topics** • **Workshops/Seminars:** Report Writing, Personality Development, Soft Skills, Leadership Talks. • **Speak, Show, Shine:** Presentation / Poster Presentation / Viva and Learning Experience **Mode of Evaluation:** • **Faculty Coordinator:** To guide and evaluate student progress. • **Participation Proof:** Certificates, photos, attendance records. • **Reflective Journal:** Minimum 2–3 pages summarizing experiences, learning, and growth. • **Final Viva/Presentation:** 5-minute talk on poster presentation and on overall learning.
10	**Scheme of Examination and Assessment Pattern** **Based on 3 approved Activities** **Semester End External - 30 marks**

Activity No	Nature of Activities	Marks
1.	Title of Approved Activity - 1	10
2.	Title of Approved Activity - 2	10
3.	Title of Approved Activity - 3	10
	Total	**30**

Internal Examination: Continuous Evaluation – 20 marks

	Assessment / Evaluation	Marks
1.	Reflective journal	10
2.	Presentation/ poster presentation/viva	10
	Total	**20**

Suggested Readings:

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

Dr. Manju Lalwani Pathak

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar

(Autonomous)

Affiliated to the University of Mumbai

Bachelors of Science

(Chemistry)

(Aided Course)

Semester – III

Choice Based and Credit Based syllabus as per NEP 2020 with effect from the Academic Year 2026-2027

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Chemistry)

Semester- III

Title: Progressive Physical and Analytical Chemistry Paper-I (Theory)

Progressive Inorganic and Organic Chemistry Paper-II (Theory)

Chemistry Practicum III

Vertical – 1
(MAJOR)

with effect from
Academic Year 2026-2027

Title: Progressive Physical & Analytical Chemistry Paper-I (Theory)
[Course Code: CHMCHIII1]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of chemistry and their practical applications in in the field of chemistry. It begins with developing and understanding of major concepts in all disciplines of chemistry. The course enhances knowledge of basic analytical tools. The course helps to solve the problem and also think methodically, independently and draw a logical conclusion. Students can employ critical thinking and the scientific knowledge to design, carryout, record and analyze the results of chemical reactions. The course can help to create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To understand the basic aspects of physical chemistry and some instrumental techniques **CO(A)2**: To Know the importance and relevance of classical techniques of separation **CO(A)3**: To learn applications of metalloids like silicon and Germanium **CO(A)4**: To understand the reaction mechanism pertaining to carboxylic acid and their derivatives.	
8	**Learning Outcomes**: Upon completion of the course, student will be able to **CO1** know the significance of electrochemistry and describe the principles underlying instrumental techniques **CO2** identify and apply appropriate separation techniques while doing analysis **CO3** represent graphically obtained date by applying precise formulae. **CO4** explain uses of silicon polymers and Germanium semiconducting properties. **CO5** understand different reactions involved in carboxylic acid derivative preparations	
9	**Syllabus** **Progressive Physical & Analytical Chemistry Paper – I**	

UNIT I: Physical Chemistry

Electrochemistry

- Electrolytes: Definition, Strong and Weak electrolytes and their conductance measurement, ions and electrical conductivity by ions.
- Kohlrausch law of independent migration of ions.
- Applications of conductance measurements: determination of degree of ionization and ionization constant of weak electrolyte, solubility and solubility product of sparingly soluble salts. (Numerical expected).
- Transference number and its experimental determination using Moving boundary method. (Numerical expected). Factors affecting transference number.

Chemical Kinetics-II

- Introduction to reaction mechanism (concept of elementary steps, intermediates, and the overall reaction mechanism with an example of Thermal chain reactions: H_2 and Br_2 reaction.
- Types of Complex Chemical reactions: Reversible or opposing, consecutive and parallel reactions (No derivations, only examples expected)

Basics of Polymer chemistry

- Basic Terms: Macromolecule, monomer, repeat unit, Polymerisation, (addition and condensation polymerization) Degree of Polymerisation
- Polymer structures linear, branched and cross-linked
- Molecular weight of Polymers: Definition and formulae of Number average molecular weight, weight average molecular weight Z- average molecular weight, and viscosity average molecular weight. (numerical expected)

UNIT II: Analytical Chemistry

Introduction to Analytical Chemistry

- Important terms and their significance in Analytical Chemistry.
- Types of chemical analysis and their importance
- Classification of analytical methods
- Introduction and definition of sampling
- Terms involved in sampling
- Types of sampling and Techniques used in sampling of solids.

Classical methods: Titrimetric Methods of Analysis

- Terms involved in Titrimetric analysis. i) Titrant ii) Titrand iii) Equivalence Point iv) Indicator v) End point vi) Titration Error
- Types of volumetric analysis with examples: i) Neutralisation (Acidimetry, alkalimetry) ii) Redox (Iodometry, Iodimetry) iii) Precipitation iv) Complexometric titrations
- Introduction to gravimetric analysis and its Types

\

Basic concepts in Instrumental methods

- Types and principle of analytical Instrumental methods (optical interaction, Electroanalytical interaction, Thermal Interaction)
- Theory of UV visible spectroscopy, important Terms Used in spectroscopy , Theory of Colorimetry, Beer Lamberts law, Block diagrams for single beam n double Beam colorimeter (Principle, construction And working, details of components Expected), Block diagrams for single beam n double Beam spectrophotometer (Principle, construction and working, details of components Expected)

10 **Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Theory Examination: Semester End Total Marks - 30 Time- 1.0 hour

Format of Question Paper

Question	Particulars	Marks
Q.1 Unit I	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
Q.2 Unit II	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Quizzes/Class Tests/presentation/ Project/real time assignment etc.	15
2.	Active participation	05
	Total 20	

11 **REFERENCES:**

Physical Chemistry

1) Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014).
2) Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
3) Keith J. Laidler & John H. Meiser, Physical Chemistry, 2nd Ed. (2004)
4) Puri B. R., Sharma L. R. & Pathania M. S. Principles of Physical Chemistry, Vishal Publishing Company, 2008
5) Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6) Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
7) Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
8) McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
9) Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).
10) Laboratory Experiments in Chemistry I & II, University Practical Book of Chemistry, University of Mumbai.
11) Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

Analytical Chemistry

1) Analytical Chemistry, Gary D. Christan, Purnendu Dasgupta, 7th Edition, Wiley.
2) Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Holler, S. R. Crouch, 10th edition.
3) Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R.Crouch, 7th edition.
4) Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, New academic sciences.
5) Modern Analytical Chemistry, David Harvey,2nd edition, 2009.

Inorganic Chemistry

1) B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013 -2014
2) W. W. Porterfield, Inorganic Chemistry-A Unified Approach, 2nd Ed., Academic Press, 1993.
3) B. W. Pfennig, Principles of Inorganic Chemistry, Wiley, 2015.
4) C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, 2nd Edition 2005.
5) J. Huheey, F. A. Keiter and R. I. Keiter, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Ed., Harper Collins, 1993.
6) R. L. Dekock and H.B.Gray, Chemical Structure and Bonding, The Benjamin Cummings Publishing Company 1989.
7) G. Miessler and D. Tarr, Inorganic Chemistry, 3rd Ed., Pearson Education, 2004.
8) R. Sarkar, General and Inorganic Chemistry, Books & Allied (P) Ltd., 2001.
9) C. M. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd., 1985.
10) G. A. Jeffrey, An Introduction to Hydrogen Bonding, Oxford University Press, Inc., 1997.
11) D. Banerjea ,Coordination Chemistry Tata McGraw Hill,1993.

Organic Chemistry

1) Organic Chemistry, Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers-Oxford University Press.
2) Stereochemistry of Organic Compounds, Ernest Eliel, Samual Wilen, A Wiley-Inter-science Publication.
3) Organic Chemistry, G. Marc Loudon (4th Edition) Oxford University Press
4) Stereochemistry of Organic Compounds, Principles and Applications, D. Nasipuri, 4th Edition, New Academic Science

Title: Progressive Inorganic & Organic Chemistry Paper – II (Theory)

[Course Code: CHMCHIII2]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of chemistry and their practical applications in in the field of chemistry. It begins with developing and understanding of major concepts in all disciplines of chemistry. The course enhances knowledge of basic analytical tools. The course helps to solve the problem and also think methodically, independently and draw a logical conclusion. Students can employ critical thinking and the scientific knowledge to design, carryout, record and analyze the results of chemical reactions. The course can help to create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:**To understand the basic aspects of physical chemistry and some instrumental techniques **CO(A)2:**To Know the importance and relevance of classical techniques of separation **CO(A)3:**To learn applications of metalloids like silicon and Germanium **CO(A)4:**To understand the reaction mechanism pertaining to carboxylic acid and their derivatives.	
8	**Learning Outcomes**: Upon completion of the course, student will be able to **CO1** know the significance of electrochemistry and describe the principles underlying instrumental techniques **CO2** identify and apply appropriate separation techniques while doing analysis **CO3** represent graphically obtained date by applying precise formulae. **CO4** explain uses of silicon polymers and Germanium semiconducting properties. **CO5** understand different reactions involved in carboxylic acid derivative preparations	

Syllabus

Progressive Inorganic and Organic Chemistry Paper II (Theory)

UNIT I: Inorganic Chemistry

Chemical Bonding

- **Non directional Bonding**
- Ionic Bond: Conditions for the Formation of Ionic Bond and properties,Types of Ionic Crystals,Radius Ratio Rules,Born-Haber Cycle and its Applications

- **Directional bonding**
- VBT, introduction and basic tenets,Concept of homo nuclear diatomic molecule from He_2 to Ne_2 ,Bonding in Polyatomic Species: The Role of Hybridization. And types of hybrid orbitals-sp, sp^2,sp^3, sp^3d, sp^3d^2, d^2sp^3. Sp^3d^3 with examples.

- **Molecular Orbital Theory**
- Comparing Atomic Orbitals and Molecular Orbitals, Linear combination of atomic orbitals to give molecular orbitals LCAO-MO approach for diatomic homonuclear molecules).
- Molecular orbital Theory and Bond Order and magnetic property: with reference to O_2, O_2^-,O_2^{2-} (Numerical problems and Schematic representation of bonding and antibonding molecular orbitals expected)

UNIT II: Organic Chemistry

Chemistry of Carbonyl Compounds

- **Recapitulation**
- Nomenclature of aliphatic, alicyclic and aromatic carbonyl compounds. Structure, reactivity of aldehydes and ketones and methods of preparation; Oxidation of primary and secondary alcohols using PCC, hydration of alkynes, Rosenmund reduction and Gattermann – Koch formylation.

- **Reactions of aldehydes and ketones**
- General mechanism of nucleophilic addition, and acid-catalyzed nucleophilic addition reactions, Reactions of aldehydes and ketones with NaHSO3, HCN, RMgX, alcohol, amine, phenylhydrazine, 2,4-Dinitrophenyl hydrazine, LiAlH4 and NaBH4.

- **Mechanisms of following reactions**
- a) Benzoin condensation, b) Knoevenagel condensation, c) Claisen- Schmidt and Cannizzaro reaction. d) Keto-enol tautomerism: Mechanism of acid and base catalyzed enolization.

- **Active methylene compounds**
- Introduction and reactivity of active methylene compound and enolate formation, Examples: ethyl acetoacetate, acetyl acetone, malonic ester. Some characteristic reactions of these compounds like salt formation, alkylation. Application of active methylene compounds in name reactions viz: 1) Michael addition 2) Knoevenagel condensation

10 **Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Theory Examination: Semester End Total Marks - 30 Time- 1.0 hour

Format of Question Paper

Question	Particulars	Marks
Q.1 Unit I	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
Q.2 Unit II	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Quizzes/Class Tests/presentation/ Project/real time assignment etc.	15
2.	Active participation	05
	Total 20	

11 **REFERENCES:**

Physical Chemistry

1) Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014).
2) Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
3) Keith J. Laidler & John H. Meiser, Physical Chemistry, 2nd Ed. (2004)
4) Puri B. R., Sharma L. R. & Pathania M. S. Principles of Physical Chemistry, Vishal Publishing Company, 2008
5) Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6) Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
7) Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
8) McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
9) Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).
10) Laboratory Experiments in Chemistry I & II, University Practical Book of Chemistry, University of Mumbai.
11) Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

Analytical Chemistry

1) Analytical Chemistry, Gary D. Christan, Purnendu Dasgupta, 7th Edition, Wiley.
2) Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Holler, S. R. Crouch, 10th edition.
3) Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R.Crouch, 7th edition.
4) Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, New academic sciences.
5) Modern Analytical Chemistry, David Harvey,2nd edition, 2009.

Inorganic Chemistry

1) B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013 -2014
2) W. W. Porterfield, Inorganic Chemistry-A Unified Approach, 2nd Ed., Academic Press, 1993.
3) B. W. Pfennig, Principles of Inorganic Chemistry, Wiley, 2015.
4) C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, 2nd Edition 2005.
5) J. Huheey, F. A. Keiter and R. I. Keiter, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Ed., Harper Collins, 1993.
6) R. L. Dekock and H.B.Gray, Chemical Structure and Bonding, The Benjamin Cummings Publishing Company 1989.
7) G. Miessler and D. Tarr, Inorganic Chemistry, 3rd Ed., Pearson Education, 2004.
8) R. Sarkar, General and Inorganic Chemistry, Books & Allied (P) Ltd., 2001.
9) C. M. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd., 1985.
10) G. A. Jeffrey, An Introduction to Hydrogen Bonding, Oxford University Press, Inc., 1997.
11) D. Banerjea, Coordination Chemistry Tata McGraw Hill,1993.

Organic Chemistry

1) Organic Chemistry, Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers- Oxford University Press.
2) Stereochemistry of Organic Compounds, Ernest Eliel, Samual Wilen, A Wiley-Inter-science Publication.
3) Organic Chemistry, G. Marc Loudon (4th Edition) Oxford University Press
4) Stereochemistry of Organic Compounds, Principles and Applications, D. Nasipuri, 4th Edition, New Academic Science

Title: Practicum in Chemistry - III
[Course Code: CHMCHIII3]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of chemistry and their practical applications in in the field of chemistry. It begins with developing and understanding of major concepts in all disciplines of chemistry. The course enhances knowledge of basic analytical tools. The course helps to solve the problem and also think methodically, independently and draw a logical conclusion. Students can employ critical thinking and the scientific knowledge to design, carryout, record and analyze the results of chemical reactions. The course can help to create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:**To introduce students to fundamental principles and techniques of physical chemistry through hands-on experiments, including conductometric, potentiometric, and temperature-based methods. **CO(A)2:**To develop students' ability to analyze, interpret, and quantify experimental data to understand chemical equilibria, reaction kinetics, and thermodynamic properties. **CO(A)3:**To provide students with hands-on experience in the use, care, and maintenance of analytical instruments and glassware essential for qualitative and quantitative analysis. **CO(A)4:**To develop students' competence in gravimetric and instrumental techniques for the estimation of chemical substances and evaluation of solution properties like buffer capacity **CO(A)5:**To equip students with the skills to identify and separate cations in inorganic mixtures through systematic qualitative analysis. **CO(A)6:**To introduce students to quantitative and preparative techniques in inorganic chemistry, including complexometric titrations and synthesis of coordination and inorganic compounds. **CO(A)7:**To familiarize students with fundamental organic synthesis techniques, including functional group transformations, substitution reactions, and recrystallization methods. **CO(A)8:**To develop student's ability to carry out and monitor organic reactions, isolate and purify products, and confirm their identity using physical properties and chemical behavior.	

8	**Learning Outcomes**: Upon completion of the course, student will be able to **CO1** verify theoretical chemical principles such as Ostwald's dilution law and chemical kinetics through practical measurements and data analysis. **CO2** use conductometric and potentiometric techniques to determine unknown concentrations and understand molecular interactions, such as those in weak acid dissociation and CST phenomena. **CO3** identify, operate, and maintain various analytical tools and instruments, and explain their principles and applications in chemical analysis. **CO4** demonstrate the ability to carry out gravimetric estimations, buffer capacity determinations, and pharmaceutical compound analysis with accuracy and understanding of underlying chemical reactions and techniques. **CO5** identify and analytically separate metal cations in a mixture using classical qualitative analysis techniques. **CO6** perform complexometric titrations and synthesizing coordination and inorganic compounds with proper stoichiometric control and laboratory techniques. **CO7** perform organic preparations such as oxime and osazone formation, bromination, and nitration with a clear understanding of reaction mechanisms and reagent functions. **CO8** execute organic synthesis safely & efficiently and of purifying and characterizing the products through melting point determination and recrystallization.
9	**Syllabus** **Physical chemistry** • To verify Ostwald's dilution law for weak acid conductometrically. • To determine the critical solution temperature (CST) of Phenol - Water System. • Determination of energy of activation of acid-catalyzed hydrolysis of methyl acetate. • To determine the amount of HCl in the given sample potentiometrically. **Analytical Chemistry** • Tools of Analytical Chemistry: Analytical glass wares (Burettes, pipettes, Standard flasks, Separating funnels), Weighing tools (two pan balance and mono pan balance, digital balances), Incineration devices (Burners, Electrical Incinerators, Muffle Furnace), Drying Devices (Hot Air Oven, microwave oven, Desiccators, Vacuum desiccators), Monochromators, Filters, Sample holders, Prisms, Diffraction Gratings, Photo emissive cells, Photomultiplier tubes. • Gravimetric estimation of Ni (II) as Ni-DMG. • Determination of buffer capacity of acid buffer and basic buffer. • Estimation of Aspirin. **Inorganic Chemistry** • Identification of cations in a given mixture and analytically separating them from a mixture containing not more than two of the following: Pb(II), Ba(II), Ca(II), Sr (II), Cu(II), Cd(II), Mg(II), Zn(II), Fe(II), Fe(III), Ni(II), Co(II) Al(III), Cr(III)] • Estimation of Zn^{2+} ion by titrating with EDTA (complexometric titration). • Preparation of Tris (ethylenediamine) nickel (II) thiosulphate. • Complexometric estimation of Calcium and Magnesium in Dolomite ore.

Organic Chemistry

- **Small scale organic preparation and purification:** Use 0.5-1.0g/1.0-1.5 cm^3 of the organic compound. Purify the product by recrystallization. Report theoretical yield, percentage yield and melting point of the purified product.

Preparation of:

- Cyclohexanone oxime from cyclohexanone
- Glucosazone from dextrose or fructose
- Tribromoaniline from aniline
- p-Bromoacetanilide from acetanilide
- m-Dinitrobenzene from nitrobenzene

10 **Scheme of Practicum Examination and Assessment Pattern**

Total – 50 Marks

A. External Examination: Semester End Total Marks - 30 Time- 3.0 hour

Format of Question Paper

	Particulars	**Marks**
1	Experiment	25
2	Journal	5
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Particulars	**Marks**
1	Scheme development/numerical solving skills/Practical skills / collation of data	15
2	Active participation	5
	Total	**20**

11 **REFERENCES:**

A. Physical Chemistry:

1) Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2) Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3) Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4) Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)

	B. Inorganic Chemistry: 1) Practical Inorganic Chemistry by G. Marr and B. W. Rockett van Nostrand Reinhold Company (1972) **C. Organic Chemistry:** 1) Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009) 2) Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009) 3) Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012) 4) Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996 **D. Analytical Chemistry:** 1) D. A. Skoog, D. M. West, F. J .Holler, and S.R. Crouch, Analytical Chemistry: An Introduction, 7th ed., Chapter 15, pp. 345-381. 2) A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961). 3) R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y.(1974). 4) Some Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B. BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi.

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

Second Year B. Sc. (Chemistry)

Semester- III

Title: General Principles of Chemistry

Vertical - 2
(MINOR)

with effect from
Academic Year 2025-2026

Title: General Principles of Chemistry
[Course Code: CHMCHIII4]

Sr. No.	Heading	Particulars
1	**Description of the Course**	The course aims to acquaint the students to the fundamental concepts of Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Analytical Chemistry and their applications.
2	**Vertical**	2
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:**To understand basic aspects of physical chemistry and some instrumental techniques **CO(A)2:**To Know the importance and relevance of classical techniques of separation **CO(A)3:**To learn applications of metalloids like silicon and Germanium **CO(A)4:**To understand reaction mechanism pertaining to carboxylic acid and their derivatives.	
8	**Learning Outcomes**: On completing the course, the student will be able to **CO1** know the significance of electrochemistry and describe the principles underlying instrumental techniques **CO2** identify and apply appropriate separation techniques while doing analysis **CO3** represent graphically obtained data by applying precise formulae. **CO4** explain uses of silicon polymers and Germanium semiconducting properties. **CO5** understand different reactions involved in carboxylic acid derivative preparations	

9	**Syllabus** **General Principles of Chemistry I** **UNIT I: Physical Chemistry and Analytical Chemistry** **Concepts of Electrochemistry** • Galvanic cell or voltaic cell, reversible and irreversible cell • Types of reversible electrodes (Metal-metal ion electrode, Metal-insoluble salt electrode, Redox electrodes, Gas electrode, Glass electrode, Reference electrodes (SHE, SCE) • Electrochemical conventions, Nernst equation for the emf of the cell, Nernst equation for electrode potential **Principles and applications of Conductometry and pH metry** • Conductance, Titration curves for titration of strong acid vs strong base, Titration of weak acid vs strong base • Concept of pH, End point equivalence point, Titration curve in strong acid base titration **Classical separation techniques in analytical chemistry** • Importance of analytical separation method • Basic principles of classical separation techniques (Precipitation, Filtration, Crystallization, Centrifugation, Distillation, Electrophoresis, chromatography, solvent extraction, ion exchange) • Various terms in solvent extraction: Nernst's distribution law, Distribution ratio, Partition co-efficient, separation factors. (Numerical problems expected wherever possible) **UNIT II: Inorganic and Organic Chemistry** **Chemistry of Silicon and Germanium** • Occurrence, Important properties and uses of silicon compounds • Types, preparation, properties of synthetic silicon polymer silicones • Occurrence, extraction and purification of Germanium (schematic process of extraction expected) • Semi conducting properties of silicon and Germanium • Applications of Silicon & Germanium **Carboxylic acids and their derivatives** • Nomenclature, structure and physical properties, acidity of carboxylic acids, effects of substituents on acid strength of aliphatic and aromatic carboxylic acids. • Preparation of carboxylic acids: oxidation of alcohols and alkylbenzene, carbonation of Grignard and hydrolysis of nitriles. • Reactions: Acidity, salt formation, decarboxylation, Reduction of carboxylic acids with LiAlH4, Conversion of carboxylic acid to acid chlorides, esters, amides reactivity.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Theory Examination: Semester End Total Marks - 30 Time- 1.0 hour

Format of Question Paper

Question	Particulars	Marks
Q.1 Unit I	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
Q.2 Unit II	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Quizzes/Class Tests/presentation/ Project/real time assignment etc.	15
2.	Active participation	05
	Total 20	

11

REFERENCES:

Physical Chemistry

1) Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014).
2) Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
3) Keith J. Laidler & John H. Meiser, Physical Chemistry, 2nd Ed. (2004)
4) Puri B. R., Sharma L. R. & Pathania M. S. Principles of Physical Chemistry, Vishal Publishing Company, 2008
5) Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6) Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
7) Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
8) McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
9) Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).
10) Laboratory Experiments in Chemistry I & II, University Practical Book of Chemistry, University of Mumbai.
11) Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

Analytical Chemistry

1) Analytical Chemistry, Gary D. Christan, Purnendu Dasgupta, 7th Edition, Wiley.
2) Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Holler, S. R. Crouch, 10th edition.
3) Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R.Crouch, 7th edition.

4) Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, New academic sciences.
5) Modern Analytical Chemistry, David Harvey,2nd edition, 2009.

Inorganic Chemistry

1) R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013 -2014
2) W. W. Porterfield, Inorganic Chemistry-A Unified Approach, 2nd Ed., Academic Press, 1993.
3) B. W. Pfennig, Principles of Inorganic Chemistry, Wiley, 2015.
4) C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, 2nd Edition 2005.
5) J. Huheey, F. A. Keiter and R. I. Keiter, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Ed., Harper Collins, 1993.
6) R. L. Dekock and H.B.Gray, Chemical Structure and Bonding, The Benjamin Cummings Publishing Company 1989.
7) G. Miessler and D. Tarr, Inorganic Chemistry, 3rd Ed., Pearson Education, 2004.
8) R. Sarkar, General and Inorganic Chemistry, Books & Allied (P) Ltd., 2001.
9) C. M. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd., 1985.
10) G. A. Jeffrey, An Introduction to Hydrogen Bonding, Oxford University Press, Inc., 1997.
11) D. Banerjea ,Coordination Chemistry Tata McGraw Hill,1993.

Organic Chemistry

1) Organic Chemistry, Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers- Oxford University Press.
2) Stereochemistry of Organic Compounds, Ernest Eliel, Samual Wilen, A Wiley-Inter-science Publication.
3) Organic Chemistry, G. Marc Loudon (4th Edition) Oxford University Press
4) Stereochemistry of Organic Compounds, Principles and Applications, D. Nasipuri, 4th Edition, New Academic Science

Title: Practicals in General Principles of Chemistry
[Course Code: CHMCHIII5]

Sr. No.	Heading	Particulars
1	**Description of the Course**	The course aims to acquaint the students to the fundamental concepts of Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Analytical Chemistry and their applications.
2	**Vertical**	2
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:**To develop an understanding of the principles and applications of conductometric and potentiometric techniques in analyzing chemical systems. **CO(A)2:**To train students in experimental methods for determining dissociation constants, solubility of salts, and electrochemical properties such as EMF and Gibbs free energy. **CO(A)3:**To introduce students to quantitative analytical techniques for the estimation of essential compounds and water quality parameters using titrimetric and instrumental methods. **CO(A)4:**To develop practical skills in microscale inorganic synthesis with an emphasis on precision, yield, and environmental safety. **CO(A)5:**To train students in the systematic qualitative analysis of bi-functional organic compounds through preliminary tests, solubility behavior, and detection of elements and functional groups. **CO(A)6:**To enable students to identify unknown organic compounds by determining their physical constants and correlating results with theoretical knowledge. **CO(A)7:**To develop the skills of using the counterpoise technique used in gravimetric estimation and to develop the ability to state the error estimate of their result. **CO(A)8:**To introduce the learners the use of colorimetric technique to understand the relation between concentration and absorbance.	

8	**Learning Outcomes**: Students will be able to **CO1**: use conductometric methods to determine the dissociation constant of weak acids and solubility of sparingly soluble salts accurately. **CO2**: demonstrate the ability to construct electrochemical cells, measure EMF potentiometrically, and calculate thermodynamic parameters like standard free energy change. **CO3**: perform estimate essential compounds and check water quality parameters using titrimetric and instrumental methods. **CO4**: develop practical skills in microscale inorganic synthesis with an emphasis on precision, yield, and environmental safety. **CO5**: systematically analyze bi-functional organic compounds using physical tests, solubility profiles, and elemental detection methods. **CO6**: accurately determine physical constants (melting point/boiling point) and identify functional groups, leading to successful identification of unknown organic compounds. **CO7**: learn the use of simple acid-base titration to find out strength of commercial samples **CO8**: operate colorimeter and understand relation between concentration and Absorbance, and to draw the calibration curve. They are also expected to state the error estimate of their results.
9	**Syllabus** **Physical chemistry** • To determine dissociation constant of weak acid conductometrically. • To determine solubility of sparingly soluble salts (any two) conductometrically. • To determine standard EMF and the standard free energy change of Daniel cell potentiometrically **Analytical Chemistry** • Colorimetric Determination of Copper ions in a given Solution by using calibration curve method and calculation of % error. • Gravimetric estimation of barium ions using K_2CrO_4 as precipitant. • To determine concentration of acetic acid in the commercial sample of vinegar. **Inorganic Chemistry** • Estimation of total hardness of water (Standardization of EDTA expected). • Estimation of Fe from Ferrous Ammonium Sulphate solution. • Inorganic preparation – Nickel dimethyl glyoxime using microscale method. • Determination of strength of solution of Oxalic acid and Potassium oxalate. **Organic Chemistry** Qualitative Analysis of bi-functional organic compounds on the basis of • Preliminary examination • Solubility profile • Detection of elements C, H, (O), N, S, X. • Detection of functional groups • Determination of physical constants (M.P./B.P.)

10

Scheme of Practicum Examination and Assessment Pattern

Total – 50 Marks

A. External Examination: Semester End Total Marks - 30 Time- 3.0 hours

	Particulars	**Marks**
1	Experiment	25
2	Journal	5
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Particulars	**Marks**
1	Scheme development/numerical solving skills/Practical skills / collation of data	15
2	Active participation	5
	Total	**20**

11

REFERENCES:

Physical Chemistry practicals:

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)

Inorganic Chemistry practicals:

1. Practical Inorganic Chemistry by G. Marr and B. W. Rockett van Nostrand Reinhold Company (1972)

Organic Chemistry practicals:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
4. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996

	Analytical Chemistry practicals: 1. D.A. Skoog, D.M. West, F.J. Holler, and S.R. Crouch, Analytical Chemistry: An Introduction,7th ed., Chapter 15, pp. 345-381. 2. A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961). 3. R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y.(1974). 4. Some Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B. BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Chemistry)

Semester- III

Vertical – 3
(OPEN ELECTIVE)

with effect from
Academic Year 2025-2026

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

(Affiliated to the University of Mumbai)

University College Code: 217 | JD Office: T14

Estd. Year 1965

Faculty of Interdisciplinary

Vertical 3: List of Open Elective Skill Based Courses for Second Year: Semester – III

Sr. No.	Nomenclature of the Paper
1	Data Analysis And Visualization Using Excel
2	2D Animation And Motion Graphics
3	Advance Tools Of AI For Economics And Education - I
4	English For Journalism And Advertising
5	Urbanization And Real Estate: Infrastructure, Technology And Urban Change
6	Tourism Marketing
7	Managing Family Wealth Through Family Office-III
8	Responsive &Amp; Modern Web Designing
9	Basics Of Nutrition -3
10	Reel Making For Media And Social Change
11	Preforming Art- Dance-3
12	Data Analysis With Excel And Power BI
13	Digital Political Strategy, AI And Public Engagement Skills
14	Psychology Of Personal Relationship-I
15	Introduction To Sociology And Digital Society
16	Mushroom Cultivation Training And Trading Level 3
17	Yogasanas: Intermediate Series
18	Perfumery Course Level 3
19	Workplace And Professional Skills
20	Beautician: Strategic Business Planning III
21	Current Trends In Fashion Designing: Financial Perspective Level 3
22	Basics Of Accounting-III
23	Digital Marketing -III
24	Advanced Trading Strategies In Stock Market

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar (Autonomous)

P.B. No 17, Opp. Railway Station, Smt. Chandibai Himathmal Mansukhani Road, Ulhasnagar- 421003, Dist. Thane, (MAHARASHTRA)
Tel. : +91 251 273 4940 • Telefax + 91 251 273 1869 • E-mail: principal.chmc@gmail.com • Website: www.chmcollege.in

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Chemistry)

Semester- III

Title: Technical and Analytical skill Enhancement in Chemistry (Practical)

Vertical – 4
(SEC)

with effect from
Academic Year 2025-2026

Title: Technical and Analytical skill Enhancement in Chemistry (Practical)
[Course Code: CHMCHIII7]

Sr. No.	Heading	Particulars
1	**Description of the Course**	The course aims to develop analytical skills of the students underlying routine non instrumental and instrumental experimental techniques by carrying out practical sessions
2	**Vertical**	4
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:**To enable learners to have practical knowledge and understanding of the concepts in stoichiometry. **CO(A)2:**To identify and use the equipments / glassware required for Chemical experiments **CO(A)3:**To develop the skill to use apparatus and prepare solution using proper technique. **CO(A)4:**To plot graphs on proper scale using obtained data and interpretation of it **CO(A)5:**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	**Course Outcomes**: Upon Completion of this course student will be able to **CO1**:To develop knowledge in stoichiometric calculations and differentiate various terms used to express concentrations **CO2**: To handle laboratory apparatus and apply acquired techniques used during solution preparation **CO3:** Identify various types of titration techniques, reagents and methods used in chemical investigation. **CO4:** To solve and evaluate the numerical and graphical problems obtained during chemical analysis at professional level.	
9	**Syllabus** : • Preparation of solutions on the basis of $(\frac{Weight}{volume})$, $(\frac{Volume}{volume})$ and $(\frac{Weight}{Weight})$ using stoichiometric calculations (stoichiometric calculations to be done on the basis of provided data and set of minimum 5 solutions to be prepared) • Amongst given compounds, identify primary standard required for the standardization of NaOH and KMnO4. (Identification of primary standard , preparing its standard solution and carrying out titration is expected) • Amongst given indicators, identify suitable indicator for the neutralization titration of acid using 1) strong base 2) weak base. (Titration using suitable indicators expected) • Estimation of Fe^{2+} by redox titration and determine amount of Fe present in given solution. • Polt graphs from given data and comment on the nature of graphs obtained. (any two graphs are expected)	

- Synthesis of a compound. Calculation of theoretical yield. Determining % yield.(Scheme to be developed by students)

(Student is expected to calculate amount of compound required to be weighed to prepare the solution throughout practicals)

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End Total Marks - 30 Time- 2.0 hour

Format of Question Paper

	Particulars	**Marks**
1	Experiment	20
2	Journal	10
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	**Marks**
1.	Scheme development/numerical solving skills/Practical skills / collation of data	15
2.	Active participation	05
	Total 20	

11

REFERENCES:

1. D.A. Skoog, D.M. West, F.J. Holler, and S.R. Crouch, Analytical Chemistry: An Introduction,7th ed., Chapter 15, pp. 345-381.
2. A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961).
3. R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y.(1974).
4. Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B. BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)
HSNC Board't. Chandibai Himathmal Mansukhani College, Ulhasnagar
(Autonomous)
Affiliated to the University of Mumbai

Second Year B.Sc.

Semester- III

Bachelor of Arts
(Department of English)

Vertical 5

Ability Enhancement Course (English)
2 Credits

(To be offered to Students who opted Sindhi AEC in Sem I & II)

Semester – I

with effect from
Academic Year 2025-2026

Choice Based and Credit Based syllabus as per NEP 2020 with effect from the Academic Year 2025-2026

Title: Introduction to Communication Skills in English
Course Code: CHMBSCAECIII

Sr. No.	Heading	Particulars
1	**Description the Course:**	Effective communication is the cornerstone of academic and professional success. This course introduces learners to foundational skills in English communication, with a focus on both oral and written competencies essential in academic, social, and workplace contexts. It aims to equip learners with the ability to read critically, write precisely, speak confidently, and listen actively. Emphasis is placed on building clarity, coherence, and conciseness in communication, along with an understanding of audience, purpose, and tone. The course integrates grammar reinforcement, vocabulary building, reading comprehension, and practice-oriented modules such as email etiquette, group discussion, and formal writing. Through dynamic classroom interactions and practical assessments, learners will gain confidence in using English effectively and purposefully.
2	**Vertical 4**	Ability Enhancement Course
3	**Type** Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: CO(A)1: To introduce learners to the fundamentals of effective communication and its components. CO(A)2: To enhance learners' reading comprehension through exposure to multiple genres and contexts. CO(A)3: To develop grammatical accuracy and lexical resourcefulness for academic and professional communication. CO(A)4: To strengthen verbal and non-verbal presentation skills and promote interactive speaking abilities.	

	CO(A)5: To build competence in real-world writing tasks such as email drafting, bio-data preparation, and descriptive writing.
8	**Course Outcomes**: Student will be able to CO-1: Understand and apply key principles of effective communication in varied contexts. CO-2: Comprehend and analyze written texts using appropriate reading strategies. CO-3: Recognize and correct common grammatical and lexical errors. CO-4: Engage in clear, confident, and context-appropriate spoken interactions. CO-5: Produce structured, coherent, and grammatically correct written content for academic and workplace use.

9	**Syllabus**

UNIT I: Foundations of English Communication

A) Core Concepts of Communication

- Principles of Effective Communication: The 7 Cs
- Verbal and Non-verbal Communication with Examples
- Cross-cultural Communication in the Globalized World
- Technology in Communication: Email, Messaging, Video Conferencing
- Listening for Detail and Intent: Barriers to Listening and Strategies

B) Reading Comprehension

- Understanding the Main Idea and Supporting Details
- Interpreting Tone, Purpose, and Bias
- Using Context Clues for Vocabulary Building
- Reading Visual Texts: Graphs, Charts, and Infographics
  Sample readings will include excerpts from news articles, reports, editorials, and educational essays (200–250 words).

C) Grammar and Vocabulary

- Subject-Verb Agreement
- Sentence Structures
- Punctuation and Capitalization
- Commonly Confused Words
- Editing and Proofreading Practice

A remedial and functional approach will be followed with contextual exercises.

UNIT II: Applied Communication Skills

A) Speaking and Listening Skills

- Introducing Oneself in Academic/Professional Settings
- Participating in Group Discussions and Expressing Opinions
- Delivering a Short Speech (2–3 minutes) on Familiar Topics
- Understanding and Responding to Instructions
- Listening Comprehension Practice through Audio/Video Clips

B) Functional Writing Skills

- Formal Email Writing with Subject and Tone Sensitivity
- Descriptive Paragraph Writing (People, Places, Processes)
- Bio-data and Resume Writing
- Drafting Job Applications (Solicited and Unsolicited)
- Writing a Statement of Purpose

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 1:00 hour

Format of Question Paper

Question No	Nature of Questions	Marks
Q. 1	**Short Notes** (Attempt any 3 out of 5) - **Unit 1** **OR** **Essay-Type Question** (Attempt any 1 out of 2)- **Unit 1**	15
Q. 2	**Short Notes** (Attempt any 3 out of 5) - **Unit 2** **OR** **Essay-Type Question** (Attempt any 1 out of 2)- **Unit 2**	15
	Total	**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Students are required to draft a job application letter along with a resume using the following AI assistance: Canva Resume Builder, Resume.oi, Zety, Novopresume, Rezi etc **OR** Draft an SoP with the help of the following AI assistance: Quillbot, Yocket, Writesonic, Jasper AI	15
2.		05
	Total	**20**

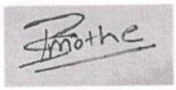
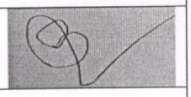
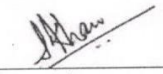
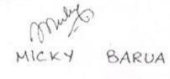
11

REFERENCES:

1. Adler, Ronald B., et al. *Understanding Human Communication*. 15th ed., Oxford UP, 2021.
2. Bailey, Stephen. *Academic Writing: A Handbook for International Students*. 5th ed., Routledge, 2018.
3. Barrass, Robert. *Students Must Write: A Guide to Better Writing in Coursework and Examinations*. Routledge, 2005.
4. Brown, Gillian, and George Yule. *Teaching the Spoken Language: An Approach Based on the Analysis of Conversational English*. Cambridge UP, 1983.
5. Carnegie, Dale. *The Quick and Easy Way to Effective Speaking*. Pocket Books, 2006.
6. Chaney, Lillian, and Jeanette Martin. *Intercultural Business Communication*. 6th ed., Pearson, 2014.
7. Cullen, Pauline, et al. *English Grammar in Use Supplementary Exercises*. Cambridge UP, 2019.
8. Eastwood, John. *Oxford Guide to English Grammar*. Oxford UP, 2005.

9. Gerson, Sharon J., and Steven M. Gerson. *Technical Communication: Process and Product*. 9th ed., Pearson, 2021.
10. Hewings, Martin. *Advanced Grammar in Use: A Self-study Reference and Practice Book for Advanced Learners of English*. 3rd ed., Cambridge UP, 2013.
11. Jones, Leo. *Functions of English: Communication Practice in English*. Cambridge UP, 1981.
12. Kumar, Sanjay, and Pushp Lata. *Communication Skills*. 2nd ed., Oxford UP, 2018.
13. Lynch, Tony. *Listening in Language Learning*. Longman, 1988.
14. McCarthy, Michael, and Felicity O'Dell. *Academic Vocabulary in Use*. Cambridge UP, 2008.
15. Nordquist, Richard. *The Essentials of English Grammar*. McGraw-Hill Education, 2016.
16. Quirk, Randolph, et al. *A Comprehensive Grammar of the English Language*. Longman, 1985.
17. Seely, John. *The Oxford Guide to Writing and Speaking*. Oxford UP, 2005.
18. Straus, Jane, et al. *The Blue Book of Grammar and Punctuation*. 12th ed., Jossey-Bass, 2021.
19. Wallace, Catherine. *Reading*. Oxford UP, 1992.
20. Zinsser, William. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Perennial, 2016.

Syllabus Committee:

Sr. No	Name of the Faculty	Designation and College	Signature
1.	Prof. (Dr.) Kailas Aute	Professor & Head, Dept. of English, Smt. CHM College	
2.	Prof. (Dr.) B. R. Hiramani,	(VC Nominee, University of Mumbai) Pancham Khemraj College, Sawantwadi	
3.	Prof. (Dr.) Vikas Raskar	(Subject Expert outside University) Hutatma Rajguru Mahavidyalay, Rajguru Nagar, Khed, (Affiliated to Savitribai Phule University)	
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University	
5.	Mr. Ananda Pandhare	Asst. Professor, Dept. of English, Smt. CHM College	
6.	Ms. Sana Khan	Asst. Professor, Dept. of English, Smt. CHM College	
7.	Dr. Micky Barua	Faculty Vidyalankar Institute of technology, Alumni Member	 MICKY BARUA
8.	Ms. Sofy Verghese	Accenture, Industry Representative	

Name & Signature of the Ad-hoc BoS Chairperson: Prof. (Dr). Kailas Aute

Name & Signature of the Dean: Prof. (Dr). Nitin Arekar

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Second Year

Semester - III

Title: Environmental Management and Sustainable Development-I

Vertical - 5
VEC Subject - 2 Credits

With effect from Academic Year 2026-2027

Title: Environmental Management and Sustainable Development-I
Course Code: CHMVECI

Sr. No.	Heading	Particulars
1	**Description the Course:**	This course introduces students to the basics of environmental management and sustainable development. It explains how ecosystems work, the importance of biodiversity, and the need to protect our natural resources. Students will learn about different environmental problems, human impact on nature, and how to manage disasters. The course also covers Indian environmental movements, ethics, and the role of public awareness. Real-life examples and case studies help students understand the connection between nature and human communities in a simple and practical way.
2	**Vertical 5**	VEC
3	**Type & Teaching Methods**	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To introduce about ecosystems, biodiversity and to make aware for the need of conservation. **CO(A)2:** To sensitize students towards environmental concerns, issues, and impacts of human population. **CO(A)3:** To analyze the impact of human population growth and development activities on the environment, including issues related to displacement, disaster response, and rehabilitation. **CO(A)4:** To foster awareness of environmental ethics and the role of cultural and social movements in shaping sustainable environmental practices through communication, policy, and activism.	
8	**Course Outcomes**: Student will be able to **CO1:** Explain the interrelationships within ecosystems and analyze energy flow and succession, using examples from various ecological zones. **CO2:** Critically evaluate biodiversity levels and conservation strategies, applying knowledge of endemic species, threats, and ecological services to real-world scenarios. **CO3:** Assess the socio-environmental implications of population growth, displacement, and disasters, incorporating case studies to understand sustainable development challenges. **CO4:** Demonstrate an understanding of environmental ethics and advocacy, by interpreting the influence of cultural values, environmental movements, and communication strategies on sustainability.	

9

Syllabus

UNIT I: Ecosystems, Biodiversity and Conservation

- Introduction, structure, and function of ecosystems; Energy flow: food chains, food webs and ecological succession. Case studies of the following:
  - Forest ecosystem
  - Grassland ecosystem
  - Desert ecosystem
  - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)
- Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns.
- India as a mega-biodiversity nation; Endangered and endemic species of India.
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational value.

UNIT II: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g. CNG vehicles in Delhi).

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 1:00 hours

Format of Question Paper

Attempt any 3 out of 4 questions.

Question No	**Nature of Questions**	**Marks**
Q1	Theory based on Unit I	10
Q2	Theory based on Unit I	10
Q3	Theory based on Unit II	10
Q4	Theory based on Unit II	10
TOTAL		**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Class Test, Creative writing/visits/role play (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Quiz)	10
2.	Project /Presentation / Viva/Group Discussion/Case study	10
TOTAL		**20**

11 **REFERENCES:**

1. Carson, R. (2002). *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. (1993). *This Fissured Land: An Ecological History of India*. University of California Press.
3. Gleeson, B., & Low, N. (Eds.). (1999). *Global Ethics and Environment*. Routledge.
4. Gleick, P. H. (1993). *Water in Crisis*. Pacific Institute for Studies in Development, Environment & Security; Stockholm Environment Institute; Oxford University Press.
5. Sodhi, N. S., Gibson, L., & Raven, P. H. (Eds.). (2013). *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
6. Thapar, V. (1998). *Land of the Tiger: A Natural History of the Indian Subcontinent.*
7. Warren, C. E. (1971). *Biology and Water Pollution Control*. W. B. Saunders.
8. Wilson, E. O. (2006). *The Creation: An Appeal to Save Life on Earth*. W. W. Norton.
9. Harper, Charles L. (2017). *Environment and Society: Human Perspectives on Environmental Issues* (6th Edition). Routledge.
10. Rajagopalan, R. (2011). *Environmental Studies: From Crisis to Cure*. Oxford University Press.
11. Harris, Frances (2012). *Global Environmental Issues* (2nd Edition). Wiley-Blackwell.

Name & Signature of the Dean &Ad-hoc BoS Chairperson (Interdisciplinary):

Dr. Nitin Arekar

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Chemistry)

Semester- III

Survey on Water Quality

Vertical – 6
(FIELD PROJECT)

with effect from
Academic Year 2025-2026

Title: Progressive Physical & Analytical Chemistry Paper-I (Theory)
[Course Code: CHMCHIII8]

Sr. No.	Heading	Particulars
1	**Description of the Course**	Chemistry field project involves applying chemical principles and techniques in real-world settings, often outside a traditional laboratory environment. It can involve investigating environmental issues, analyzing industrial processes, or studying the chemistry of everyday materials. Introduction of fileld project course under NEP would bridge theoretical knowledge with practice and enhance awareness of scientific temperament .Field project course shall certainly foster a deeper understanding of environmental and socio-economic issues., developing practical skills, and exploring research methodologies. Field projects also aim to promote teamwork, problem-solving, and ethical conduct.
2	**Vertical**	6
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:**To provide students with a holistic learning experience that combines theoretical knowledge with practical application. **CO(A)2:**To connect Classroom Learning to Real-World Situations **CO(A)3:**To Develop Practical and Research Skills **CO(A)4:**To Understand Social Issues and Contributing to Solutions **CO(A)5:**To Promoting human values and ethical conduct	
8	**Learning Outcomes**: Upon completion of the course, student will be able to **CO1:** apply effectively theoretical knowledge in practical situations. **CO2:** identify problems, collect data, analyze information, and propose solutions. **CO3:** understand the value of teamwork , collaboration and communication skills. **CO4:** enhance Interdisciplinary approach by integrating knowledge from different areas of chemistry, such as analytical chemistry, organic chemistry, and environmental chemistry.	

9

Syllabus

Field project duration structure

No.of credits	2
Duration	60hrs
Survey and selection of Field site/location	4 hrs
Survey action plan	4 hrs
Sample collection at selected sites	8 hrs
Scheme development for laboratory /statistical analysis	8 hrs
Experimental work/review reports	20 hrs
Data analysis and interpretation	8 hrs
Compilation of data and Report preparation (min.20pages) A	8 hrs

Examples of Field Project Schemes:

- **Environmental Chemistry:**
  - **Water Quality Assessment:** Collect water samples from different locations, analyze them for physic0-chemical parameters (heavy metals, pesticides, etc.), and assess the impact on human health.
  - **Soil Analysis:** Investigate the chemical composition of soils, identify pollutants, and assess their impact on plant growth or ecosystems.
- **Industrial Chemistry:**
  - **Analysis of Industrial Waste:** Analyze waste streams from industries to identify pollutants and evaluate treatment methods.
  - **Process Optimization:** Study chemical reactions in industrial settings to optimize reaction conditions, reduce waste, and improve efficiency.
- **Material Science:**
  - **Investigate the Chemistry of Everyday Materials:** Analyze the chemical composition and properties of materials like detergents, soaps, cosmetics, or plastics.
  - **Study Corrosion:** Investigate the causes and prevention of corrosion in various materials,
  - **Study the Chemistry of Food:** Investigate the chemical composition and properties of foods, such as the effects of different cooking methods on nutrients or the chemistry of food spoilage.

Thrust areas

1. Water Quality Assessment: Drinking water samples

- **Objective:** Evaluate the impact of industrial or agricultural runoff on a nearby river or creek.
- **Method:** Collect water samples from different locations along the water body, analyze for chemical pollutants, and correlate results with the presence of aquatic life (e.g., fish, invertebrates).
- **Data Analysis:** Compare water quality parameters (pH, temperature, dissolved oxygen, nutrient levels) at different locations and assess the impact on aquatic ecosystems. [4]

Proposed Field Project outline :

A] Drinking water quality assessment for some essential physico- chemical parameters:

A sample field chemistry project for a college level could involve **investigating the quality of drinking water in different localities in vicinity** . This could involve sampling water from different locations, analyzing the chemical composition of the water (e.g., pH, dissolved oxygen, heavy metals, hardness, acidity,alkalinity).

B] Food Chemistry: Assessment of acidity, pH, vitamins in Processed tomato puree/ketchups samples

- **Objective:** Analyze the chemical composition of different food samples.
- **Method:** Collect samples of food (e.g., processed food products) and analyze for essential parameters .
- **Data Analysis:** Compare the nutritional content of different food samples and assess their contribution to a balanced diet.

C]. Material Chemistry: Comparitive study of Saponification value of different soap samples

- **Objective:** Investigate the saponification value of different soap materials.
- **Method:** Collect samples of materials (local and branded) and analyze their physical and chemical properties.
- **Data Analysis:** Compare the properties of different materials and assess their suitability for specific applications.

Specimen of Proposed project B

Ascorbic acid (vitamin C) in tomato paste can be determined by a simple titration method using iodine or DCPIP. The process involves **oxidizing the ascorbic acid with a standard iodine or DCPIP solution, using starch as an indicator for the endpoint**.

Here's a breakdown of the process:

1. Sample Preparation:

- A known weight or volume of tomato paste is accurately measured.
- The paste is diluted with water to create a solution for titration.

2. Titration:

- **Method 1 (Iodine Titration):**
  - An aliquot of the diluted sample is placed in a flask.]
  - A few drops of starch solution are added as an indicator.
  - The sample is titrated with a standard iodine solution (e.g., 0.005 mol/L).
  - As iodine is added, it oxidizes the ascorbic acid to dehydroascorbic acid.
  - The endpoint is reached when the first blue-black color appears, indicating that all ascorbic acid has been oxidized and excess iodine is reacting with starch.]
- **Method 2 (DCPIP Titration):**
  - An aliquot of the diluted sample is placed in a flask. (2,6-dichloroindophenol) is used as the titrant.
  - DCPIP is blue in solution, and its color changes to pink when reduced by ascorbic acid.
  - The titration continues until the solution turns pink, indicating the endpoint.

3. Calculation:

- The volume of titrant used is carefully measured and recorded.
- The concentration of ascorbic acid in the sample is calculated based on the titration value and the known concentration of the titrant.
- The results are typically expressed as mg of ascorbic acid per 100 g or 100 ml of the tomato paste.

10

Scheme of Practicum Examination and Assessment Pattern

Total – 50 Marks

A. External evaluation pattern: Semester End Total Marks - 30

Criteria-Project Report	**Marks**
Literature survey and methodology	05
Data analysis	10
Interpretation and recommendation	10
Overall content presentation	05
Total	30

B. Internal evaluation pattern: Semester End Total Marks - 20

Criteria-Field visit	Marks
Active participation in visits	10
Participation in discussion/viva/seminar	10
Total	20

11 REFERENCES:

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

Smt

First Year

Semester- III

Title: Cocurricular Course I

Vertical - 6
Cocurricular Course - 2 Credits

with effect from
Academic Year 2025-2026

Title: Cocurricular Course - I

Course Code: CHMCCI6

Sr. No.	Heading	Particulars
1	**Description the Course:**	This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year. Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting. This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.
2	**Vertical 6**	Cocurricular Course (Mandatory)
3	**Type** **Teaching Methods**	Non Theory Participation, Report Writing, Presentation etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities. 2. To enhance personal and interpersonal skills through real-life experiences and teamwork. 3. To foster a sense of responsibility, leadership, and community engagement among students. 4. To develop self-confidence and emotional well-being through creative expression and collaboration. 5. To integrate classroom learning with experiential learning for holistic growth.	
8	**Learning Outcomes**: By the end of the course, students will be able to: **LO1:** Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences. **LO2:** Demonstrate improved communication, leadership, and teamwork skills. **LO3:** Exhibit increased awareness of social responsibility and civic engagement. **LO4:** Build confidence through creative, cultural, and intellectual expressions. **LO5:** Maintain a portfolio or activity log to track participation and personal development.	

9	**Syllabus** **Unit I - Suggested Areas of Participation in the activities:** • **Cultural Events:** Drama, dance, music, literary events, debates, etc. • **Social Outreach:** Blood donation, awareness campaigns, cleanliness drives. • **Clubs & Societies:** Photography, quiz, environment club, shram club, etc. • **Sports & Fitness:** College tournaments, yoga, marathons, fitness challenges. • **Institutional Events:** Foundation Day, Annual Day, College Festivals, Intercollegiate events. • **National Festivals:** Independence Day, Republic Day etc. **Unit II - Program Specific Topics** • **Workshops/Seminars:** Report Writing, Personality Development, Soft Skills, Leadership Talks. • **Speak, Show, Shine:** Presentation / Poster Presentation / Viva and Learning Experience **Mode of Evaluation:** • **Faculty Coordinator:** To guide and evaluate student progress. • **Participation Proof:** Certificates, photos, attendance records. • **Reflective Journal:** Minimum 2–3 pages summarizing experiences, learning, and growth. • **Final Viva/Presentation:** 5-minute talk on poster presentation and on overall learning.
10	**Scheme of Examination and Assessment Pattern** **Based on 3 approved Activities** **Semester End External - 30 marks**

Activity No	Nature of Activities	Marks
1.	Title of Approved Activity - 1	10
2.	Title of Approved Activity - 2	10
3.	Title of Approved Activity - 3	10
	Total	**30**

Internal Examination: Continuous Evaluation – 20 marks

	Assessment / Evaluation	Marks
1.	Reflective journal	10
2.	Presentation/ poster presentation/viva	10
	Total	**20**

Suggested **Readings:**

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

Dr. Manju Lalwani Pathak

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar

(Autonomous)

Affiliated to the University of Mumbai

Bachelors of Science (Chemistry) (Aided Course)

Semester – IV

Choice Based and Credit Based syllabus as per NEP 2020 with effect from the Academic Year 2025-2026

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Chemistry)

Semester- IV

Title: Progressive Physical and Analytical Chemistry II
Paper-I (Theory)

Progressive Inorganic and Organic Chemistry II Paper-II (Theory)

Practicum in Chemistry-IV

Vertical – 1
(MAJOR)

with effect from Academic Year 2025-2026

Title: Progressive Physical & Analytical Chemistry II Paper-I (Theory)
[Course Code: CHMCHIV1]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of chemistry and their practical applications in in the field of chemistry. It begins with developing and understanding of major concepts in all disciplines of chemistry. The course enhances knowledge of basic analytical tools. The course helps to solve the problem and also think methodically, independently and draw a logical conclusion. Students can employ critical thinking and the scientific knowledge to design, carryout, record and analyze the results of chemical reactions. The course can help to create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** learn laws of crystallography, types of crystals and the determination of crystal structure by X-rays diffraction method **CO(A)2:** To understand chemical cell, types of electrodes and representation of the electrochemical cell reaction **CO(A)3:**To understand the Phase Rule and apply it to one and two-component systems **CO(A)4:** To learn chromatography and Solvent Extraction as a tool for Separation **CO(A)5:** To understand the basic concepts of some instrumental method of analysis **CO(A)6:** To learn about the Statistical treatment of analytical data.	
8	**Course Outcomes**: Upon completion of the course, student will be able to **CO1** Learn characteristics and types of unit cell of cubic crystal and apply it for calculations of interplanar distance to find unit cell crystal structure **CO2** Learn chemical cell, distinguish in reversible/ irreversible cells and types of electrodes **CO3** Develop a clear understanding of criteria for phase equilibrium and apply Gibbs Phase Rule to different systems **CO4** Develop a clear understanding of the principle, technique and application of PC and TLC, Solvent extraction **CO5** Understand working, application of potentiometer, Conductometer and pH-meter	

Syllabus

Progressive Physical & Analytical Chemistry II Paper – I

UNIT I: Physical Chemistry II

Solid State

- laws of Crystallography and Types of Crystals
- Characteristics of simple cubic, face-centered cubic and body-centered cubic systems, interplanar distance in a cubic lattice (only expression for ratio of interplanar distances are expected)
- Use of X-rays in the study of crystal structure, Bragg's equation (derivation expected), X-rays diffraction method of studying crystal lattice structure, structure of NaCl and KCl. (Numericals expected)

Phase equilibria

- Introduction to Phase equilibria, Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule.
- Phase diagrams of one-component systems (water and sulphur).
- Two-component systems involving eutectics – Condensed Phase rule, Definition of eutectic Phase diagram of Lead-Silver system.

Electrochemistry-II

- Electrochemical cells, Nernst equation and its importance in generating electricity through chemical reactions. Types of electrochemical cells - Reversible and irreversible cells (Definition, example, characteristics)
- Types of electrodes, Standard electrode potential, Electrochemical series, Cell reaction.

UNIT II: Analytical Chemistry II

Methods of Separation

- Types of separation methods Based on volatility – Distillation (definition, types and example) Based on electrical effects – Electrophoresis (definition, principle and applications)
- Chromatography – General idea of paper chromatography and thin layer chromatography (principle, technique and applications)
- Solvent Extraction – Introduction, Nernst Distribution Law, Distribution Ratio. Single-step and multistep extraction, Percentage extraction for single-step and multistep extraction. Batch Extraction (Simple separating technique -diagram and process) (Numerical problems expected)

Instrumental Methods-II

- Potentiometry – Principle, role of reference and indicator electrodes, Graphical Methods of detection of end points. (first derivative and second derivative methods)
- pH metry – Principle, construction and working of the glass electrode.
- Conductometry – Conductivity cell: Construction. Principle, application in neutralization titration with respect to strong acid–strong base, strong acid – weak base, strong base – weak acid.

\

Statistical Treatment of Analytical Data

- Normal error curve or Gaussian distribution curve: Equation and important features of Gaussian distribution curve. Gaussian error curve and precision and accuracy.
- Linear Regression analysis between two variables: Obtaining equation of the best fitting line for line passing through origin and for line not passing through origin using: i) method of averages ii) method of least squares [Numerical problems expected]

10 **Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Theory Examination: Semester End Total Marks - 30 Time- 1.0 hour

Format of Question Paper

Question	Particulars	Marks
Q.1 Unit I	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
Q.2 Unit II	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Quizzes/Class Tests/presentation/ Project/real time assignment etc.	15
2.	Active participation	05
	Total 20	

11 **REFERENCES:**

Physical Chemistry

1) Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014).
2) Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
3) Keith J. Laidler & John H. Meiser, Physical Chemistry, 2nd Ed. (2004)
4) Puri B. R., Sharma L. R. & Pathania M. S. Principles of Physical Chemistry, Vishal Publishing Company, 2008
5) Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6) Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
7) Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
8) McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
9) Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).
10) Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

Analytical Chemistry

1) Analytical Chemistry, Gary D. Christan, Purnendu Dasgupta, 7th Edition, Wiley 1997.
2) Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Holler, S. R. Crouch, 10th edition 1967.
3) Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R.Crouch, 7th edition 1965.
4) Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, New academic sciences 1985.
5) Modern Analytical Chemistry, David Harvey,2nd edition, 2009.

Inorganic Chemistry

1) B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013 -2014
2) W. W. Porterfield, Inorganic Chemistry-A, 2nd Ed., Academic Press, 1993.

3) B. W. Pfennig, Principles of Inorganic Chemistry, Wiley, 2015.
4) C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, 2nd Edition 2005.
5) J. Huheey, F. A. Keiter and R. I. Keiter, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Ed., Harper Collins, 1993.
6) R. L. Dekock and H.B.Gray, Chemical Structure and Bonding, The Benjamin Cummings Publishing Company 1989.
7) G. Miessler and D. Tarr, Inorganic Chemistry, 3rd Ed., Pearson Education, 2004.
8) R. Sarkar, General and Inorganic Chemistry, Books & Allied (P) Ltd., 2001.
9) C. M. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd., 1985.
10) G. A. Jeffrey, An Introduction to Hydrogen Bonding, Oxford University Press, Inc., 1997.
11) D. Banerjea, Coordination Chemistry Tata McGraw Hill,1993.

Organic Chemistry

1) Organic Chemistry, Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers-Oxford University Press 1974.
2) Stereochemistry of Organic Compounds, Ernest Eliel, Samual Wilen, A Wiley-Inter-science Publication 1970.
3) Organic Chemistry, G. Marc Loudon (4th Edition) Oxford University Press
4) Stereochemistry of Organic Compounds, Principles and Applications, D. Nasipuri, 4th Edition, New Academic Science 1982.

Title: Progressive Inorganic & Organic Chemistry II Paper – II (Theory) [Course Code: CHMCHIV2]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces students to the fundamental principles of chemistry and their practical applications in in the field of chemistry. It begins with developing and understanding of major concepts in all disciplines of chemistry. The course enhances knowledge of basic analytical tools. The course helps to solve the problem and also think methodically, independently and draw a logical conclusion. Students can employ critical thinking and the scientific knowledge to design, carryout, record and analyze the results of chemical reactions. The course can help to create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To understand the position of transition elements, properties and qualitative analysis. **CO(A)2:** To understand the rules, theories of coordination compounds and their application. **CO(A)3:** To learn classification and name five- and six-membered heterocyclic compounds containing one heteroatom and its synthesis and substitution reactions. **CO(A)4:** Predict conformational preferences and stereochemical behavior of mono- and disubstituted cyclohexanes. **CO(A)5:** Identify symmetry elements in organic molecules and relate them to optical activity. **CO(A)6:** Explain mechanisms and applications of selected named reactions.	
8	**Learning Outcomes**: Upon completion of the course, student will be able to **CO1** explain comparative chemistry of transition metals and their positions in periodic table. **CO2** explain coordination chemistry and theories of coordination compounds. **CO3** explain introduction, classification and nomenclature of five and six-membered heterocycles containing one heteroatom. **CO4** explain stereochemistry of mono and disubstituted cyclohexanes, Elements of symmetry.	

Syllabus

Progressive Inorganic and Organic Chemistry II Paper II (Theory)

UNIT I: Inorganic Chemistry II

Comparative chemistry of transition metals

- Position of transition elements in periodic table, occurrence (ores and minerals), oxidation state and transition elements
- Magnetic properties of transition metal compounds. Origin of magnetism (Spin & Spin-Orbital)
- Qualitative tests for transition metal ions (Cr, Mn, Fe, Co, Ni, and Cu)

Coordination chemistry

- Introduction to coordination compounds, basic terms and nomenclature, types of ligands
- Isomerism (stereoisomerism of coordination compounds no. 6)
- Theories of coordination compounds (Werner's Theory), Effective atomic number rule, Eighteen electron rule.
- Valence Bond Theory (VBT) for sp^3d^2 and d^2sp^3 hybridization, inner and outer orbital, Complexes, limitation of VBT
- Applications of coordination compounds

UNIT II: Organic Chemistry

Heterocyclic Compounds:

- **Introduction:** Introduction, classification, nomenclature of 5 and 6-membered heterocycles containing one heteroatom
- **Five membered heterocycles (Furan, Pyrrole and Thiophene):** Synthesis of furan, pyrrole and thiophene (Paal-Knorr synthesis, Knorr pyrrole synthesis, and Hantzsch synthesis), thiophene (Hantzsch synthesis), Reactivity of furan, pyrrole and thiophene towards electrophilic substitution on the basis of stability of intermediate. Reactions of furan, pyrrole and thiophene: halogenation, nitration, sulphonation, Vilsmeier- Haack reaction, Friedel-Crafts reaction. Furan: Diels-Alder reaction, ring opening reaction. Pyrrole: Acidity and basicity of pyrrole, comparison of basicity of pyrrole, pyrrolidine and pyridine.
- **Six membered heterocycles (Pyridine):** Hantzsch synthesis pyridine. Reactivity of pyridine towards electrophilic and nucleophilic substitution on the basis of electron distribution. Pyridine: Basicity, sulphonation of pyridine (with and without catalyst), (Chichibabin reaction)

Stereochemistry of mono and disubstituted cyclohexanes

- **Conformational analysis:** Monosubstituted cyclohexanes: methyl cyclohexane, tert-butylcyclohexane. Disubstituted cyclohexanes: 1,2-dimethylcyclohexane, 1-tert-butyl-4 methylcyclohexane.
- **Cis-trans isomerism in disubstituted cyclohexanes:** 1-chloro-2-methylcyclohexane, 1,3-dimethylcyclohexane
- **Elements of Symmetry:** Mirror plane symmetry, inversion center, rotation -reflection axis
- **Stereochemical Consequences:** Cis-1,2-dimethylcyclohexane, cis-1,3-dimethyl cyclohexane-optically inactive (presence of plane of symmetry), trans-1,2-dimethyl cyclohexane-optically active. Note: Gauche-butane interaction to be discussed.

Name Reactions (Mechanism and Applications)

- Darzens reaction
- Wittig reaction
- McMurry reaction
- Wagner-Meerwein rearrangement

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Theory Examination: Semester End Total Marks - 30 Time- 1.0 hour

Format of Question Paper

Question	Particulars	Marks
Q.1 Unit I	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
Q.2 Unit II	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Quizzes/Class Tests/presentation/ Project/real time assignment etc.	15
2.	Active participation	05
	Total 20	

11

REFERENCES:

Physical Chemistry

1) Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014).
2) Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
3) Keith J. Laidler & John H. Meiser, Physical Chemistry, 2nd Ed. (2004)
4) Puri B. R., Sharma L. R. & Pathania M. S. Principles of Physical Chemistry, Vishal Publishing Company, 2008
5) Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6) Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
7) Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
8) McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
9) Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).
10) Laboratory Experiments in Chemistry I & II, University Practical Book of Chemistry, University of Mumbai.
11) Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

Analytical Chemistry

1) Analytical Chemistry, Gary D. Christan, Purnendu Dasgupta, 7th Edition, Wiley 1997.
2) Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Holler, S. R. Crouch, 10th edition 1967.

3) Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R.Crouch, 7th edition 1965.
4) Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, New academic sciences 1990.
5) Modern Analytical Chemistry, David Harvey,2nd edition, 2009.

Inorganic Chemistry

1) B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013 -2014
2) W. W. Porterfield, Inorganic Chemistry-A Unified Approach, 2nd Ed., Academic Press, 1993.
3) B. W. Pfennig, Principles of Inorganic Chemistry, Wiley, 2015.
4) C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, 2nd Edition 2005.
5) J. Huheey, F. A. Keiter and R. I. Keiter, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Ed., Harper Collins, 1993.
6) R. L. Dekock and H.B.Gray, Chemical Structure and Bonding, The Benjamin Cummings Publishing Company 1989.
7) G. Miessler and D. Tarr, Inorganic Chemistry, 3rd Ed., Pearson Education, 2004.
8) R. Sarkar, General and Inorganic Chemistry, Books & Allied (P) Ltd., 2001.
9) C. M. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd., 1985.
10) G. A. Jeffrey, An Introduction to Hydrogen Bonding, Oxford University Press, Inc., 1997.
11) D. Banerjea, Coordination Chemistry Tata McGraw Hill,1993.

Organic Chemistry

1) Organic Chemistry, Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers-Oxford University Press 1974.
2) Stereochemistry of Organic Compounds, Ernest Eliel, Samual Wilen, A Wiley-Inter-science Publication 1970.
3) Organic Chemistry, G. Marc Loudon (4th Edition) Oxford University Press 1967.
4) Stereochemistry of Organic Compounds, Principles and Applications, D. Nasipuri, 4th Edition, New Academic Science 1974.

Title: Practicum in Chemistry - IV
[Course Code: CHMCHIV3]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This comprehensive course delves into the foundational principles of chemistry, exploring core concepts across its diverse disciplines. Students will build a strong understanding of fundamental chemical theories and their real-world applications. The curriculum is designed to foster essential skills, including the mastery of basic analytical tools and techniques necessary for scientific inquiry. Furthermore, students will develop critical thinking and problem-solving abilities, learning to approach complex chemical challenges methodically, draw logical conclusions, and apply scientific knowledge to design, execute, analyze, and interpret experimental results effectively. The course also aims to cultivate an awareness of chemistry's broader impact on the environment and society, extending beyond the scientific community.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Practical Experimental \ Demonstration \ Handling of instruments
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To develop an understanding of the principles and applications of conductometric and potentiometric techniques in analysing chemical systems. **CO(A)2:** To develop practical skills in microscale inorganic synthesis with an emphasis on precision, yield, and environmental safety. **CO(A)3:** To train students in the systematic qualitative analysis of bi-functional organic compounds through preliminary tests, solubility behaviour, detection of elements & functional groups. **CO(A)4:** To develop the skills of using the counterpoise technique used in gravimetric estimation and to develop the ability to state the error estimate of their result.	
8	**Learning Outcomes**: Upon completion of the course, student will be able to **CO1** Learners will be able to use conductometric and potentiometric methods to determine various parameters like dissociation constant, solubility product, EMF of cell. **CO2** Learners will able to prepare inorganic complexes, analyze samples volumetric methods. **CO3** Learners will be able to systematically analyse bi-functional organic compounds using physical tests, solubility profiles, and elemental detection methods. **CO4** The students are expected to learn to operate colorimeter and understand relation between concentration and Absorbance, and to draw the calibration curve. They are also expected to state the error estimate of their results.	

9

Syllabus

Physical chemistry

- To determine dissociation constant of weak acid conductometrically.
- To determine the solubility of sparingly soluble salts (any two) conductometrically.
- To determine standard EMF and the standard free energy change of Daniel cell potentiometrically

Analytical Chemistry

- Estimation of concentration of Iron from a given sample calorimetrically by using 1,10-phenanthroline.
- Estimation of Fe (II) in the given solution by titrating against $K_2Cr_2O_7$ potentiometrically.
- Gravimetric estimation of Sulfate as $BaSO_4$.
- Conductometric titration: Estimation of given acid with by conductometric titration with strong base (HCl Vs NaOH).

Inorganic Chemistry

- Estimation of total hardness of water (Standardization of EDTA is expected).
- Estimation of Fe from Ferrous ammonium sulphate solution.
- Inorganic preparation – Nickel dimethyl glyoxime using microscale method.
- Determination of strength of Oxalic acid and Potassium oxalate solution.

Organic Chemistry

- Qualitative Analysis of bi-functional organic compounds on the basis of
  1. Preliminary examination
  2. Solubility profile
  3. Detection of elements C, H, (O), N, S, X
  4. Detection of functional groups
  5. Determination of physical constants (M.P/B.P)

10

Scheme of Practicum Examination and Assessment Pattern

Total – 50 Marks

A. External Examination: Semester End Total Marks - 30 Time- 3.0 hour

Format of Question Paper

	Particulars	**Marks**
1	Experiment	25
2	Journal	5
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Particulars	Marks
1	Scheme development/numerical solving skills/Practical skills / collation of data	15
2	Active participation	5
	Total	**20**

11 REFERENCES:

A. Physical Chemistry:

1) Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2) Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3) Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4) Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)

B. Inorganic Chemistry:

1) Practical Inorganic Chemistry by G. Marr and B. W. Rockett van Nostrand Reinhold Company (1972)

C. Organic Chemistry:

1) Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2) Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3) Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
4) Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996

D. Analytical Chemistry:

1) D. A. Skoog, D. M. West, F. J .Holler, and S.R. Crouch, Analytical Chemistry: An Introduction, 7th ed. 1965, Chapter 15, pp. 345-381.
2) A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961).
3) R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y.(1974).
4) Some Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B. BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi 2001.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc. (Chemistry)

Semester- IV

Title: General Principles of Chemistry

Vertical - 2
(MINOR)

with effect from
Academic Year 2025-2026

Title: General Principles of Chemistry
[Course Code: CHMCHIV4]

Sr. No.	Heading	Particulars
1	**Description of the Course**	The course aims to acquaint the students to the fundamental concepts of Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Analytical Chemistry and their applications.
2	**Vertical**	2
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To understand polymer structures and polymerization **CO(A)2:** To Know various titrimetric methods and gravimetric analysis **CO(A)3:** To Understand the properties of transition elements and basics of co-ordination compounds **CO(A)4:** To Learn the chemical reactions involved in Halogenated hydrocarbons	
8	**Course Outcomes**: On completing the course, the student will be able to **CO1** know the significance of polymer chemistry **CO2** identify and apply appropriate titrimetric, gravimetric and instrumental method while doing analysis **CO3** understand chemistry of transition metals and co-ordination compounds **CO4** understand different reactions involved in Halogenated hydrocarbons	

9	**Syllabus** **General Principles of Chemistry I** **UNIT I: Physical Chemistry and Analytical Chemistry** **Basics of Polymer chemistry** • Basic Terms: Macromolecule, monomer, repeat unit, Polymerisation, (addition and condensation polymerization) Degree of Polymerisation • Polymer structures linear, branched and cross-linked • Molecular weight of Polymers: Definition and formulae of Number average molecular weight, weight average molecular weight Z- average molecular weight, and viscosity average molecular weight. (numerical expected) **Classical Analytical methods** • Classical methods: Titrimetry and Gravimetry • Terms involved in Titrimetric analysis, Types of titrimetric analysis with examples: i) Neutralisation (Acidimetry, alkalimetry) ii) Redox (Iodometry, Iodimetry) iii) Precipitation iv) Complexometric titrations • Gravimetry Principle, types and steps involved in precipitation gravimetry **Basic concepts in Instrumental methods** • Types and principle of analytical Instrumental methods (optical interaction, Electroanalytical interaction, Thermal Interaction) • Theory of UV visible spectroscopy, important Terms Used in spectroscopy , Theory of Colorimetry, Beer Lamberts law, Block diagrams for single beam n double Beam colorimeter (Principle, construction And working, details of components Expected), Block diagrams for single beam n double Beam spectrophotometer (Principle, construction and working, details of components Expected) **UNIT II: Inorganic and Organic Chemistry** **Inorganic Chemistry** • Study of oxides, volatile oxides and oxo acids • Oxides of nitrogen with respect to preparation and structure of NO, NO_2, N_2O and N_2O_4 • Volatile oxides and oxo acids of Sulphur and nitrogen • Uses and environment aspects of sulphuric acid and nitric acid with respect to acid rain and photochemical smog respectively **Organic Chemistry** • Reactions and reactivity of Halogenated hydrocarbon • Alkyl halides –nucleophilic substitution reactions:SN^1,SN^2 and SN^i mechanisms with stereochemical aspects and factors affecting nucleophilic substitution reactions, nature of substrate, solvent, nucleophilic reagent and leaving group. • Aryl Halides- reactivity of aryl halides towards nucleophilic substitution reactions. Nucleophilic aromatic substitution (S_NAr) addition-elimination mechanism and benzyne mechanism.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Theory Examination: Semester End Total Marks - 30 Time- 1.0 hour

Format of Question Paper

Question	Particulars	Marks
Q.1 Unit I	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
Q.2 Unit II	A) Objective Questions 06 out of 10	06
	B) Subjective Questions 03 out of 05	09
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Quizzes/Class Tests/presentation/ Project/real time assignment etc.	15
2.	Active participation	05
	Total 20	

11

REFERENCES:

Physical Chemistry

1) Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014).
2) Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
3) Keith J. Laidler & John H. Meiser, Physical Chemistry, 2nd Ed. (2004)
4) Puri B. R., Sharma L. R. & Pathania M. S. Principles of Physical Chemistry, Vishal Publishing Company, 2008
5) Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6) Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
7) Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
8) McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
9) Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).
10) Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

Analytical Chemistry

1) Analytical Chemistry, Gary D. Christan, Purnendu Dasgupta, 7th Edition, Wiley, 1965.
2) Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Holler, S. R. Crouch, 10th edition, 1967.
3) Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch, 7th edition, 1965.
4) Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, New academic sciences, 1997.
5) Modern Analytical Chemistry, David Harvey, 2nd edition, 2009.

Inorganic Chemistry

1) R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013 -2014
2) W. W. Porterfield, Inorganic Chemistry-A Unified Approach, 2nd Ed., Academic Press, 1993.
3) B. W. Pfennig, Principles of Inorganic Chemistry, Wiley, 2015.
4) C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, 2nd Edition 2005.
5) J. Huheey, F. A. Keiter and R. I. Keiter, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Ed., Harper Collins, 1993.
6) R. L. Dekock and H.B.Gray, Chemical Structure and Bonding, The Benjamin Cummings Publishing Company 1989.
7) G. Miessler and D. Tarr, Inorganic Chemistry, 3rd Ed., Pearson Education, 2004.
8) R. Sarkar, General and Inorganic Chemistry, Books & Allied (P) Ltd., 2001.
9) C. M. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd., 1985.
10) G. A. Jeffrey, An Introduction to Hydrogen Bonding, Oxford University Press, Inc., 1997.
11) D. Banerjea, Coordination Chemistry Tata McGraw Hill,1993.

Organic Chemistry

1) Organic Chemistry, Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers- Oxford University Press, 1975.
2) Stereochemistry of Organic Compounds, Ernest Eliel, Samual Wilen, A Wiley-Inter-science Publication, 1967.
3) Organic Chemistry, G. Marc Loudon (4th Edition) Oxford University Press, 1965.
4) Stereochemistry of Organic Compounds, Principles and Applications, D. Nasipuri, 4th Edition, New Academic Science, 1997.

Title: Practicals in General Principles of Chemistry
[Course Code: CHMCHIV5]

Sr. No.	Heading	Particulars
1	**Description of the Course**	The curriculum cultivates critical thinking skills, enabling students to approach complex chemical problems systematically, formulate logical arguments, and make informed decisions. This involves applying scientific understanding to design, execute, and interpret experiments, fostering an ability to analyze and troubleshoot real-world chemical challenges.
2	**Vertical**	2
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To introduce students to fundamental principles and techniques of physical chemistry through hands-on experiments, including potentiometric, colorimeter and pharmaceutical compound analysis with accuracy. **CO(A)2:** To introduce students to quantitative and preparative techniques in inorganic chemistry, including complexometric titrations and synthesis of coordination and inorganic compounds. **CO(A)3:** To familiarize students with fundamental organic synthesis techniques, including functional group transformations, substitution reactions, and recrystallization methods.	
8	**Course Outcomes**: Students will be able **CO1**: To verify theoretical chemical principles such as Ostwald's dilution law and chemical kinetics through practical measurements and data analysis. **CO2**: To perform complexometric titrations and synthesize coordination and inorganic compounds with proper stoichiometric control and laboratory techniques. **CO3**: To execute organic synthesis safely and efficiently, and of purifying and characterizing the products through melting point determination and recrystallization. **CO4**: To carry out estimation of aspirin, buffer capacity determinations, and estimation of iron by potentiometric titration.	

9

Syllabus

Physical chemistry

- To verify Ostwald's dilution law for weak acid conductometrically.
- To determine the critical solution temperature (CST) of phenol - Water System.
- Determination of the energy of activation of acid-catalyzed hydrolysis of methyl acetate.
- To determine the amount of HCl in the given sample potentiometrically.

Analytical Chemistry

- Determination of buffer capacity of acid buffer and basic buffer.
- Estimation of Aspirin
- Estimation of Fe (II) in the given solution by titrating against $K_2Cr_2O_7$ potentiometrically.

Inorganic Chemistry

- Identification of cations in a given mixture and analytically separating them [From a mixture containing not more than two of the following: Pb (II), Ba (II), Ca (II), Sr (II), Cu (II), Cd (II), Mg (II), Zn (II), Fe (II), Fe (III), Ni (II), Co (II), Al (III), C r(III)]
- Estimation of Zn^{2+} ion by titrating with EDTA (complexometric titration).
- Preparation of Tris (ethylenediamine) nickel (II) thiosulphate.
- Determination of strength of Hydrogen Peroxide solution.

Organic Chemistry

- Short organic preparation and purification: Use 0.5-1.0g/1.0-1.5 cm^3 of the organic compound. Purify the product by recrystallization. Report theoretical yield, percentage yield and melting point of the purified product. Preparation of:

1. Preparation of Oxime: Cyclohexanone oxime from cyclohexanone.
2. Preparation of Osazone: Glucosazone from dextrose or fructose.
3. Bromination: Tribromoaniline from aniline, p-Bromoacetanilide from acetanilide.
4. Nitration: m-Dinitrobenzene from nitrobenzene

10

Scheme of Practicum Examination and Assessment Pattern

Total – 50 Marks

A. External Examination: Semester End Total Marks - 30 Time- 3.0 hours

	Particulars	**Marks**
1	Experiment	25
2	Journal	5
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Particulars	Marks
1	Scheme development/numerical solving skills/Practical skills / collation of data	15
2	Active participation	5
	Total	**20**

11 REFERENCES:

Physical Chemistry practicals:

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)

Inorganic Chemistry practicals:

1. Practical Inorganic Chemistry by G. Marr and B. W. Rockett van Nostrand Reinhold Company (1972)

Organic Chemistry practicals:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
4. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996

Analytical Chemistry practicals:

1. D.A. Skoog, D.M. West, F.J. Holler, and S.R. Crouch, Analytical Chemistry: An Introduction,7th ed. 1965, Chapter 15, pp. 345-381.
2. A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961).
3. R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y.(1974).
4. Some Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B. BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi 2001.

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Second Year B. Sc. (Chemistry)

Semester- IV

Vertical – 3
(OPEN ELECTIVE)

with effect from
Academic Year 2025-2026

Faculty of Interdisciplinary

List of Skill Based Open Electives for Second Year: Semester – IV

Sr. No.	Semester IV Subject
1	Digital Interface, Web Design And Publishing
2	3D Modeling And Character Animation Fundamentals
3	Advance Tools Of AI For Economics And Education - II
4	English For Leadership and Strategic Communication
5	Urbanization And Real Estate: Applied Urban Planning, Design And Sustainable Cities
6	Travel Agency And Tour Operators Business
7	Managing Family Wealth Through Family Office-IV
8	Advanced Web Designing &Amp; Portfolio Development
9	Basics Of Nutrition - 4
10	Reel Strategy And Influencer Management
11	Preforming Art- Dance-4
12	Data Analysis Project Based Approach
13	Strategic Political Communication, Digital Governance And AI-Driven Public Engagement Skills
14	Psychology Of Personal Relationship-II
15	Digital Society And Social Change
16	Mushroom Cultivation Training And Trading Level 4
17	Pranayama And Yogic Breathing Practices
18	Perfumery Course Level 4
19	Career Launchpad: Communication And Employability Skills
20	Beautician: Strategic Business Planning -IV
21	Current Trends In Fashion Designing: Financial Perspective Level 4
22	Basics Of Accounting-IV
23	Digital Marketing -IV
24	Online Trading For Investment Management

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar (Autonomous)

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Second Year B. Sc. (Chemistry)

Semester- IV

Title: Skill Development in Essential Oil Extraction and Application (Practical)

Vertical – 4
(VSC)

with effect from
Academic Year 2025-2026

Title: Technical and Analytical skill Enhancement in Chemistry (Practical) [Course Code: CHMCHIV7]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course is to provide students with fundamental knowledge and practical skills in the extraction of essential oils from various plant-based natural sources. The course aims to familiarize learners with different extraction methods and their applications in value-added aromatic products
2	**Vertical**	4
3	**Type** **Teaching Methodology**	Practicum Experimental \ Demonstration \ Handling of instruments
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** Understand the principles and techniques of essential oil extraction from different plant parts such as leaves, fruit peels, and flowers. **CO(A)2:** Perform hands-on extraction of essential oils from selected plant materials. **CO(A)3:** Explore practical applications of extracted oils in the formulation of natural dhoop and scented wax candles.	
8	**Course Outcomes**: Upon Completion of this course student will be able to **CO1**: Explain the fundamental principles and techniques involved in the extraction of essential oils from various plant parts such as leaves, fruit peels, and flowers. **CO2**: Demonstrate the ability to perform hands-on extraction of essential oils from selected natural plant materials using appropriate extraction methods. **CO3:** Apply sustainable and eco-friendly practices in the extraction and utilization of essential oils.	
9	**Syllabus** • To discuss methods of extraction of essential oils from plant based natural sources. • Extraction of essential oil from foliage (plant leaves, Any one) Ex: Lemon grass/ Eucalyptus / Mint leaves • Extraction of essential oil from fruit peels (Any one) Ex: Orange/ Lemon • Extraction of essential oil from flowers (Any one) Parijatak (Coral jasmin), Gulchadi (Tuberose)/ Sonchafa (Plumeria). • Applications of extracted oil in the preparation of: a) Natural Dhoop b) Scented wax candles	

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End Total Marks - 30 Time- 2.0 hour

Format of Question Paper

	Particulars	**Marks**
1	Experiment	20
2	Journal	10
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	**Marks**
1.	Scheme development/numerical solving skills/Practical skills / collation of data	15
2.	Active participation	05
	Total 20	

11

REFERENCES:

1. D.A. Skoog, D.M. West, F.J. Holler, and S.R. Crouch, Analytical Chemistry: An Introduction,7th ed. 1965, Chapter 15, pp. 345-381.
2. A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961).
3. R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y.(1974).
4. Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B. BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi, 2001.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B.Sc.

Semester- IV

Vertical – 5

Ability Enhancement Course (English)
2 Credits

(To be offered to Students who opted Sindhi AEC in Sem I & II)

with effect from Academic Year 2025-2026

Title: Advanced Business Communication Skills

Course Code:

Title: Advanced English for Workplace and Academic Communication
Course Code: CHMBSCAECIV

Sr. No.	Heading	Particulars
1	**Description of the Course:**	In an increasingly competitive academic and professional landscape, learners require advanced communication skills that enable clarity, precision, critical thinking, and professionalism. This course focuses on practical, real-world communication abilities needed for college-level academic work, job applications, workplace collaboration, and digital interactions. Through hands-on tasks, real-world assignments, and communication practice, learners become adept in using English confidently and appropriately in diverse settings.
2	**Vertical 5**	**AEC: Advanced English for Workplace and Academic Communication**
3	**Type** Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: CO(A)1: To develop advanced communication skills required for academic and professional success. CO(A)2: To train learners in report writing, summary writing, and formal documentation. CO(A)3: To enhance proficiency in digital and virtual communication platforms. CO(A)4: To strengthen presentation, interview, and workplace communication skills. CO(A)5: To build confidence in expressing ideas clearly to varied audiences.	
8	**Course Outcomes**: After completing this course, learners will be able to: **CO-1:** Demonstrate clarity, precision, and professionalism in communication. **CO-2:** Interpret and summarize written texts, visuals, and data accurately. **CO-3:** Prepare well-structured reports, emails, and professional documents.	

CO-4: Use digital tools and virtual communication etiquette effectively.

CO-5: Communicate confidently in interviews, presentations, and teamwork situations

9

Syllabus

UNIT I: Communication for Academic & Professional Settings (15 Hours)

A. Communication in Academic & Workplace Contexts

1. Features of formal communication
2. Audience-centered communication
3. Ethics in communication: integrity, attribution, clarity
4. Explaining concepts in simple and clear language
5. Interpreting graphs, charts, tables, and infographics
6. Summarizing data concisely

B. Grammar & Style for Professional Writing

1. Tone: formal, neutral, objective
2. Avoiding redundancy and ambiguity
3. Active vs. passive structures
4. Editing, revising, and proofreading techniques

UNIT II: Practical Documentation & Employability Skills (15 Hours)

1. Report writing (academic/field-based/observational)
2. Project summary reports
3. Preparing short presentations
4. Creating informational posters or digital slides
5. Writing a formal complaint or request email
6. Creating a short informational or awareness write-up

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 1:00 hour

Format of Question Paper

All questions are compulsory:

Question No	Nature of Questions	Marks
Q. 1	**Short Notes** (Attempt any 3 out of 5) - **Unit 1** **OR** Attempt **Essay Type** question. (1 out of 2) - **Unit 1**	15
Q. 2	**Short Notes** (Attempt any 3 out of 5) - Unit 2 **OR** Attempt **Essay Type** question. (1 out of 2) - Unit 2	15
	Total	**30**

Internal Examination: Continuous Evaluation - 20 marks

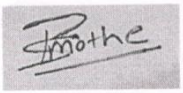
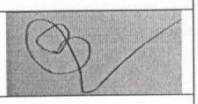
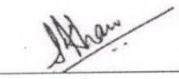
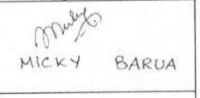
	Assessment / evaluation	Marks
1.	Assignments on **any one** of the following topics: Academic/Scientific Report/ Informational Poster / Digital Infographic (Students are required to use AI assistance in the preparation of their drafts. Eg: Notion AI, Otter.ai, Grammarly, Google Gemini, Canva, Piktochart, etc)	15
2.	Class Attendance and Participation	05
	Total	**20**

11

References:

1. Adler, Ronald B., et al. *Understanding Human Communication*. 15th ed., Oxford UP, 2021.
2. Bailey, Stephen. *Academic Writing: A Handbook for International Students*. 5th ed., Routledge, 2018.
3. Cargill, Margaret, and Patrick O'Connor. *Writing Scientific Research Articles*. Wiley-Blackwell, 2013.
4. Eastwood, John. *Oxford Guide to English Grammar*. Oxford UP, 2005.
5. Gerson, Sharon J., and Steven M. Gerson. *Technical Communication: Process and Product*. 9th ed., Pearson, 2021.
6. Hewings, Martin. *Advanced Grammar in Use*. Cambridge UP, 2013.
7. Kumar, Sanjay, and Pushp Lata. *Communication Skills*. 2nd ed., Oxford UP, 2018.
8. McCarthy, Michael, and Felicity O'Dell. *Academic Vocabulary in Use*. Cambridge UP, 2008.
9. Nordquist, Richard. *The Essentials of English Grammar*. McGraw-Hill Education, 2016.
10. Seely, John. *The Oxford Guide to Writing and Speaking*. Oxford UP, 2005.
11. Zinsser, William. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Perennial, 2016.

Syllabus Committee:

Sr. No	Name of the Faculty	Designation and College	Signature
1.	Prof. (Dr.) Kailas Aute	Professor & Head, Dept. of English, Smt. CHM College	
2.	Prof. (Dr.) B. R. Hiramani,	(VC Nominee, University of Mumbai) Pancham Khemraj College, Sawantwadi	
3.	Prof. (Dr.) Vikas Raskar	(Subject Expert outside University) Hutatma Rajguru Mahavidyalay, Rajguru Nagar, Khed, (Affiliated to Savitribai Phule University)	
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University	
5.	Mr. Ananda Pandhare	Asst. Professor, Dept. of English, Smt. CHM College	
6.	Ms. Sana Khan	Asst. Professor, Dept. of English, Smt. CHM College	
7.	Dr. Micky Barua	Faculty Vidyalankar Institute of technology, Alumni Member	
8.	Ms. Sofy Verghese	Accenture, Industry Representative	

Name & Signature of the Ad-hoc BoS Chairperson: Prof. (Dr). Kailas Aute

Name & Signature of the Dean: Prof. (Dr). Nitin Arekar

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year

Semester - IV

Title: Environmental Management and Sustainable Development - II

Vertical - 5
VEC Subject - 2 Credits

with effect from
Academic Year 2026-2027

Title: Environmental Management and Sustainable Development - II
Course Code: CHMVEC2

Sr. No.	Heading	Particulars
1	**Description the Course:**	This course examines the relationship between environmental pollution and human health, with detailed coverage of air, water, soil, noise, thermal, and radioactive pollution and their sources, standards, and impacts. It enables learners to understand pollution generation processes, waste management challenges, and the assimilative capacity of the environment. The course also introduces environmental laws, constitutional provisions, and regulatory frameworks, along with tools such as Environmental Management Systems (ISO 14001), life cycle analysis, and cost–benefit analysis. Emphasis is placed on sustainable practices, pollution control measures, the 3R concept, ecolabeling, and global initiatives such as the Sustainable Development Goals and Mission LiFE.
2	**Vertical 5**	VEC
3	**Type & Teaching Methods**	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To develop a comprehensive understanding of various types of environmental pollution, their sources, standards, and impacts on human health and ecosystems. **CO(A)2:** To familiarize students with environmental laws, constitutional provisions, and regulatory frameworks related to environmental protection and management. **CO(A)3:** To equip learners with knowledge of environmental management tools, pollution control measures, and sustainable waste management practices. **CO(A)4:** To create awareness about global and national sustainability initiatives such as the Sustainable Development Goals, Mission LiFE, and their role in achieving sustainable development.	

8	**Course Outcomes**: Student will be able to **CO1**: Identify and analyze different types of environmental pollution and assess their impacts on human health and ecological systems. **CO2**: Explain key environmental laws, constitutional provisions, and institutional mechanisms for environmental protection. **CO3**: Apply environmental management tools and sustainable waste management practices in real-world contexts. **CO4**: Evaluate sustainability initiatives such as the SDGs and Mission LiFE and relate them to environmental management and sustainable development practices.
9	**Syllabus** **UNIT I: Environmental Pollution and Health** • Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution. • Air pollution: Sources of air pollution; Primary and secondary pollutants; Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards. • Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. • Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. • Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. • Thermal and Radioactive pollution: Sources and impact on human health and ecosystems. **UNIT II: Environmental Management** • Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; • Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001 Life cycle analysis; Cost-benefit analysis • Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme. • Introduction to Millennium Development Goals, Sustainable Development Goals, & Mission Life.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 1:00 hours

Format of Question Paper

Attempt any 3 out of 4 questions.

Question No	Nature of Questions	Marks
Q1	Theory Question based on Unit I	10
Q2	Theory Question based on Unit I	10
Q3	Theory Question based on Unit II	10
Q4	Theory Question based on Unit II	10
TOTAL		**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Assignment / Project	10
2.	Case Study / Assignment	10
TOTAL		**20**

11

REFERENCES:

1. Barrow, C. J. (2012). *Environmental management for sustainable development* (2nd ed.). Routledge.
2. Doabia, T. S. (2023). *Environmental and pollution laws in India* (4th ed.). Eastern Book Company.
3. Kumar, S. (2009). *Environmental policies in India*. Northern Book Centre.
4. Rajagopalan, R. (2023). *Environmental studies* (4th ed.). Oxford University Press India.
5. Rogers, P. P., Jalal, K. F., & Boyd, J. A. (2007). *An introduction to sustainable development*. Earthscan.
6. Singh, J., Singh, A., & Gupta, S. (2019). *Environmental science and engineering*. New Age International Publishers.

Sr No	Name of the Faculty	Designation and College	Signature
1.	Dr. Sunil Lalchandani	Dean, Faculty of Interdisciplinary	

SMT. CHANDIBAI HIMATHMAL MANSUKHANI COLLEGE ★ ULHASNAGAR 421 003.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc. (Chemistry)

Semester- IV

Title: Analysis of water samples for chemical parameters

Vertical – 6
(FIELD PROJECT)

with effect from
Academic Year 2025-2026

Title: Water Quality Management
[Course Code: CHMCHIV8]

Sr. No.	Heading	Particulars
1	**Description of the Course**	Chemistry field project involves applying chemical principles and techniques in real-world settings, often outside a traditional laboratory environment. It can involve investigating environmental issues, analyzing industrial processes, or studying the chemistry of everyday materials. Introduction of fileld project course under NEP would bridge theoretical knowledge with practice and enhance awareness of scientific temperament .Field project course shall certainly foster a deeper understanding of environmental and socio-economic issues., developing practical skills, and exploring research methodologies. Field projects also aim to promote teamwork, problem-solving, and ethical conduct.
2	**Vertical**	6
3	**Type** **Teaching Methodology**	Practical Experimental \ Demonstration \ Handling of instruments
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To provide students with a holistic learning experience that combines theoretical knowledge with practical application. **CO(A)2:** To connect Classroom Learning to Real-World Situations **CO(A)3:** To Develop Practical and Research Skills **CO(A)4:** To Understand Social Issues and Contributing to Solutions	
8	**Course Outcomes**: Upon completion of the course, student will be able to **CO1:** apply effectively theoretical knowledge in practical situations. **CO2:** identify problems, collect data, analyze information, and propose solutions. **CO3:** understand the value of teamwork, collaboration and communication skills. **CO4:** enhance Interdisciplinary approach by integrating knowledge from different areas of Chemistry, such as analytical chemistry, organic chemistry, and environmental chemistry.	

9

Syllabus

Experiments

1. Sample collection and preservation by applying sampling techniques
2. Analysis of water samples for determination of Total hardness using complexometric titration
3. Analysis of water samples for determination of Total acidity and alkalinity
4. Analysis of water samples for detection of metals /chloride/phosphate using qualitative analysis
5. Analysis of water samples for determination of Dissolved oxygen

Activities:

1. preparation of flow sheets/charts /posters for sources of water pollution (any one)

2. write up on inferences of water analysis

3. Preparation of summary report of water analysis

10

Scheme of Practicum Examination and Assessment Pattern

Total – 50 Marks

A. External evaluation pattern: Semester End Total Marks - 30

Criteria-	**Marks**
Experimental summary Report (journal)	**20**
Viva	**10**

B. Internal evaluation pattern: Semester End Total Marks - 20

Experimental performance	15
Activity participation	5

11	**REFERENCES:** 1. D.A. Skoog, D.M. West, F.J. Holler, and S.R. Crouch, Analytical Chemistry: An Introduction,7th ed. 1965, Chapter 15, pp. 345-381. 2. A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961). 3. R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y.(1974). 4. Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B. BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi, 2001.

HSNC Board's
Smt. Chandibai Himathmal Mansukhani College
(Autonomous)
Affiliated to the University of Mumbai

Bachelors of Science (Chemistry)
(Aided)

As per NEP 2020

With Effect From the Academic Year 2026-2027

PREAMBLE

The Bachelor of Science (B.Sc.) in Chemistry programme for Semester V and VI has been designed in accordance with the recommendations of the **National Education Policy (NEP) 2020**, with the objective of providing students a comprehensive, multidisciplinary, and outcome-based education in Chemical Sciences. The curriculum aims to strengthen the fundamental understanding of Physical, Organic, Inorganic, and Analytical Chemistry while fostering scientific temper, critical thinking, problem-solving abilities, and practical competencies required in the modern scientific world.

The programme integrates advanced theoretical concepts with extensive laboratory training to develop analytical, experimental, and research skills among learners. Courses in spectroscopy, thermodynamics, polymer chemistry, chromatography, organometallic chemistry, stereochemistry, natural products, and analytical techniques provide students with a strong academic foundation and exposure to contemporary developments in chemistry. Practical courses are designed to enhance proficiency in chemical synthesis, instrumental analysis, data interpretation, and laboratory safety practices.

In alignment with the holistic vision of NEP 2020, the curriculum incorporates experiential and skill-based learning through Vocational Skill Courses, On-the-Job Training, Field Projects, and elective courses such as Drugs and Dyes. The inclusion of the Indian Knowledge System highlights the rich scientific heritage of India and promotes appreciation of indigenous contributions to chemical sciences.

The programme emphasizes quality assurance, ethical scientific practices, environmental sustainability, and responsible application of chemical knowledge. It prepares students for higher education, research, entrepreneurship, and careers in chemical, pharmaceutical, environmental, and allied industries. Overall, the curriculum seeks to develop competent, innovative, and socially responsible chemistry graduates equipped to meet the challenges of a rapidly evolving scientific and technological landscape.

PROGRAMME OUTCOMES (POs)

1. Demonstrate comprehensive knowledge and understanding of scientific concepts, principles, theories, laboratory practices, and applications in the chosen discipline to address scientific and societal challenges.
2. Critically evaluate scientific information, analyze qualitative and quantitative data, assess evidence from multiple sources, and draw logical, evidence-based conclusions
3. Apply scientific methods, laboratory techniques, experimental procedures, instrumentation, and quantitative skills to investigate and solve biological and interdisciplinary problems.
4. Formulate research questions, design and conduct investigations, collect and interpret data, apply appropriate statistical methods, respect intellectual property, and communicate research findings effectively.
5. Effectively use ICT, digital resources, computational tools, bioinformatics, artificial intelligence applications, and statistical software for scientific learning, research, and decision-making.
6. Communicate knowledge effectively through written reports, oral presentations, scientific publications, visual media, and interpersonal interactions with diverse audiences.
7. Apply scientific knowledge for biodiversity conservation, environmental protection, sustainable development, public health awareness, and community service through responsible citizenship.
8. Demonstrate integrity, ethical conduct, biosafety, academic honesty, respect for intellectual property, and professional responsibility in scientific practice and research.
9. Work effectively as an individual and as a member or leader of multidisciplinary teams by demonstrating leadership, collaboration, inclusiveness, and professional responsibility.
10. Demonstrate self-directed learning, reflective thinking, adaptability to emerging technologies, and commitment to continuous professional development throughout life.
11. Apply scientific knowledge, creativity, innovation, and entrepreneurial skills for employment, higher education, research, startups, and societal development.
12. Demonstrate constitutional values, social responsibility, multicultural competence, empathy, respect for diversity, gender equity, and commitment to national and global well-being.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

After completion of Bachler of Chemistry program students will be able to,

PSO1: Comprehend knowledge of advanced concepts in Physical, Organic, Inorganic, and Analytical Chemistry and apply them to solve chemical problems in academic, industrial, and research settings.

PSO2: Design, execute, and interpret laboratory experiments, chemical syntheses, and research-based investigations while adhering to laboratory safety, ethical practices, and quality assurance protocols.

PSO3: Apply chemical principles to interdisciplinary areas such as pharmaceuticals, materials science, environmental monitoring, metallurgy, polymers, and industrial processes, environmental sustainability, and get acquainted with sophisticated analytical equipments thereby enhancing employability and entrepreneurship potential.

PSO4: Develop critical thinking, scientific communication, data analysis, and problem-solving skills, research pursuits, and professional growth in chemistry and allied fields.

PSO5: Appreciate the contributions of the Indian Knowledge System and sustainable chemical practices, and apply scientific knowledge responsibly for societal and environmental well-being

Program Structure for Sem. V & VI (NEP 2020)

Vertical No		Paper Title	Credits
Sem. V			
1.	**Mandatory**	**Advanced Physical and Analytical Chemistry - Paper I**	**2**
		Advanced Analytical and Inorganic Chemistry – Paper II	**2**
		Advanced Inorganic and Organic Chemistry – Paper III	**2**
		IKS in Chemistry	**2**
		Practical in Advanced Chemistry - I	**2**
	Electives	**Drugs and Dyes**	**2**
		Practical in Drugs and Dyes	**2**
2.		**Minor (To be selected from other discipline)**	2(1T+1P)
3		**CC**	**2**
4.	**VSC (Practical)**	**Techniques in Chemical Analysis and Synthesis**	**2**
5.		**FP- Efficacy of household disinfectants**	**2**
		Credits	**22**
Sem. VI			
1.	**Mandatory**	**Advanced Physical Chemistry – Paper IV**	**2**
		Advanced Inorganic Chemistry – Paper V	**2**
		Advanced Organic Chemistry – Paper VI	**2**
		Advanced Analytical Chemistry – Paper VII	**2**
		Practicals in Advanced Chemistry - II	**2**
		Practicals in Advanced Chemistry - III	**2**
		Industrial aspects of chemistry	2(1T+1P)
	Electives	**Drugs and Dyes**	**2**
		Practical in Drugs and Dyes	**2**
6.	**VI**	**OJT**	**4**
			22
		Total Credits	**44**

HSNC Board's
Smt. Chandibai Himathmal Mansukhani College
(Autonomous)
Affiliated to the University of Mumbai

Third Year B. Sc.
(Chemistry)

Syllabus for Semester – V

As per NEP 2020

With Effect From the Academic Year 2026-2027

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - V

Title: Major/ Mandatory
Advanced Physical and Analytical Chemistry
Vertical 1

With effect from
Academic Year 2026 - 2027

Title: Major Chemistry
Advanced Physical and Analytical Chemistry - Paper I
[Course Code: CHMCHEMV1]

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**	V1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion/ Demonstration/ Presentation/ Real time Problem Solving
4	**Credits**	02
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives** The course aims to: **CO (A) 1:** Introduce the fundamental principles of molecular spectroscopy understanding of rotational and vibrational spectroscopy and applications in chemical science **CO (A) 2:** Understand the fundamental principles of molecular spectroscopy, including rotational and vibrational spectroscopy, and their applications in chemical sciences. **CO (A) 3:** Apply the concepts of chemical thermodynamics and colligative properties to solve problems related to molecular mass determination **CO (A) 4:** Analyze adsorption phenomena, adsorption isotherms, and polymer characteristics, including methods for molecular weight determination.	
8	**Course Outcomes:** Upon completion of the course, students will be able to: **CO1:** Explain the basic concepts of spectroscopic method, molecular energy levels, spectroscopic transitions and applications. **CO2:** Apply thermodynamic relations and colligative property concepts to determine molecular masses and solve related numerical problems. **CO3:** Analyze adsorption behavior using adsorption isotherms, classify polymers, and determine polymer molecular weights using viscosity methods. **CO4:** Interpret the principles and applications of spectroscopic instruments and evaluate the role of quality assurance practices such as GLP and GMP in chemical laboratories.	

9	Syllabus	
		MODULE 1: Physical Chemistry (15 Hours)
	1.1	**Molecular Spectroscopy (10 Hours)** **Introduction**: Definition of Spectroscopy, Electromagnetic radiation, Inter-conversion of units, Electromagnetic Spectrum, Molecular energy levels. **Rotational Spectroscopy**: Introduction: 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. Infrared spectra of simple molecules like H_2O and CO_2. (Numerical expected) **Chemical Thermodynamics: (5 Hours)** **Colligative Properties**: vapor pressure and relative lowering of vapour pressure, (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)
		MODULE 2 Physical and Analytical Chemistry(15Hrs) **Surface Chemistry: (4 Hours)** **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. ((Numerical expected) **Polymer chemistry: (3 Hours)** Recapitulations: Basic terms of polymer Classification of polymer: Classification based on Source, Thermal response, physical properties Method of determination molar masses of polymer: Viscosity method using Ostwald Viscometer (derivation and numerical expected), Light Emitting Polymer: Introduction, Characteristics, Method of preparation and applications. **Spectroscopic Techniques and Their Analytical Applications (4 Hours)** Introduction, Spectrometer and components of spectrometer Type of spectrometry, Principle, basic instrumentation and applications: Mass spectrometry, UV-Visible and FTIR, AAS, Raman spectrometry, Analyzing spectra for qualitative and quantitative data

Quality in Analytical Chemistry (4 Hours)

Concepts of Quality, Quality Control and Quality Assurance
Introduction to Good laboratory Practices (GLP) and Good manufacturing Practices (GMP) Safety precautions in laboratories Chemical Standards and Certified Reference Materials: Importance in chemical analysis Quality of material: Various grades of laboratory reagents

10 Scheme of Examination and Assessment Pattern

Paper - 50 Marks

A. External Examination: Semester End External - 30 marks Time: 1.0 hour

Format of Question Paper

Scheme 1 - Proposed Theory Question Paper Pattern

Question No.	Nature of Questions	Module	Marks
Q1	Attempt any 03 out of 06	1	15
Q2	Attempt any 03 out of 06	2	15
	Total		**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Tests	10
2.	Classroom Activity Participation (worksheet/open book)	10
	Total	**20**

11 REFERENCES:

1. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford University Press Oxford.
2. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
3. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
4. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co. Ltd.
5. Chemical Kinetics, K. Laidler, Pearson Education India, 1987.
6. A Textbook of Physical Chemistry - Dynamics of Chemical Reactions, Statistical Thermodynamics, Macromolecules and Irreversible Processes| Volume 5, 3rd Edition by K.L Kapoor, McGraw Hill Education.
7. E Prichard, Quality in the analytical chemistry laboratory, John Wiley and sons N.Y 1997
8. E Prichard, Quality in the analytical chemistry laboratory, John Wiley and sons N.Y 1997

	9. W Funk, V Dammann, G. Donnevert, Quality assurance in analytical Chemistry, VCH Weinheim 1995. 10. Douglas A. Skoog, Donald M. West, F. James Holler, and Stanley R. Crouch, Fundamentals of Analytical Chemistry, 7th edition , 1995 11. Gary D. Christian, Purnendu K. Dasgupta, and Kevin A. Schug, Analytical Chemistry, 5th edition, 2013 12. Francis F.Pitard and Maxime A.Pitard, Theory of sampling and sampling practice by CRC Press, 4th Edition, 2025 …….

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - V

Title: Major/ Mandatory
Advanced Analytical and Inorganic Chemistry

Vertical 1

With effect from
Academic Year 2026 - 2027

Title: Major Chemistry
Advanced Analytical and Inorganic Chemistry – Paper II
[Course Code: CHMCHEMV2]

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**	V1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion/ Demonstration/ Presentation/ Real time Problem Solving
4	**Credits**	02
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives** The course aims to: **CO (A) 1**: To introduce and explain students to the principles, instrumentation, and analytical applications of atomic spectroscopy techniques. **CO (A) 2:** Apply the concepts of chemical thermodynamics and colligative properties to solve problems related to molecular mass determination. **CO (A) 3:** Analyze adsorption phenomena, adsorption isotherms, and polymer characteristics, including methods for molecular weight determination. **CO (A) 4:** Explain the principles, instrumentation, applications of spectroscopic techniques, and the importance of quality assurance practices in analytical chemistry.	
8	**Course Outcomes:** **At the end of the course, students will be able to:** **CO1**: Explain the principles, instrumentation, advantages, limitations, and applications of spectroscopy techniques. **CO2**: Apply qualitative and quantitative analytical methods in spectroscopic techniques for chemical analysis. **CO3**: Analyze the factors affecting solvent extraction and evaluate the role of chelation, ion-pair formation, and solvation in separation processes. **CO4**: Interpret the principles, instrumentation, detectors, and applications of gas chromatography and distinguish between GSC and GLC techniques.	
9	**Syllabus** **MODULE 1: Analytical Chemistry (15 Hours)** **Atomic Spectroscopy: (8hours)** Flame Emission spectroscopy(FES) and Atomic Absorption Spectroscopy(AAS): Introduction to	

spectroscopy : Types of spectra Introduction to Atomic spectroscopy : Absorption and Emission Spectra

Flame Photometry – Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors)

Atomic Absorption Spectroscopy – Principle, Instrumentation

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

Separation techniques : (7Hours)

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, apparatus and 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 (**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

Module 2 :Inorganic Chemistry(15hours)

Molecular symmetry (4 Hours)

Introduction and Importance of Symmetry in Chemistry.

Symmetry elements and Symmetry operations.

Concept of a Point Group with illustrations using the following point groups: (i) $C_{\infty V}$ (ii) $D_{\infty h}$ (iii) C_{2V} (iv) C_{3v} (v)C_{2h} and (vi)D_{3h}

Chemical Bonding(4hours)

Comparison between homonuclear and heteronuclear diatomic molecules.

Heteronuclear diatomic molecules like CO, NO and HCl

Metal Toxicity and Remediation (4 Hours)

Examples of Metal toxicity and mechanism, speciation, sources, Hazardous effect of metal toxicity; Remediation; advanced measures to reduce metal toxicity, case studies (minimum2

Chemistry of Interhalogens (3hours)

Preparation, properties and structures(XY3,XY5,XY7)on the basis of VSEPR

10

Scheme of Examination and Assessment Pattern

Paper - 50 Marks

B. External Examination: Semester End External - 30 marks Time: 1.0 hour

Proposed Theory Question Paper Pattern

Question No.	Nature of Questions	Module	Marks
Q1	Attempt any 03 out of 06	1	15
Q2	Attempt any 03 out of 06	2	15
	Total		**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Test	10
2.	Classroom Activity Participation (worksheet/open book)	10
	Total	**20**

11

REFERENCES:

1 Analytical Chemistry, Gary.D Christan, 5th edition

2 Analytical Chemistry, Skoog, West ,Holler,7th Edition

3 Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International

4 Limited Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969

5 Fundamentals of Analytical Chemistry by Skoog and West , 8th Edition

6 Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition,CBS Publisher and distribution Pvt Ltd

7 Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House

8 Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman

9 Gary Wulfsberg, Inorganic chemistry, Viva Books Pvt. Ltd., 2002.

10 J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi, Inorganic chemistry- Principles of structure and reactivity, 4th edition,

11 Pearson, 2006. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press1999.

12 R. L. Carter, Molecular symmetry and group theory, John Wiley & Sons, New York,1998.

13 B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013-2014. W. W. Porterfield, Inorganic Chemistry-A Unified Approach, 2nd Ed., Academic Press, 1993.

14 J. Huheey, F. A. Keiter and R. I. Keiter, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Ed., Harper Collins, 1993.

15 G. Miessler and D. Tarr, Inorganic Chemistry, 3rd Ed., Pearson Education, 2004

16 C. J. Ballhausen and H. B. Gray, Molecular orbital Theory, McGraw-Hill, New York, 1965.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - V

Title: Major/ Mandatory
Inorganic Chemistry & Organic Chemistry

Vertical 1

With effect from
Academic Year 2026 - 2027

Title: Chemistry III (Organic Inorganic Chemistry)

[Course Code: CHMCHEMV3]

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**	V1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	02
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO (A) 1** To explain the students about structure, properties, synthesis of organometallic compounds and the concept of Molecular chirality. **CO (A) 2** To familiarize students with basics of pericyclic reactions including discussion on reactions that involve a cyclic transition state and the fundamental aspects of photochemical reactions including their mechanisms. **CO (A) 3** To develop a comprehensive understanding of the natural products viz. terpenoids, alkaloids, hormones and equip the learners with the skills to assign the IUPAC names to Cummulenes, Spiro & Bicyclic compounds. **CO (A) 4** To build the conceptual clarity of the analytical techniques viz. UV-Visible and Mass Spectroscopy with emphasis on theoretical principles and instrumentation basics in order to make the learners understand the fundamental principles of Spectroscopy.	
	Course Outcomes: Upon completion of the course, student will be able to… **CO1** understand organometallic compounds in terms of preparation, molecular geometries, bonding modes, chemical reactivity and Molecular Chirality of organic compounds like Cumulenes & Biphenyls. **CO2** predict the stereochemical outcomes, mechanisms of Pericyclic reactions and common photochemical transformations **CO3** understand the basics of natural products including Terpenoids, Alkaloids & Hormones and apply the knowledge of IUPAC nomenclature to assign the systematic names to Spiro and Cumulenes, Spiro and Bicyclic compounds. **CO4** understand the fundamental principles of analytical techniques viz. UV- Visible and Mass Spectroscopy and apply them for structural elucidation.	

SYLLABUS

MODULE 1: Inorganic and Organic Chemistry (15 Hours)

Inorganic Chemistry (8 Hours)

Organometallic chemistry of Main group metals (8 Hours)

- Introduction to organometallic chemistry: General characteristics of various types of organometallic compounds, viz. ionic, s-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
- Industrial applications of organometallic compounds.

Organic Chemistry (7 Hours)

Stereochemistry I (3 Hours)

- 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.

Pericyclic Reactions and Photochemistry (4 Hours)

- Basics of Pericyclic reactions: Characteristics and Classification
- Electrocyclic reactions, Cycloaddition, Sigmatropic Rearrangement, Group transfer reactions, Cheletropic reactions (General characteristics and one example of each is expected)
- Basics of Photoreactions: Characteristics, Difference between thermal and photochemical reactions. Jablonski diagram, Photosensitization.
- Photochemical reactions of olefins and carbonyl compounds: Photochemical rearrangement of 1,4-dienes (di-π methane), Norrish I & Norrish II cleavages, Photo reduction (e.g. benzophenone to benzpinacol).

MODULE 2: Organic Chemistry (15 Hours)

Natural Products (04 Hours)

- Introduction and Classification of Natural Products
- Terpenoids: Introduction, Isoprene rule, Special isoprene rule and Gem-Dialkyl rule, 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, Harmful effects of Nicotine Hormones: Introduction, Example of Adrenaline, Synthesis of Adrenaline from Catechol & Ott's Synthesis

IUPAC Nomenclature (04 Hours)

- Introduction to the IUPAC Systematic nomenclature
- IUPAC 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 e.g. Biphenyls & Cumulenes

UV - Visible Spectroscopy (04 Hours)

- Introduction to Organic 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 (03 Hours)

- Basic theory, Nature of mass spectrum, Mass Spectrometer
- Importance of Molecular ion peak, Isotopic peaks, Base peak, Nitrogen rule, General rules of fragmentation

Scheme of Examination and Assessment Pattern

Paper - 50 Marks

C. External Examination: Semester End External - 30 Marks Time: 1.0 Hour

Format of Question Paper

Scheme 1 - Proposed Theory Question Paper Pattern

Question No.	Nature of Questions	Marks
Q1	Module I (Attempt any 03 out of 06)	15
Q2	Module 2 (Attempt any 03 out of 06)	15
	Total	**30**

Internal Examination: Continuous Evaluation - 20 Marks

Sr. No	Assessment / Evaluation	Marks
1	Test	10
2	Classroom Activity Participation	10
	Total	**20**

References:

Module 1: Inorganic and Organic Chemistry

1. U. Muller, Inorganic structural chemistry, 2nd Edition, Wiley 2007.
2. Robert H. Crabtree, The Organometallic Chemistry of the Transition metals.
3. B D Gupta & Anil J Elias Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University press.
4. Ram Charan Mehrotra, Organometallic Chemistry: A Unified Approach, New Age International.
5. Organometallic chemistry, edited by Hiroshi Nakazawa, Royal society of Chemistry.
6. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
7. Stereochemistry of Carbon Compounds, E. L. Eliel, Tata McGraw Hill.
8. Stereochemistry Conformation and Mechanism (Eleventh Edition), P.S. Kalsi, New Age International Publishers.
9. Stereochemistry of Organic Compounds: Principles and Applications (Fourth Edition), D. Nasipuri, New Age International Publishers.
10. A guidebook to mechanism in Organic Chemistry (Sixth Edition), Peter Sykes, Pearson education, New Delhi.
11. Organic Reaction Mechanism (Fourth Edition), V. K. Ahluwalia, R. K. Parashar, Narosa Publication.
12. Organic Reactions and their Mechanisms (Third Revised Edition), P.S. Kalsi, New Age International Publishers.
13. Advanced Organic Chemistry- Reactions Mechanism and Structure (Seventh Edition), J. March and M. B. Smith, Wiley Student Edition.
14. Organic Chemistry (Seventh Edition), R.T. Morrison, R.N. Boyd & S. K. Bhattacharjee, Pearson.
15. Organic Chemistry (Eighth Edition), John McMurry
16. Natural Products, Vol I and Vol II (First E dition), O. P. Agarwal, Krishna Publications.
17. Chemistry of Natural Products (First Edition), S. V. Bhat, B. A. Nagasampagi, M. Sivakumar, Springer Narosa Publication.
18. Organic Chemistry (Seventh Edition), R. T. Morrison, R. N. Boyd and S. K. Bhattacharjee, Pearson Education.
19. Organic Chemistry, Vol II, (Fifth Edition), I. L. Finar, Pearson Education.
20. Natural Products Chemistry (First Edition), K. Nakanishi, T. Goto, Academic Press

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - V

Title: Major/ Mandatory
Practicals in Advanced Chemistry - I
Vertical 1

With effect from
Academic Year 2026 - 2027

Title of Paper: Practical in Advanced Chemistry - I
[Course Code: CHMCHEMV4]

Sr. No.	Heading	Particulars
1	**Description of the course:** **Including but Not limited to:**	**Practicals in Advanced Chemistry – I** provides hands-on training in physical and inorganic chemistry techniques, instrumental methods, and inorganic synthesis. The course develops laboratory skills for determination of molecular weight, reaction kinetics, solubility product, adsorption phenomena, and quantitative estimation using potentiometric, conductometric, pH-metric and colorimetric methods. It also includes synthesis of coordination compounds and volumetric analysis using redox and complexometric titrations. Emphasis is placed on accuracy in experimentation, interpretation of results, scientific reporting, and application of good laboratory practices relevant to academic research and chemical industries.
2	**Vertical:**	I (Major)
3	**Type:**	Practicals
4	**Credit**:	2 credits
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: **The course aims to:** **CO (A) 1:** Develop an understanding of physicochemical principles and apply them to determine reaction kinetics, polymer molecular weight, adsorption behavior, and quantitative chemical analysis using instrumental and non-instrumental methods. **CO (A) 2:** Demonstrate proficiency in the operation of analytical instruments such as conductometers, pH meters, colorimeters, and viscometers for data collection and interpretation. **CO (A) 3:** Analyze experimental observations and analytical data to draw scientifically valid conclusions regarding chemical reactions, equilibria, and complex formation. **CO (A) 4:** Develop practical skills in the synthesis, estimation, and characterization of inorganic coordination compounds using standard laboratory techniques and safety practices.	

8	**Course Outcome:** Upon successful completion of the course, students will be able to: **CO1:** Perform physicochemical experiments involving kinetics, adsorption, viscosity, conductometry, pH-metry, and colorimetry and accurately record experimental observations. **CO2:** Calculate and interpret physicochemical parameters such as molecular weight, rate constants, adsorption characteristics, and solution concentrations from experimental data. **CO3:** Prepare coordination compounds and carry out volumetric and complexometric estimations using appropriate reagents, indicators, and laboratory techniques. **CO4:** Evaluate experimental results, determine sources of error, and present scientific findings systematically while adhering to laboratory safety and good laboratory practices.
9	**Modules**:
	Module 1: Physical chemistry experiments
	Non-Instrumental Experiments: 1) To determine the molecular weight of polymer by Using Ostwald viscometer. 2) To interpret the order of reaction graphically from the given experimental data and calculate the specific rate constant. **Instrumental Experiments:** 1) To estimate the amount of Fe (III) in the complex formation with salicylic acid by Static method. 2) To determine the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method. 3) To find out the strength of sodium carbonate solution by titrating it against HCl pH metrically. 4) To study the adsorption of certain dyes such as methyl violet, picric acid or malachite on charcoal colorimetrically.
	Module 2: Inorganic chemistry experiments
	Inorganic Preparations and Estimations 1) Preparation of potassium trioxalato chromate (III) complex 2) Preparation of bis acetylacetonato Copper (II) 3) Preparation of Potassium dioxalatocuprate (II), $K_2[Cu(C_2O_4)_2]$ 4) Complexometric titration of Al^{3+} with Xylenol Orange (Back Titration) 5) Estimate the amount of iron present in the given ferric alum solution by using dichromate solution and diphenyl amine indicator 6) Estimation of Nickel using EDTA (Complexometric) using Murexide indicator

10	**Reference Books:** **Module 1: Physical Chemistry** 1 A. M. James and F.E. Prichard, Practical Physical Chemistry Longman publication, 3rd edition,1974 2 R.C. Das and B. Behra, Experiments in Physical Chemistry, Tata Mc Graw Hill, 1983 3 J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2006 4 J. N. Gurtu and R Kapoor, Advanced Experimental Chemistry., S. Chand and Co. Vol I, 1980 5 V.D.Athawale, Experimental Physical Chemistry, New Age International (P) Limited, 2001 6 B. D. Khosla, V. C. Garg and A. Gulati, Senior Practical Physical Chemistry, R Chand and Co.. 2011 **Module 2: Inorganic chemistry** 1 A. I. Vogel, Quantitative Inorganic Analysis, Longman Scientific and Technical, 5th Edn, 1989. 2 J. D. Woollins, Inorganic Experiments. John Wiley and Sons, 2010 3 W. G. Palmer, Experimental Inorganic Chemistry, Cambridge University Press, 1954 4 G. Raj, Advanced Practical Inorganic Chemistry. Goel Publication, 2010 5 J. E. House, Inorganic chemistry, Academic press, 2nd edition, 2013. 6 G. N. Mukherjee, Advanced Experiments in Inorganic Chemistry., U. N. Dhur & Sons Pvt. Ltd. 2010. 7 W. Conard Fernelius, Inorganic syntheses, Mc-Graw Hill, Vol.II, 1946. 8 G. Pass and H. Sutcliffe, Practical Inorganic Chemistry- Preparation, reactions and instrumental methods, Springer, 2nd edition.1974. 9 G. Marr and B. W. Rockett, Practical Inorganic Chemistry, Van Nostrand Reinhold Company 1972. 10 G. Christian, Analytical Chemistry, John Wiley, New York 4th edition 1986.	
11	**A. Internal Continuous Assessment: 40% (20Marks)**	**B. External, Semester End Examination 60% (30Marks) Duration : 3hrs**
	Continuous Evaluation through: Viva, scheme hypothesis, Test, Assignment (any 2)	Experiment from module1or 2 – 25 marks Journal – 5 Marks

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - V

Title: Major/ Mandatory
Indian Knowledge System in Chemistry

Vertical 1

With effect from
Academic Year 2026 - 2027

Title: Indian Knowledge System (Metallurgy in Ancient India)

[Course Code: CHMCHEMV5]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course explores the scientific, technological, and philosophical foundations of metallurgy in ancient India. It examines mining, metal extraction, alloy production, zinc distillation, wootz steel, corrosion-resistant iron, and metallurgical innovations documented in classical texts and archaeological evidence, highlighting their relevance to the history and development of chemical sciences.
2	**Vertical**	V1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	02
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**CO (A) 1:** Explain the philosophical foundations and scientific principles underlying ancient Indian metallurgical practices, including Mahābhūta theory, Rasavāda, mining, and metal extraction. **CO (A) 2:** Analyze ancient metallurgical processes involved in the production of copper, bronze, brass, zinc, iron, and steel using historical, archaeological, and scientific evidence. **CO (A) 3:** Examine the technological innovations associated with zinc distillation, Wootz steel production, and corrosion-resistant iron structures from a modern metallurgical perspective. **CO (A) 4:** Evaluate the contributions of ancient Indian metallurgy to the development of materials science and their relevance to contemporary scientific and technological advancements.	
8	**CO1:** Describe the evolution of ancient Indian metallurgical knowledge and explain the concepts of Mahābhūta theory, Rasavāda, mining, and metal processing. **CO2:** Analyze the chemical and metallurgical principles involved in ore beneficiation, extraction, alloy preparation, casting, forging, and metal testing techniques practiced in ancient India **CO3:** Interpret case studies such as the Zawar zinc industry, Wootz steel, Delhi Iron Pillar, and Konark iron structures using modern scientific concepts and metallurgical evidence. **CO4:** Evaluate the scientific significance and global impact of ancient Indian metallurgical innovations and assess their contribution to the advancement of materials science and engineering.	

9	**Syllabus** **Module 1: Metallurgy in Ancient India(15Hours)** **Philosophical & Conceptual Foundations (2 hrs)** The Mahābhūta theory & material transformation Pañca Mahābhūta (Earth, Water, Fire, Air, Ether) as qualitative chemical elements. • Pāka (heat/cooking) as the driver of transformation – from raw ore to refined metal. • Bhūta-saṅkrānti (elemental transmutation) – e.g., ore → metal → jewel. Rasavāda & the mercury tradition • Rasa (essence/elixir) – not just mercury but the principle of potency. • Pārada (mercury) as the supreme transformative substance. • Dhatu-vada (metals as medicines) vs. **Rasayana** (alchemical rejuvenation). **Mining, Assay & Early Extractive Metallurgy (5 hrs)** Mining in ancient India • Arthashastra (4th-3rd c. BCE) on mining administration, types of mines (*ākara*). • Ores mentioned: *suvarna* (gold), *rajata* (silver), *tāmra* (copper), *sīsa* (lead), *tīkṣṇa* (tin), *vajra* (di amond/quartz). • Śukranīti (later text) on ore washing, roasting, and fluxing. Fire assay & metal testing • Kusṭha (touchstone) method – streak color for gold purity. • Tāpana (heating) & Bhājana (cupellation) for silver-lead separation. • Nīcā (alloying) – deliberate addition of base metals. Smelting furnaces & slag • Archaeological evidence: Ganeshwar-Jodhpura (copper), Agucha (lead-zinc). • Bhūrjī (bellows) & Mūṣā (crucible) designs. • Slag analysis as a modern forensic tool (FeO/SiO_2 ratio indicates temperature). **Copper, Bronze & Brass – Alloys of Antiquity (5 hrs)** Native copper & early smelting • Khetri copper belt (Rajasthan) – 3rd millennium BCE smelting. • Ganeshwar (c. 3000 BCE) – copper arrowheads, fish hooks. • Arsenical copper vs. tin bronze – deliberate or accidental? **Bronze Age masterpieces** • Dancing Girl (Mohenjo-daro, c. 2500 BCE) – lost-wax casting (*cire perdue*). • Bronze sculpture – Chola period (Nataraja, 10th-12th c.) – alloy composition (Cu + Sn + Pb).

- Arthashastra formula for *kāṁsya* (bell metal) & *ārakūṭa* (brass).

Brass & calamine process

- Zinc oxide + copper – brass production without metallic zinc.
- Early brass at Taxila (3rd c. BCE) – copper + zinc ore co-smelting.
- Textile dyeing mordants – brass shavings in alizarin dye.

Zinc Distillation – Zawar Mines (World's First) (3 hrs)

Unique Indian zinc technology

- Zinc boils at 907°C, vaporizes before smelting – needs condensation.
- Zawar, Rajasthan (c. 1200-1500 CE) – first industrial zinc distillation.
- Retorts (*degas*) made of clay, stacked in furnaces – horizontal condensation.

Retort design & chemistry

- Ore: hemimorphite ($Zn_4Si_2O_7(OH)_2 \cdot H_2O$) or sphalerite (ZnS).
- Reduction with carbon (charcoal) – Zn vapor condensed in a downward-sloping tube.
- Purity: 98%+ zinc metal – used for brass making (imported to China as "Indian zinc").

Archaeological & modern validation

- Excavations by D.P. Agrawal & C. M. Nautiyal (1980s-90s).
- **Rasārṇava** description of zinc distillation (*yāsayantra*).
- Replication experiment: modern retort at IIT Bombay.

Module 2 (15Hours)

Wootz/Damascus Steel – Tamilakam Crucible Steel (5 hrs)

Wootz – the legendary steel

- Ukku (Telugu/Kannada) – crucible steel from Telangana/Tamil Nadu (c. 300 BCE).
- Carbon content: 1.5-2.0% – forms cementite dendrites (Fe_3C) on slow cooling.
- Damascus blades – wavy pattern from folded wootz (not pattern-welded).

Crucible process

- Raw material: wrought iron + wood/leaves (carbon source) + glass (flux).
- Sealed clay crucible – heated for hours – slow cooling over days.
- Sīhala yantra (Sri Lankan/Indian) – unique crucible shape.

Metallurgical mystery & modern rediscovery

- Why wootz disappeared (18th c.) – loss of specific ores (vanadium trace?).
- J.D. Verhoeven & A.H. Pendray (1990s) – rediscovered vanadium carbide as pattern-former.
- Modern nano-indentation studies – superior edge retention.

Case study: A Damascus sword (Oriental Museum, Durham) – micrograph analysis.

Delhi Iron Pillar – Corrosion Resistance Mystery (4 hrs)

The pillar's metallurgy

Iron Pillar of Delhi (4th c. CE, King Chandragupta II, originally from Udayagiri).

- Weight: ~6 tonnes, height: 7.2 m.
- Forged by hammering large blooms – no welding lines visible.

The passive layer

- Misawite (δ-FeOOH) – a crystalline iron oxyhydroxide + amorphous phase.
- High phosphorus content (0.11-0.15%) in ancient iron (from charcoal).

- $P + Fe \rightarrow Fe_2PO_5$ (phosphate layer) → inhibits further rust.

Why it doesn't rust – critical analysis

- Role of slag inclusions (Ca, Si, P) – glassy phases seal grain boundaries.
- Low sulfur (good) – no pitting corrosion.
- Alternate wet-dry cycles of Delhi climate promote stable passive film.

Monumental Iron – Konark, Mahabalipuram & Forging (4 hrs)
Iron beams of Konark Sun Temple (1 hr)

- **Konark, Odisha** (13th c. CE) – 10 iron beams, largest ~8 m long, ~2.5 tonnes.
- Forged from multiple blooms welded together – hammer marks visible.
- Corrosion state today – some beams spalling (due to marine environment).

Mahabalipuram & other iron artifacts

- **Mahabalipuram** (7th c. CE) – iron clamps holding stone sculptures.
- **Sarnath iron pillar** (5th c. CE) – smaller but similar composition.
- **Mount Abu iron column** – 11th-12th c., still intact.

Forging & welding techniques (2 Hrs)

- **Lap welding** – overlapping red-hot blooms.
- **Stacking & hammering** – to consolidate slag inclusions.
- Role of **borax** (from Tibet) as flux – known in medieval India.

10

Scheme of Examination and Assessment Pattern

Paper - 50 Marks

A. External Examination: Semester End External - 30 Marks Time: 1.0 Hour

Format of Question Paper

Scheme 1 - Proposed Theory Question Paper Pattern

Question No.	Nature of Questions	Marks
Q1	Module I (Attempt any 03 out of 06)	15
Q2	Module 2 (Attempt any 03 out of 06)	15
	Total	**30**

Internal Examination: Continuous Evaluation - 20 Marks

	Assessment / Evaluation	Marks
1.	Test	10
2.	Classroom Activity Participation	10
	Total	**20**

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester- V

Title: Elective Chemistry
Drugs and Dyes

With effect from
Academic Year 2026-2027

Title: Elective Chemistry

[Course Code: CHMCHEMV6]

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 dyes and processes underlying dyes manufacturing is covered under the course.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	2
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives** The course aims to: **CO (A) 1:** To acquire concepts of medicinal chemistry and dye chemistry, including classification, nomenclature, dosage forms, dye classes, and their industrial significance. **CO (A) 2:** Apply knowledge of chemical structures, synthesis pathways, therapeutic uses, and mechanisms of action to understand important classes of drugs and their pharmaceutical applications. **CO (A) 3:** Analyze the relationship between chemical structure and properties of dyes, including colour production, dyeing mechanisms, and theories of colour. **CO (A) 4:** Evaluate the role of chemical processes such as nitration and sulphonation in the synthesis of drugs and dyes and their significance in pharmaceutical and dye industries.	
8	**Course Outcomes:** Upon completion of the course, students will be able to: **CO1:** Describe the classification, nomenclature, routes of administration, dosage forms, and therapeutic applications of various classes of drugs and dyes. **CO2:** Apply the concepts of medicinal chemistry to explain the synthesis, pharmacological action, and uses of selected drugs including CNS agents, analgesics, anti-inflammatory, antihistaminic, cardiovascular, and antidiabetic drugs. **CO3:** Analyze the structural features of dyes, explain theories of colour, and interpret the relationship between chemical constitution and dyeing behaviour. **CO4:** Evaluate dyeing methods, unit processes, and industrial applications of drugs and dyes, and assess their importance in pharmaceutical and chemical industries.	

9	**Syllabus**
	Module 1: Drugs (15 Hours) **General Introduction to Drugs: (4 Hours)** Definition, sources, classification, Nomenclature, Definition of various medicinal terms **Routes of Drug Administration and Dosage Forms: (3 Hours)** Oral and Parenteral routes with advantages and disadvantages, Formulations & combination formulation, Different dosage forms
	Pharmacodynamic agents (8 Hours) Study of pharmacodynamics agents with respect to their chemical structure, chemical class, therapeutic uses, and side effects. CNS Drugs: - Classification based on pharmacological actions, concept of Sedation, Hypnotics, & Anesthesia, Trimethadione (Oxazolidinedione), Amphetamine (Phenyl ethylamine). **Synthesis of trimethadione from acetone**. Analgesics and Antipyretics Aspirin (Salicylates) Paracetamol (p-Amino phenols) **Synthesis of Paracetamol from Nitro benzene** Anti-inflammatory Drugs: Mechanism of inflammation and various inflammatory conditions. Ibuprofen (Propionic acids), Aceclofenac (N-Aryl acetic acid) **(Synthesis from 2, 6-dichlorodiphenyl amine)** Antihistaminic Drugs: Diphenhydramine (Ethanol amines) Cetrizene (Piperazine) , Pantoprazole (Benzimidazoles) Cardiovascular drugs: Classification based on pharmacological action**,** Atenolol (Aryloxy propanol amines) (**Synthesis from 3-Hydroxy phenyl acetamide),** Frusemide /Furosemide (Sulfamoyl benzoic acid) Antidiabetic Agents: General idea and types of diabetes; Insulin therapy**,** Glibenclamide (Sulphonyl ureas), Metformin (Biguanides) **Module 2: Dyes (15 Hours)** **Introduction to the dye-stuff Industry: (2 Hours)** Definition of dyes, requirements of a good dye Fastness properties **Classification of Dyes based on Chemical constitution: (3 Hours)** Azo dyes: mono azo (Methyl Orange), Dis Azo (Congo Red) Triphenylmethane dyes (Acid magenta), Indigoid dyes (Indigo), Anthraquinone dyes (Indanthrene Blue), Quinoline dyes (Quinoline yellow) **Dyeing methods: (4 Hours)** Basic Operations involved in dyeing process, Direct dyeing, Vat dyeing, Mordant dyeing **Colour and Chemical Constitution of Dyes: (4 Hours)** Armstrong theory (quinonoid theory) and its limitations. 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, Anthraquinones. **Unit processes: (2 Hours)** Introduction to primaries and intermediates. Unit processes: definition and brief ideas of following unit processes: (a) Nitration (b) Sulphonation .

10

Scheme of Examination and Assessment Pattern

B. External Examination: Semester End External - 30 marks Time: 1.0 hour

Format of Question Paper

Scheme 1 - Proposed Theory Question Paper Pattern

Question No.	Nature of Questions	Module	Marks
Q1	Attempt any 03 out of 06	1	15
Q2	Attempt any 03 out of 06	2	15
	Total		**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Test	10
2.	Classroom Activity Participation (worksheet/open book)	10
	Total	**20**

11

REFERENCES:

1. Foye's principles of medicinal chemistry. 6th Edition, 2 0 0 8 , 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, 1973
9. Environmental Studies, Joseph Benny, Tata McGraw Hill Education, 2005
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
13. Synthetic organic Chemistry, Gurdeep R. Chatwal, Himalaya Publishing House, 2001

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester- V

Title: Elective Chemistry
Practical in Drugs and Dyes

With effect from
Academic Year 2026-2027

Title: Practicals in Drugs and Dyes

[Course Code: CHMCHEMV7]

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**	1
3	**Type** **Teaching Methodology**	Practical Experimental \ Demonstration \ Handling of instruments
4	**Credits**	2
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives** The course aims to: **CO (A) 1:** Develop fundamental knowledge of organic synthesis, pharmaceutical formulations, analytical techniques, dyeing processes, and chromatographic methods used in chemistry laboratories. **CO (A) 2:** Apply laboratory skills to prepare chemical compounds, pharmaceutical products, and dyes while following standard operating procedures and safety practices. **CO (A) 3:** Perform quantitative and qualitative analyses using titrimetric, colorimetric, spectrophotometric, and chromatographic techniques for chemical and pharmaceutical applications. **CO (A) 4:** Utilize AI-assisted tools and scientific databases to predict, analyze, compare, and validate experimental results for informed scientific decision-making.	
8	**Course Outcomes:** Upon completion of the course, students will be able to: **CO1**: Perform the preparation of organic compounds, pharmaceutical formulations, and azo dyes using appropriate laboratory techniques and safety protocols. **CO2**: Conduct quantitative and qualitative analyses of chemical and pharmaceutical samples using titration, colorimetry, UV-visible spectrophotometry, and chromatographic methods, and interpret the experimental data obtained. **CO3**: Evaluate the quality, purity, and functional properties of chemical substances, drugs, dyes, and formulations through analytical testing and comparison with standard specifications. **CO4**: Integrate AI-assisted tools, scientific databases, and experimental observations to predict chemical behavior, compare theoretical and experimental results, and generate scientifically justified conclusions.	

<table>
<tr><td>9</td><td>Syllabus
Preparation of Drugs and Dyes
1) Preparation of p-Nitroacetanilide from acetanilide
2) Preparation of p-Nitroaniline from p-Nitroacetanilide
3) Preparation of ORS (Oral Rehydration solution)
4) Preparation of Orange II dye (Azo dye)
5) Dyeing of cotton fabric using Direct dye
6) To check purity of a drug Paracetamol by Thin Layer Chromatography (TLC)

Estimations of Drugs and Dyes
1) Estimation of Aspirin by back titration
2) Determination of iron content in iron tablets (Redox titration)
3) Estimation of Acid neutralizing capacity of antacids
4) Determination of λmax of dye using colorimeter of UV spectrophotometer
5) Estimation of methyl orange using colorimeter
6) Experimental determination of solubility behaviour of drug and comparison with AI predictions</td></tr>
<tr><td>10</td><td>Scheme of Examination and Assessment Pattern
Paper – 50 Marks
<table><tr><td>A. Internal Continuous Assessment: 40% (20Marks)</td><td>B. External, Semester End Examination 60% (30Marks) Duration : 3hrs</td></tr><tr><td>Continuous Evaluation through:
Viva, scheme hypothesis, Test, Assignment (any 2)</td><td>Experiment from module1or 2 – 25 marks
Journal – 5 Marks</td></tr></table></td></tr>
<tr><td>11</td><td>REFERENCES:
1. Chemistry of Synthetic Dyes,VolI –VIII,VenkatramanK.,Academic Press 1972.
2. The Chemistry of Synthetic Dyes and Pigments,LubsH.A.,Robert E Krieger Publishing Company, NY ,1995
3. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications, 1973
4. Dyes: Overview, Shrikrishna D. Tupare, Lulu publications, 2021
5. Synthetic organic Chemistry, Gurdeep R. Chatwal, Himalaya Publishing House, 2001</td></tr>
</table>

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - V

Title: Minor Chemistry
Vertical 2

With effect from
Academic Year 2026 - 2027

Title: Minor Chemistry

[Course Code: CHMCHEMV8]

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**	V2
3	**Type** **Teaching Methodology**	Theory Classroom Discussion/ Demonstration/ Presentation/ Real time Problem Solving
4	**Credits**	01
5	**Hours allotted**	15 Hours
6	**Marks allotted**	25 Marks
	Course Objectives The course aims to: **CO (A) 1:** Develop an understanding of the fundamental principles of chemical kinetics, reaction mechanisms, and analytical techniques used in modern chemistry. **CO (A) 2:** Acquire knowledge of chromatographic methods and their applications in qualitative and quantitative chemical analysis. **CO (A) 3:** Understand the concepts of superconductivity and the chemistry, synthesis, reactivity, and applications of important heterocyclic compounds. **CO (A) 4:** Apply theoretical concepts to solve chemical problems and evaluate the industrial, medicinal, and technological significance of chemical systems and materials.	
8	**Course Outcomes**: Upon completion of the course, student will be able to… **CO1**: Explain the principles of collision theory, reaction kinetics, fast reactions, gas chromatography, superconductivity, and heterocyclic chemistry. **CO2**: Apply the concepts of chemical kinetics and chromatographic techniques to interpret reaction behavior and analytical data. **CO3**: Analyze the reactivity, preparation, and reaction mechanisms of Pyridine N-oxide and Quinolone, and differentiate among various types of superconductors and chromatographic methods. **CO4**: Evaluate the suitability of analytical techniques, heterocyclic compounds, and superconducting materials for medicinal, industrial, and technological applications	

9

Syllabus

MODULE 1: Physical & Analytical Chemistry (8 Hours)

Chemical Kinetics (4 Hours)

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. (derivation not expected)

Gas Chromatography (4 Hours)

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

MODULE 2 Inorganic and Organic Chemistry (7 Hours)

Superconductivity (3 Hours) Explanation of terms like superconductivity, transition temperature, Meissner effect. Different types of superconductors viz. conventional superconductors, alkali metal fullerides, high temperature super conductors.

Brief application of superconductors

Chemistry of Heterocyclic compounds: Pyridine N-oxide and Quinoline (4 Hours) Physical properties, Chemical reactivity of Pyridine N-oxide and Quinoline.

Preparation of Pyridine N-oxide and Quinoline (Skraup synthesis)

Reactions of Pyridine N-oxide: halogenation, nitration and reaction with NaNH2/liq.NH3, n-BuLi Reactions of Quinoline: oxidation, reduction, nitration, halogenation and reaction with NaNH2/liq.NH3, n-BuLi

Applications of Heterocyclic compounds: Medicinal and Industrial

Reactions of Quinoline: oxidation, reduction, nitration, halogenation and reaction with $NaNH_2$/liq.NH3, n-BuLi

Applications of Heterocyclic compounds: Medicinal and Industrial

Scheme of Examination and Assessment Pattern

Paper - 25 Marks

A. External Examination: Semester End External -15 marks Time: 1.0 hour

Format of Question Paper

Scheme 1 - Proposed Theory Question Paper Pattern

External Examination: Continuous Evaluation - 15 marks

Question No.	Nature of Questions	Marks
Q1	Module 1 (Attempt any 01 out of 02)	08
Q2	Module 2 (Attempt any 01 out of 02)	07
	Total	**15**

Internal Examination: Continuous Evaluation - 20 marks

Sr. No.	Assessment / evaluation	Marks
1	Classroom Activity Participation / Test	**10**
	Total	**10**

References:

1. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford University Press Oxford.
2. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
3. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
4. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co. Ltd.
5. Chemical Kinetics, K. Laidler, Pearson Education India, 1987.
6. A Textbook of Physical Chemistry - Dynamics of Chemical Reactions, Statistical Thermodynamics, Macromolecules and Irreversible Processes| Volume 5, 3rd Edition by K.L Kapoor, McGraw Hill Education.
7. E Prichard, Quality in the analytical chemistry laboratory, John Wiley and sons N.Y 1997
8. W Funk, V Dammann, G. Donnevert, Quality assurance in analytical Chemistry, VCH Weinheim 1995.
9. Douglas A. Skoog, Donald M. West, F. James Holler, and Stanley R. Crouch, Fundamentals of Analytical Chemistry, 7th Edition, 1995
10. Gary D. Christian, Purnendu K. Dasgupta, and Kevin A. Schug, Analytical Chemistry, 5th Edition, 2013
11. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
12. Cotton Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition
13. R.G. Sharma Superconductivity: Basics and Applications to Magnets
14. SatyaPrakash, G.D. Tuli, R.D. Madan, Advanced Inorganic Chemistry, S. Chand & Co Ltd
15. Handbook of Heterocyclic Chemistry (Second Edition), Alan R. Katritzky and Alexander F. Pozharskii, Elsevier Science Ltd, 2000.
16. Heterocyclic Chemistry (Third Edition), Thomas L. Gilchrist, Pearson Education, 2007.

Title: Practicum in Chemistry (Minor)

[Course Code: CHMCHEMV8]

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course delivers a comprehensive introduction to core chemical principles and their practical applications. Students will build a foundational understanding of major concepts across all chemical disciplines while mastering essential analytical tools. The curriculum emphasizes methodical, independent problem-solving and logical reasoning. Through hands-on application, participants will leverage critical thinking and scientific frameworks to safely design, execute, log, and evaluate chemical reactions.
2	**Vertical**	2
3	**Type** **Teaching Methodology**	Practical Experimental \ Demonstration \ Handling of instruments
4	**Credit**	1 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	25 Marks
7	**Course Objectives** The course aims to: **CO (A) 1**: To understand the principles and applications of conductometry and pH-metry in physical chemistry experiments. **CO (A) 2**; To study reaction kinetics, dissociation behavior and the effect of temperature on chemical reactions using instrumental methods. **CO (A) 3**: To provide students with hands-on experience in the use, care and maintenance of analytical instruments and glassware essential for qualitative and quantitative analysis. **CO (A) 4**: To develop students' competence in instrumental techniques for the estimation of chemical substances and evaluation of solution properties like redox potential. **CO5**: To develop the student's expertise in the synthesis of inorganic coordination complexes.	
8	**Course Outcomes:** Upon completion of the course, students will be able to: **CO1** to perform conductometric and pH-metric experiments and analyze experimental data accurately. **CO2** to determine kinetic parameters, dissociation constants, and interpret the effect of temperature on reaction rates. **CO3** identify, operate, and maintain various analytical tools and instruments, and explain their principles and applications in chemical analysis. **CO4** understand Redox Concepts, application of the Nernst Equation, how light absorption relates to chemical concentration **CO5** synthesize coordination and inorganic compounds with proper stoichiometric control and laboratory techniques.	

Syllabus

Physical chemistry

- Conductometry: To evaluate the velocity constant of alkaline hydrolysis of ethyl acetate by monitoring conductance changes during the reaction.
- pH-metry: To estimate the acidic and basic dissociation constants of an amino acid and determine its isoelectric point by pH-metric titration.
- Effect of Temperature on Reaction Rate: To examine the influence of temperature on the rate of acid hydrolysis reaction using kinetic measurements.

Analytical Chemistry

- Conductometric titration of weak acid against strong base
- To verify Beer Lambert law by colorimetric method and calculate molar extinction coefficient of Cu2+ in cuprammonium sulfate complex
- Determination of redox potential of Fe^{2+}/Fe^{3+} using $FeSO_4.7H_2O$ solution by potentiometric titration against standard solution of potassium dichromate.

Inorganic Chemistry

- Preparation of Tris (acetylacetonato) iron (III).
- Preparation of tetraamine copper sulphate $[Cu(NH_3)_4]SO_4.H_2O$ complex.
- Estimation of Manganese by EDTA complexometric titration method using EBT indicator.
- Estimation of Nickel by EDTA complexometric titration method using Mureoxide indicator.

Organic Chemistry

Small scale organic preparation and purification: Use 0.5-1.0g/1.0-1.5 cm^3 of the organic compound. Purify the product by recrystallization. Report theoretical yield, percentage yield and melting point of the purified product**.**

Preparation of:

- p-Nitroacetanilide from Acetanilide
- m-Nitroacetanilide from m-Nitroaniline
- 1,1-bis-2-naphthol from 2-naphthol
- Benzoic acid from Benzamide

Phthalimide from Phthalic anhydride

Scheme of Practicum Examination and Assessment Pattern

A. External Examination: Semester End Total Marks – 15 , Time- 2 H**ours**

Sr. No	Particulars	Marks
	Scheme development/numerical solving skills/Practical skills / Active participation	**10**

B. Internal Examination: Continuous Evaluation - 10 **marks**

C.

Sr. No	Particulars	Marks
	Experiment	**15**

REFERENCES:

A. Physical Chemistry:

1) Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2) Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3) Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).

B. Inorganic Chemistry:

1) Practical Inorganic Chemistry by G. Marr and B. W. Rockett van Nostrand Reinhold Company (1972)

C. Organic Chemistry:

1) Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2) Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3) Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)

D. Analytical Chemistry:

1) D. A. Skoog, D. M. West, F. J. Holler, and S.R. Crouch, Analytical Chemistry: An Introduction, 7th ed., Chapter 15, pp. 345-381.
2) A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961).
3) R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y. (1974).

CC

[CHMCCV]

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - V

Title: VSC
Techniques in Chemical Analysis and Synthesis
Vertical 4

With effect from
Academic Year 2026 - 2027

Title: VSC - Techniques in Chemical Analysis and Synthesis

[Course Code: CHMCHEMV9]

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**	4 (VSC)
4	**Credits**	02
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** The course aims to: **CO (A) 1:** Develop systematic approach and understanding of principles involved in separation and qualitative analysis of binary organic mixtures based on solubility and acid-base properties. **CO (A) 2:** Provide knowledge of systematic separation schemes and enable the learners for the selection of suitable reagents for separation or isolation of individual organic compounds/ components based on their unique physical and/ or chemical properties. **CO (A) 3:** Develop skills in identification of organic compounds using functional group characteristics and determination of percentage yield. **CO (A) 4:** Provide the knowledge of techniques required for determination of important metals	
8	**Learning Outcomes:** Upon completion of the course, student will be able to **CO1:** Determine the chemical and physical type of the organic mixture and classify components of binary organic mixtures as acidic, basic or neutral using solubility behaviour and functional group properties. **CO2:** Apply systematic separation scheme to separate the mixture of organic compounds and isolate components using chemical/ physical properties from at least seven binary organic mixtures using appropriate reagents. **CO3:** Identify separated organic component using characteristic functional group tests and calculate percentage yield of the second component. **CO4** Learn techniques required for determination of metals.	

Syllabus

MODULE 1 (Organic Chemistry)

Separation of Binary solid-solid mixture (1.5 - 2.0 g mixture to be given) (Minimum 7 mixtures)

i) Each student shall complete the analysis of a minimum of seven binary organic mixtures.

ii) The components of the mixtures should include water-soluble and water-insoluble carboxylic acids, water-insoluble phenols (1-naphthol and 2-naphthol), water-insoluble bases (nitroanilines), water-soluble neutral compounds (thiourea), and water-insoluble neutral compounds such as anilides, amides, m-dinitrobenzene, and hydrocarbons.

iii) After correct identification of the chemical nature of the components, the appropriate separating reagent should be selected by the student for separation.

iv) The systematic separation scheme shall then be followed for the bulk sample of the given binary mixture.

v) Upon separation into Component A and Component B, one component (as assigned by the examiner) shall be analyzed and identified with melting point, while the yield of the other component shall be determined.

MODULE 2 (Analytical Chemistry)

1 Determination of Ferrous (Fe II) ion by calibration curve method.

2 Determination of Lead (Pb) / Cadmium (Cd) / Cobalt (Co) by complexometric titration (Standardization of EDTA with Zinc sulfate is expected)

3 Conductometric titration of strong acid against strong base

4 Verification of Beer Lambert law using standard addition method colorometrically.

5 Separation of Mg from a mixture of Fe and Mg by solvent extraction and estimation of Mg

6 Determination of purity of NaCl by ion exchange method

7 Estimation of K in fertilizer by flame photometry

10

Scheme of Examination and Assessment Pattern

Paper - 50 Marks

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

B.

Internal Continuous Assessment: 40% (20 M)	**External, Semester End Examination 60% Individual Passing in Internal and External Examination (30 M)**
Continuous Evaluation through: Quizzes, Class Tests, presentation, project, creative writing, assignment (any 2)	Experiment(O1)-25 Marks Journal-5 Marks

11	**REFERENCES:** **Module 1: Organic Chemistry** 1. Furniss, Hannaford, Smith & Tatchell, Vogel's Textbook of Practical Organic Chemistry, Pearson Education, 5th Edition, 1989. 2. F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Pearson Education, 4th Edition, 2009. 3. John C. Gilbert & Stephen F. Martin, Experimental Organic Chemistry - Cengage Learning, 5th Edition, 2011. 4. O. P. Agarwal, Practical Organic Chemistry, Krishna Prakashan Media (P) Ltd, 2014. 5. Practical Organic Chemistry - A. I. Vogel. 6. Practical Organic Chemistry - H. Middleton **Module 2: Analytical Chemistry** 1 A. Skoog, D. M. West, F. J. Holler, and S.R. Crouch, Analytical Chemistry: 2 An Introduction, 7th ed., Chapter 15, pp. 345-381. 3 A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London 4 (1961). 5 R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y. 6 (1974). 7 Some Experiments for B. Tech in Chemistry & Chemical Technology compiled 8 by Prof. J.B. BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B. Sc. (Chemistry)

NEP

Semester- V

Vertical – 6 (FIELD PROJECT)

Academic Year 2026-27

Title: Efficacy of household disinfectants
[Course Code: CHMCHEMV10]

Heading	Particulars
Description of the Course	Chemistry field project involves applying chemical principles and techniques in real-world settings, often outside a traditional laboratory environment. It can involve investigating environmental issues, analyzing industrial processes, or studying the chemistry of everyday materials. Introduction of fileld project course under NEP would bridge theoretical knowledge with practice and enhance awareness of scientific temperament .Field project course shall certainly foster a deeper understanding of environmental and socio-economic issues., developing practical skills, and exploring research methodologies. Field projects also aim to promote teamwork, problem-solving, and ethical conduct.
Vertical	6
Type **Teaching Methodology**	Practical Experimental \ Demonstration \ Handling of instruments
Credit	2 Credits
Hours allotted	60 Hours
Marks allotted	50 Marks

Course Objectives

The course aims to:

CO1:To provide students with a holistic learning experience that combines theoretical knowledge with practical application.

CO2:To connect Classroom Learning to Real-World Situations

CO3:To Develop Practical and Research Skills

CO4: To Understand Social Issues and Contributing to Solutions

Learning Outcomes:

Upon completion of the course, students will be able to:

LO1: identify problems, collect data, analyze information, and propose solutions..

LO2: apply effectively theoretical knowledge in practical situations

LO3: understand the value of teamwork, collaboration and communication skills.

LO4: Evaluate and addressing problems in the areas of Chemistry, such as analytical chemistry, organic chemistry, and environmental chemistry.

9

Field project activity:

1. To determine the types of disinfectants used in households.
2. To assess the frequency and purpose of disinfectant use.
3. To evaluate knowledge regarding safe handling and storage of disinfectants.
4. To identify factors influencing disinfectant selection.
5. To assess potential health and environmental concerns associated .

Modalities of survey

- Cross-sectional household survey
- Quantitative data collection using a structured questionnaire

Survey Questionnaire preparation

10

Scheme of Practicum Examination and Assessment Pattern

Total – 50 Marks

A. External evaluation pattern: Semester End Total Marks - 30

Criteria-	**Marks**
Survey summary Report	**20**
Viva	**10**

Internal evaluation pattern: Semester End Total Marks – 20

Pre-survey and post survey assignments	10
Active participation in survey	10

11

REFERENCES:

1. D.A. Skoog, D.M. West, F.J. Holler, and S.R. Crouch, Analytical Ch Introduction,7th ed. 1965, Chapter 15, pp. 345-381.
2. A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, Londo
3. R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.
4. Experiments for B. Tech in Chemistry & Chemical Technology compiled BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi, 2001.

HSNC Board's
Smt. Chandibai Himathmal Mansukhani College
(Autonomous)
Affiliated to the University of Mumbai

Bachelors of

Science (Chemistry)

(Aided)
Syllabus for Semester – VI

(As per NEP 2020 With Effect From the Academic Year 2026-2027)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - VI

Title: Major/ Mandatory
Advanced Physical Chemistry – Paper IV
Vertical 1

With effect from
Academic Year 2026 - 2027

Title: Major Chemistry - Advanced Physical Chemistry – Paper IV [Course Code: CHMCHEMVI1]

Sr. No.	Heading	Particulars
1	**Description of the Course**	**Advanced Physical Chemistry – Paper IV** covers the fundamentals of nuclear chemistry, quantum chemistry, electrochemistry, and the phase rule. It includes radioactivity, nuclear reactions, quantum mechanics, electrochemical cells, activity coefficients, and phase diagrams of three-component systems, emphasizing theoretical concepts, mathematical treatment, and applications in modern chemical research and technology.
2	**Vertical**	V1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion/ Demonstration/ Presentation/ Real time Problem Solving
4	**Credits**	02
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **The course aims to:** **CO (A) 1:** Introduce fundamental principles of quantum chemistry, including limitations of classical mechanics, wave-particle duality, uncertainty principle, Schrödinger wave equation, and operator concept. **CO (A) 2:** Develop understanding of nuclear chemistry, including radioactive decay processes, nuclear reactions, fission process, nuclear reactors, and applications of radioisotopes as tracers. **CO (A) 3:** Provide knowledge of electrochemistry, including activity and activity coefficients, ionic strength, Debye-Hückel theory, and classification of electrochemical cells. **CO (A) 4:** Explain principles of applied electrochemistry, including decomposition potential, overvoltage, and factors affecting electrode processes.	
8	**Course Outcomes:** Upon completion of the course, students will be able to: **CO1:** Explain concepts in nuclear chemistry, electrochemistry, and quantum chemistry. **CO2:** Apply mathematical relationships and theoretical principles to solve numerical problems involving nuclear chemistry, quantum chemistry, electrochemical cells, activity coefficients, and overvoltage phenomena. **CO3:** Analyze the behavior of nuclear systems, electrochemical cells, phase equilibria, and quantum mechanical models by interpreting experimental and theoretical data.. **CO4:** Evaluate the significance and applications of nuclear reactors, radioisotopes, electrochemical processes, and phase diagrams in scientific, industrial, and technological contexts.	
	Syllabus **Nuclear Chemistry (10 Hours)** 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: age determination- dating by C14 . Nuclear Transmutation: Nuclear transmutation, artificial radioactivity, Q- value of nuclear reaction, threshold energy. (Numerical expected) Fission and fusion Process: Fissile and fertile material, multiplication factor	

and critical size or mass of fissionable material, Nuclear reactor: Essential parts of nuclear reactor, power reactor

Basic of Quantum Chemistry: (5 Hours)

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. State function and its significance (Numerical expected)

Progressive and standing waves: Introduction, Schrodinger's time independent wave equation (No derivation expected), Significance of wave function.

MODULE 2: (15 Hours)

Electrochemistry (7 Hours)

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., Liquid junction potential, Chemical cells without transference, Electrolyte concentration cells with and without transference. (derivation and Numericals expected)

Applied Electrochemistry (4 Hours)

Decomposition Potential: Introduction, experimental determination, Factors affecting it.

Over Voltage: Introduction, Experimental determination, Hydrogen over voltage, Tafel's equation for hydrogen overvoltage. (Numerical expected)

Phase rule: (4 Hours)

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.

Scheme of Examination and Assessment Pattern

Paper - 50 Marks

D. External Examination: Semester End External - 30 marks Time: 1.0 hour

Format of Question Paper

Scheme 1 - Proposed Theory Question Paper Pattern

Question No.	Nature of Questions	Module	Marks
Q1	Attempt any 03 out of 06	1	15
Q2	Attempt any 03 out of 06	2	15
			30

Internal Examination: Continuous Evaluation - 20 marks

Question No.	Nature of Questions	Marks
1.	Test	10
2.	Classroom Activity Participation (worksheet/open book)	10
	Total	**20**

REFERENCES:

Module 1 and 2: Physical Chemistry

1 Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg , Modern Nuclear Chemistry, Wiley, 2017.

2 H. J. Arnikar, Essentials of Nuclear Chemistry, New Age International (P) Ltd., Publishers, 2011.

3 Ira Levine, Physical Chemistry, Tata McGraw Hill Publishing Co.Ltd. 5th Edition, 2002.

4 P.W. Atkins, The Elements of Physical Chemistry, Oxford University Press, 2nd Edition, 2003.

5 B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry VISHAL PUBLISHING Company, 2008.

6 J.O.M Bockris & A.K.N. Reddy, Maria, Modern Electrochemistry, Gamboa – Aldeco Springer, 2nd Edition, 1st Indian reprint, 2006.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - VI

Title: Major/ Mandatory
Advance Inorganic Chemistry- Paper V

Vertical 1

With effect from
Academic Year 2026 - 2027

Title: Major Chemistry -Advanced Inorganic Chemistry – Paper V
[Course Code: CHMCHEMVI2]

Sr. No.	Heading	Particulars
1	**Description of the Course**	Paper V provides comprehensive knowledge of superconductors, solid-state chemistry, molecular orbital theory, and transition metal complexes. It covers catalysis, stability and substitution reactions of metal complexes, and the electronic spectra of coordination compounds. The course emphasizes structure–property relationships and their applications in catalysis, materials science, and modern inorganic chemistry.
2	**Vertical**	V1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion/ Demonstration/ Presentation/ Real time Problem Solving
4	**Credits**	02
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **The course aims to:** **CO (A) 1**: Acquaint learners with superconductors and its applications. **CO (A) 2**: Explain structural aspects of solid-state chemistry including crystal systems, packing efficiency and density relationships. **CO (A) 3**: Impart a clear understanding of structural imperfections in solids, specifically distinguishing between vacancy and dislocation point defects and their physical consequences. **CO (A) 4**: Explain the role of transition metals in catalysis, including Wilkinson's catalyst mechanism.	
8	**Learning Outcomes**: At the end of the course, students will be able to: **CO1**: Gain knowledge of superconducting materials and its applications **CO2**: Solve numerical problems related to crystal structure, packing efficiency and density of unit cells. **CO3**: Analyze mechanisms in Explain homogeneous catalysis such as Wilkinson's catalyst. **CO4**: Interpret structural point defects in ionic solids and contrast the mechanisms, necessary criteria, and density variations associated with Schottky and Frenkel defects.	
9	**Syllabus** **Module 1** **Solid State (8 Hours)** Explanation of terms viz. crystal lattice, lattice point, unit cell and lattice constants. Calculation of packing density in simple cubic, bcc and fcc lattices. Relationship between density, radius of unit cell and lattice parameters. (Numerical problems expected) **Superconductivity (3 Hours)** Explanation of terms like superconductivity, transition temperature, Meissner effect. Different types of superconductors viz. conventional superconductors, alkali metal fullerides, high temperature super conductors Brief application of superconductors	

Role of transition metal in catalysis (4 Hours)
Comparison between homogeneous and heterogeneous catalysis
Basic steps involved in homogeneous catalysis
Mechanism of Wilkinson's catalyst in hydrogenation of alkenes.

Module 2 (15Hours)
Introduction to Crystal Field theory for metal complexes(7 Hours)
Tenets of CFT, Splitting of d orbitals in octahedral and tetrahedral complexes.
Crystal field splitting energy(10Dq) and concept of high spin -low spin complexes
Crystal field stabilization energy for octahedral complexes(calculations for d^1 to d^{10} expected)
Effects of crystal field splitting
Drawbacks of CFT-Experimental evidences of covalent character
Chemistry of Group 18 elements(4Hours)
General characteristics and trends in properties
Isolation of noble gases
Compounds of Xenon -oxides & fluorides with respect to preparation and structure(VSEPR)
Advanced applications of noble gases
Introduction to Bioinorganic chemistry(4Hours)
Essential and non essential elements in biological system
Biological importance of metal ions such as Na+,K+(with respect to ion pump),Fe2+/Fe3+.Cu2+

Scheme of Examination and Assessment Pattern
Paper - 50 Marks
E. External Examination: Semester End External - 30 marks Time: 1.0 hour
Proposed Theory Question Paper Pattern
External Examination:

Question No.	Nature of Questions	Module	Marks
Q1	Attempt any 03 out of 06	1	15
Q2	Attempt any 03 out of 06	2	15
	Total		**30**

Internal Examination: Continuous Evaluation - 20 marks

Question No.	Nature of Questions	Marks
1.	Test	10
2.	Classroom Activity Participation (worksheet/open book)	10
		20

REFERENCES:
Module 1:

1 Superconductivity: From Materials Science to Practical Applications by Paolo Mele, Kosmas Prassides, et al.
2 U. Muller, Inorganic structural chemistry, 2nd edition, Wiley 2007.
3 A. F. Wells, Structural inorganic chemistry, 5th edition, Clarendon press, Oxford 1984.
4 A. R. West, Solid state chemistry and its chemical applications, 2nd edition, Wiley 2014.
5 L. E. Smart and E. A. Moore, Solid State Chemistry-An introduction, 3rd edition, Taylor and Francis, 2005.

	6	G. W. Parshall and S. D. Ittel, Homogeneous Catalysis, John Wiley & Sons. Inc. New York, 2nd edition, 1992.
	7	F. Basolo and R. G. Pearson, Mechanism of Inorganic Reactions, Wiley, New York, 1967.
	8	Jahn Hartwig, Organotransition chemistry-From bonding to catalysis, University science books, California 2010.
	9	William L. Jolly, Modern Inorganic Chemistry, McGraw Hill, Inc. 2nd edition 1991
	10	B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013-2014.
	11	W. W. Porterfield, Inorganic Chemistry-A Unified Approach, 2nd Ed., Academic Press, 1993.
	12	C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, 2nd Edition 2005.
	13	R. L. Dekock and H.B.Gray, Chemical Structure and Bonding, The Benjamin Cummings Publishing Company, 1989.
	14	R. Kapoor and R.S. Chopra, Inorganic Chemistry, S. Chand 2019
	15	Ajay Kumar, Organometallics and Bioinorganic Chemistry, Aaryush Education, 4th Edn, 2021.
	16	M. V.Twigg, Mechanisms of Inorganic and Organometallic Reactions, Springer Nature vol 1., 1985.
	17	Gary Wulfsberg, Inorganic Chemistry; Viva Books PA Ltd., New Delhi; 2002 R. L. Madan and G. D. Tuli, Inorganic Chemistry,5th Ed., S. Chand, 2012.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - VI

Title: Major/ Mandatory
Advance Organic Chemistry-Paper VI

Vertical 1

With effect from
Academic Year 2026 - 2027

Title: Advance Organic Chemistry (Paper VI)
[Course Code: CHMCHEMVI3]

Sr. No.	Heading	Particulars
1	**Description of the Course**	**Advanced Organic Chemistry – Paper VI** provides comprehensive knowledge of biomolecules, polymers, organic reagents and modern spectroscopic techniques used for structure elucidation of organic compounds. The course covers structure, classification and synthesis of amino acids, polypeptides and proteins, along with important catalysts and reagents used in functional group transformations. It also discusses mechanisms of molecular rearrangements and fundamentals of polymer chemistry including types of polymerization, properties and applications of synthetic and biodegradable polymers. The course further introduces structure and reactions of carbohydrates and principles of UV–Visible, IR and PMR spectroscopy for identification of organic compounds. Emphasis is placed on understanding structure–reactivity relationships and interpretation of spectroscopic data relevant to research, pharmaceutical and polymer industries.
2	**Vertical**	V1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	02
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO (A) 1** To enable the learners to understand specific terms related with stereochemical outcome of organic reactions. Also, to make learners aware with basic biomolecules with reference to structural aspects, physical and chemical properties. **CO (A) 2** To provide students with a foundational understanding of industrial polymer chemistry and different catalysts & reagents useful in the field of organic synthesis & to familiarize the learners with different catalysts and reagents useful in the field of organic synthesis. **CO (A) 3** To develop a comprehensive understanding of principles of green chemistry and build the conceptual clarity about Carbohydrate chemistry. **CO (A) 4** To equip the learners with the skills to predict the products of selected rearrangement and named reactions used extensively in synthetic organic chemistry and make the learners understand the fundamental principles of Infrared and ^{1}H-NMR Spectroscopic techniques while applying them for structural elucidation of organic compounds.	

8	**Learning Outcomes**: At the end of the course, students will be able to: **CO1** explain the stereochemical outcome of different organic reactions and stereochemistry of product and the details of natural biochemical processes. **CO2** understand applications of polymers including biodegradable polymers and apply knowledge of catalysts & reagents to predict functional group transformations and synthetic outcomes. **CO3** gain comprehensive understanding of the fundamental principles of green chemistry and Carbohydrates, their stereochemistry and various chemical reactions. **CO4** understand the selected rearrangement and named reactions used extensively to synthesize the commodity chemicals of industrial/ commercial importance and apply the fundamental principles of Infrared and ^{1}H-NMR spectroscopic techniques for structural elucidation of organic compounds.
9	**Syllabus** **Module 1(15 Hours)** **Amino Acids, Polypeptides and Proteins (4 Hours)** 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's phthalimide synthesis. Polypeptides: Nature of peptide bond. Nomenclature and representation of polypeptides (di- and tri-peptides) with examples, Merrifield solid phase polypeptide synthesis. Proteins: Introduction, General idea of primary, secondary, tertiary & quaternary structure of proteins, Denaturation of Protein. **Catalyst and Reagents (4 Hours)** Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism) Catalysts: i) Raney Nickel ii) Pt and PtO_2 iii) Pd: Rosenmund Reduction and Lindlar's Catalyst Reagents i) $LiAlH_4$ (reduction of carbonyl, carboxylate, nitrile and nitro) ii) $NaBH_4$ (reduction of carbonyl) iii) SeO_2 (Oxidation of active methyl and methylene groups) iv) m-CPBA (epoxidation of alkenes) v) NBS (allylic and benzylic bromination) **Molecular Rearrangements (3 Hours)** Mechanism of the following rearrangements with examples and stereochemistry wherever applicable i) Pinacol-pinacolone rearrangement ii) Benzilic acid rearrangement iii) Favorskii rearrangement. Curtius rearrangement

Polymers (4 Hours)

Introduction to Polymers: Definition of monomer and polymers, Classification of polymers on basis of source and types of polymerization reactions

Preparation, properties, and uses of: Polyethylene (PE), Polypropylene (PP), Polystyrene (PS), Polyvinyl chloride (PVC), and Polytetrafluoroethylene (Teflon), Polycarbonates, Polyurethanes; Polyamides (Nylon)

Tacticity in Polymers: Definition and concept, Types: Isotactic, Syndiotactic, Atactic polymers, and Effect of tacticity on polymer properties

Biodegradable polymers & Biomedical uses of polymers

Module 2(15Hours)

Carbohydrates (7 Hours)

2Introduction: Classification, Fischer projection (4-6 carbon monosaccharides), D-L notation, reducing and non-reducing sugars.

Ring structures of monosaccharides: Evidences in support of ring structures, Interconversion of open chain into Haworth forms of monosaccharides (Furanose and Pyranose forms of D-Glucose and D-Fructose)

Reactions of D-glucose and D-fructose:

i) Osazone formation
ii) Reduction: (i) H_2/Ni (ii) $NaBH_4$
iii) Oxidation: (i) Bromine water (ii) conc. HNO_3, (iii) HIO_4
iv)Acetylation*
v) Methylation*

*with cyclic pyranose forms

Organic Spectroscopy (8 Hours)

Introduction: Electromagnetic spectrum, units of wavelength and frequency.

UV-Visible Spectroscopy: Introduction, Electromagnetic radiations, electronic transitions, λmax & εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts

IR Spectroscopy: Introduction, Infrared radiation and types of molecular vibrations, Selection rule, functional group and fingerprint region. Application of IR Spectroscopy

PMR Spectroscopy: Basic theory of PMR, nature of PMR spectrum, chemical shift (δunit), TMS as reference and its advantages, solvents used. Factors affecting chemical shift: (1) inductive effect (2) anisotropic effect (with reference to alkenes, alkynes, aldehyde and

benzene ring). Spin-spin coupling and coupling constant, application of deuterium exchange technique.

Problems of structure elucidation of simple organic compounds using individual or combined use of UV-Vis, IR and PMR spectroscopic data. (Molecular Formulae to be provided) (Calculation of Index of hydrogen deficiency should be the first step in solving the problems)

10

Scheme of Examination and Assessment Pattern

Paper - 50 Marks

F. External Examination: Semester End External - 30 Marks Time: 1.0 Hour

Format of Question Paper

Scheme 1 - Proposed Theory Question Paper Pattern

Question No.	Nature of Questions	Marks
Q1	Module I (Attempt any 03 out of 06)	15
Q2	Module 2 (Attempt any 03 out of 06)	15
	Total	**30**

Internal Examination: Continuous Evaluation - 20 Marks

	Assessment / Evaluation	Marks
1.	Test	10
2.	Classroom Activity Participation	10
	Total	**20**

11

References:

Module 1: Organic Chemistry

Amino Acids, Polypeptides and Proteins

1 J. M. Berg, J. L. Tymoczko, G. J. Gatto Jr., L. Stryer, W. H. Freeman Biochemistr Eighth Edition, 2015

2 D. L. Nelson and M. M. Cox, Lehninger, W. H. Freeman, Principles of Biochemistry Seventh Edition, 2017

3 U. Satyanarayana and U. Chakrapani, Biochemistry, CBS, Seventh Edition,2025

4 G. Odian, Principles of polymerisation, John Wiley &Sons., 3 rd edition,2004

5 P. Bahadur, N. V. Sastry, Polymer Chemistry, Narosa Publishing House, 2nd Edition 2002

6 V. K. Ahluwalia& A. Misra, Polymer Science-A Text Book, Ane Books, India, 1s Edition, 2008

7 Charles E. Carraher Jr., Introduction to Polymer Chemistry, CRC Press, 3rd Edition 2017

Module 2: Organic Chemistry

Catalyst and Reagents / Molecular Rearrangements / Carbohydrates

	1	Jie Jack Li, Name Reactions, Springer, 4th Edition, 2009
	2	I. L. Finar, Organic Chemistry, Pearson Education, 6th Edition, 2006
	3	Morrison, Boyd and Bhattacharjee, Organic Chemistry Pearson Education, Sevent Edition, 2010.
	4	T. W. Graham Solomons, Craig B. Fryhle & Scott A. Snyder, Organic Chemistry Wiley , 12th Edition, 2016
	5	B. S. Bahl & Arun Bahl, Advanced Organic Chemistry, S. Chand, Revised Multi-Colou Edition, 2012
	6	V.K. Ahluwalia & R.K.Parashar, Organic Reaction Mechanisms, Third Edition 2006
		Organic Spectroscopy
	1	Robert M. Silverstein, Francis X. Webster & David J. Kiemle, Spectrometric Identification of Organic Compounds, Wiley, 7th Edition, 2005
	2	William Kemp, Organic Spectroscopy, Palgrave Macmillan, 3rd Edition, 1991
	3	Donald L. Pavia, Gary M. Lampman, George S. Kriz & James R. Vyvyan Introduction to Spectroscopy, Cengage, 5th Edition, 2015
	4	Jag Mohan, Organic Spectroscopy, Narosa Publishing House, 2nd Edition, 2004

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - VI

Title: Major/ Mandatory
Advance Analytical Chemistry-Paper VII

Vertical 1

With effect from
Academic Year 2026 - 2027

Title: Advance Analytical Chemistry (Paper VI)
[Course Code: CHMCHEMVI4]

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**	V1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	02
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: The course aims to make the students well acquainted with… **CO (A) 1**: The validation of analytical data. **CO (A) 2**: Modern analytical techniques for Quantitative and qualitative analysis. **CO (A) 3**: Modern separation techniques Chemistry of Food and Cosmetics.	
8	**Course Outcomes:** Upon completion of the course, students will be able to …. **CO1** Use Electroanalytical, Thermal and spectroscopic techniques for qualitative and quantitative analysis. **CO2** Apply advance chromatographic techniques for separation processes. **CO3** Analyze common food products for the presence of adulterants. **CO4** Interpret and identify the chemical constituents of common cosmetics.	
9	**Syllabus** **Module 1 (15 Hours)** • **Polarography** (**Numerical and word problems are expected) (8 Lectures)** • Difference between potentiometry and voltammetry, Polarizable and non-polarizable electrodes • Basic principle of polarography • H shaped polarographic cell, 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 $E_{1/2}$
- **Amperometric Titrations**
- Principle, Rotating Platinum Electrode(Construction, advantages and limitations)
- Titration curves with example
- Advantages and limitations

Ion Exchange Chromatography (7 Lectures)

- 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.

Module 2(15 Hours)

Thermal Methods (8 Hours)
Thermogravimetric Analysis (TGA) and Differential Thermal Analysis (DTA):
Introduction, 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:
Comparison between TGA and DTA.

Introduction to IR Spectroscopy (only Dispersive) (3 Hours)
Principle – vibrational excitation, molecular fingerprint
Instrumentation- Components of IR spectrophotometer –sources, detectors (Thermal)
Sample preparation techniques
Applications, Advantages and Disadvantages

Introduction to food and Cosmetic chemistry (4 Hours)
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)

Cosmetics

Introduction and sensory properties

Study of cosmetic products –

Face powder: Composition and Estimation of calcium and magnesium.

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

10

Scheme of Examination and Assessment Pattern

Paper - 50 Marks

G. External Examination: Semester End External - 30 Marks Time: 1.0 Hour

Format of Question Paper

Scheme 1 - Proposed Theory Question Paper Pattern

Question No.	**Nature of Questions**	**Marks**
Q1	Module I (Attempt any 03 out of 06)	15
Q2	Module 2 (Attempt any 03 out of 06)	15
Internal Examination: Continuous Evaluation - 20 Marks	**Total**	**30**

	Assessment / Evaluation	**Marks**
1.	Test	10
2.	Classroom Activity Participation	10
	Total	**20**

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.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - VI

Title: Major/ Mandatory
Practical in Advanced Chemistry - II
Vertical 1

With effect from
Academic Year 2026 - 2027

Title of Paper: Practicals in Advanced Chemistry – II
[Course Code: CHMCHEMVI5]

Sr. No.	Heading	Particulars
1	**Description of the course:**	**Practicals in Advanced Chemistry – II** provides practical training in Physical and Inorganic Chemistry through systematic laboratory experiments. The course emphasizes electroanalytical techniques such as potentiometry, conductometry, pH-metry and colorimetry for quantitative determination of ions and evaluation of physicochemical properties. The course also includes preparation of inorganic coordination compounds and estimation of metal ions using complexometric titration methods. Emphasis is placed on experimental accuracy, analytical skills and interpretation of experimental data relevant to physical and inorganic chemical systems.
2	**Vertical:**	I (Major)
3	**Type:**	Practicals
4	**Credit**:	2 credits
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: **The course aims to:** **CO (A) 1:** Develop understanding of electroanalytical techniques such as potentiometry, conductometry, pH-metry and colorimetry for quantitative chemical analysis. **CO (A) 2:** understand use of wave function in quantum chemistry. **CO (A) 3**: Learn complex preparation techniques and principles underlying estimation of metal ions.	
	Course Outcomes: **At the end of the course, students will be able to:** **CO1:** Perform instrumental and non-instrumental experiments involving potentiometry, conductometry, pH-metry, phase equilibria, kinetics, and inorganic preparations following standard laboratory procedures. **CO2:** Analyze experimental data obtained from advance analytical techniques, and graphical methods to determine physicochemical parameters and chemical compositions. **CO3:** Determine the purity, concentration, composition, and qualitative characteristics of inorganic compounds and mixtures using complexometric titration and wet chemical analysis techniques.. **CO4**: Evaluate the accuracy, reliability, and significance of experimental results and draw scientifically justified conclusions based on analytical observations and calculations.	

Syllabus

Module 1: Physical chemistry experiments

Instrumental Experiments:

- To determine the amount of iodide bromide and chloride in the mixture by potentiometric titration with silver nitrate.
- To estimate strength of Acetic acid & H_2SO_4 in the mixture of both acids conductometrically.
- To find out the strength of borax solution by titrating it against HCl pH-metrically.
- To determine the Solubility product and solubility of AgCl potentiometrically using chemical cell.
- To determine the basicity of an acid such as citric acid conductometrically.

Non- Instrumental Experiments:

- Phase equilibria::To study phase diagram of three component system water-chloroform/ toluene- acetic acid by weight method.
- Graph Plotting of mathematical functions –linear, exponential and trigonometry and identify whether functions are acceptable or non-acceptable?
- The study of energy of activation of second order reaction i.e. reaction between $K_2S_2O_8$ and KI (Unequal concentrations)

Module 2: Inorganic preparations and estimations

- Preparation of Ferrous ethylene diammonium sulphate
- Preparation of copper chloride Dimethyl Sulfoxide
- Determination of Calcium in presence of Magnesium by EDTA titration using Patton Reader indicator
- Complexometric titration of copper with EDTA using Fast sulphon Black F indicator
- Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t added impurity cation and/or anion (any Two)
    - Salts of selected Main group metal ions viz. Mg, Ba, Sr/Ca, . Quantitative analysis by titration method. (complexometric titration of all ions using Eriochrome Black T indicator). Qualitative analysis by wet test method.

Impurity : NH_4^+,K^+, Cl^-, NO_3^-, I^-, (Note: Standardization of EDTA is not expected)

Scheme of Examination and Assessment Pattern
50 Marks

A. Internal Continuous Assessment: 40% (20Marks)	**B. External, Semester End Examination 60% (30Marks) Duration : 2hrs**
Continuous Evaluation through: Viva, scheme hypothesis, Test, Assignment	Experiment from module1or 2 - 25 Marks Journal – 05 Marks

10 Reference Books:

	Module 1: Physical Chemistry
1	A. M. James and F.E. Prichard, Practical Physical Chemistry Longman publication, 3rd edition,1974
2	R.C. Das and B. Behra, Experiments in Physical Chemistry, Tata Mc Graw Hill, 1983
3	J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2006

	4	J. N. Gurtu and R Kapoor, Advanced Experimental Chemistry., S. Chand and Co. Vol I, 1980
	5	V.D.Athawale, Experimental Physical Chemistry, New Age International (P) Limited, 2001
	6	B. D. Khosla, V. C. Garg and A. Gulati, Senior Practical Physical Chemistry, R Chand and Co.. 2011
		Module 2: Inorganic Chemistry
	1	A. I. Vogel, Quantitative Inorganic Analysis, 5th Edn Longman Scientific and Technical, 1989.
	2	J. D. Woolins, Inorganic Experiments. Hohn Wiley and Sons, 2010
	3	W. G. Palmer, Experimental Inorganic Chemistry, Cambridge University Press, 1954
	4	G. Raj, Advanced Practical Inorganic Chemistry. Goel Publication, 2010
	5	J. E. House, Inorganic chemistry, Academic press, 2nd edition, 2013.
	6	G. N. Mukherjee, Advanced Experiments in Inorganic Chemistry., U. N. Dhur & Sons Pvt. Ltd. 2010.
	7	W. Conard Fernelius, Inorganic syntheses, Mc-Graw Hill, Vol.II, 1946.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - VI

Title: Major/ Mandatory
Practical in Advanced Chemistry - III
Vertical 1

With effect from
Academic Year 2026 - 2027

Title: Practicals in Advanced Chemistry III
[Course Code: CHMCHEMVI6]

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**	Major
3	**Type** **Teaching Methodology**	Practicum Experimental/ Demonstration/ Handling of instruments
4	**Credits**	02
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** The course aims to: **CO (A) 1** Develop systematic approach and understanding of principles involved in separation and qualitative analysis of binary liquid – solid and liquid - liquid organic mixtures based on physical properties. **CO (A) 2** Provide knowledge of systematic separation scheme of microscale distillation and enable the learners for isolation of individual organic compounds/ components based on their unique physical properties by simple distillation. **CO (A) 3** Develop skills in identification of organic compounds using functional group characteristics and measurement of yields.	
8	**Course Outcomes:** Upon completion of the course, student will be able to…. **CO1:** Identify the physical type of the binary organic mixture and select appropriate method for separation of liquid–liquid and liquid–solid systems. **CO2:** Separate components of binary mixtures using microscale distillation technique. **CO3:** Identify purified organic components based on physical properties and systematic experimental observations.	
9	**Syllabus** **Module 1 (Organic)** **Separation of Binary liquid-liquid and liquid- solid mixture (08 - 12 mL mixture to be given) (Minimum 06 mixtures)**	

vi) Each student shall complete the analysis of a minimum of six binary organic mixtures (03 liquid – solid) and 03 liquid - liquid).

vii) Components of the liquid-liquid mixture should include volatile liquids like acetone, methyl acetate, ethyl acetate, isopropyl alcohol, ethyl alcohol, EMK and non-volatile liquids like chlorobenzene, bromobenzene, aniline, N, N- dimethylaniline, acetophenone, nitrobenzene, ethyl benzoate.

viii) Components of the liquid - solid mixture should include volatile liquids like acetone, methyl acetate, ethyl acetate, ethyl alcohol, IPA, EMK and solids such as water insoluble acids, phenols, bases, neutral.

ix) A sample of the mixture one ml to be given to the student for detection of the physical type of the mixture.

x) After correct determination of physical type, separation of the binary mixture to be carried out by distillation method using microscale technique.

xi) After separation into component A and component B, either Volatile Liquid or Solid to be given for identification.

Module 2 (Analytical)

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

50 Marks

A. Internal Continuous Assessment: 40% (20Marks)	**B. External Examination: Semester End External - 30 marks**
Continuous Evaluation through: Viva, scheme hypothesis, Test, Assignment	**Time: 2 hours** Experiment from module1or 2 – 25 Marks Journal – 05 Marks

11

REFERENCES:

Module 1: Organic Chemistry

1 Furniss, Hannaford, Smith & Tatchell, Vogel's Textbook of Practical Organic Chemistry, Pearson Education, 5th Edition, 1989.

2 F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Pearson Education, 4th Edition, 2009.

	3 John C. Gilbert & Stephen F. Martin, Experimental Organic Chemistry - Cengage Learning, 5th Edition, 2011. 4 O. P. Agarwal, Practical Organic Chemistry, Krishna Prakashan Media (P) Ltd, 2014. 5 Practical Organic Chemistry - A. I. Vogel. 6 Practical Organic Chemistry - H. Middleton **Module 2: Analytical Chemistry** 1. D. A. Skoog, D. M. West, F. J. Holler, and S.R. Crouch, Analytical Chemistry: An Introduction, 7th ed., Chapter 15, pp. 345-381. 2. A.I. Vogel."Text book of Quantitative Inorganic Analysis", Longman, London (1961). 3. R.V. Dilts."Analytical Chemistry. Methods of Separation", van Nostrand, N.Y. (1974). 4. Some Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B. BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - VI

Title: Industrial aspects of Chemistry-paper VIII

With effect from
Academic Year 2026 - 2027

Title: Industrial aspects of chemistry
Paper VIII [Course Code: CHMCHEMVI7]

Sr. No.	Heading	Particulars
1	**Description of the Course**	The core objective of Industrial Chemistry is to bridge the gap between fundamental chemical theory and practical, real-world manufacturing. It teaches students how to economically and sustainably transform raw materials into commercial products while optimizing production efficiency and managing waste. Objective includes Translating laboratory-scale chemical reactions into mass-scale, commercially viable industrial manufacturing processes. It covers Process Optimization Maximizing the yield and efficiency of chemical processes while minimizing energy consumption and operational costs. Students will be acquainted with Sustainability and Safety. Assessing and managing the environmental impact of industrial production by promoting green chemistry and eco-friendly technologies.
2	**Vertical**	01 Mandatory
4	**Credits**	01
5	**Hours allotted**	15 Hours
6	**Marks allotted**	25 Marks
7	**Course Objectives:** The course aims to: **CO (A) 1** Develop systematic approach and understanding of principles involved in processes in chemical industries. **CO (A) 2** Provide knowledge of different manufacturing processes of important chemical reagent. **CO3** Develop skills in synthesis of commercial industrial products and determination of percentage yield. **CO (A) 4** Provide the knowledge of techniques required for determination of important metals	
8	**Course Outcomes:** Upon completion of the course, student will be able to…. **CO1:** Determine the active ingredient in samples such as Ibuprofen, milk of magnesia and aspirin **CO2**: Analyse ore/alloys for metal content and determine its percentage **CO3**: Synthesize commercial chemical reagents . **CO4:** schematically represent the approach of the experiment	

9

Syllabus

Module 1 (8Hours)

Unit operations and unit processes in chemical industries (8Hours) Definitions and Differences between Unit operations and Unit processes Principles underlying Distillation, filtration evaporation , crystallization

,polymerization

Types of unit operations , Examples of distillation of acetone with water, methylene dichloride with water

Types of Unit processes ,Examples of sulphonation, nitration, halogenation ,oxidation, esterification (Chemical reactions expected)Industrial processes such as electrolysis of sodium chloride, steam methane reforming process

Module 2 (7Hours)

Green solvents in industrial chemical processes (2hours)

Classification,, Examples (any 5), Applications

Effluent Treatment and waste Management in chemical industries (3hours) Principles and equipment for aerobic, anaerobic treatment, adsorption, filtration, sedimentation.

S**afety standards and measures in chemical industry (2Hours)**

10

Scheme of Examination and Assessment Pattern

Paper - 50 Marks

B. External Examination: Semester End External - 30 marks Time: 1.0 hour

Format of Question Paper

Scheme 1 - Proposed Theory Question Paper Pattern

Question No.	**Nature of Questions**	**Marks**
Q1	Module 1 (Attempt any 01 out of 02)	08
Q2	Module 2 (Attempt any 01 out of 02)	07
	Total	**15**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	**Marks**
1.	Classroom Activity Participation / Test/Industrial visit report	10
	Total	**10**

11	**REFERENCES:** 1. Industrial Inorganic Chemistry-Buchner, Schliebs, Winter, translated by D. H. Tenell, VCH Publishers, New York. 2. Industrial Organic Chemistry- K. Welssermel, H. J. Arpe, VCH Publishers, New York. 3. B.Pearson- Speciality Chemical Innovations in Industrial Synthesis. 4. Text Book of Organic Medicinal and Pharmaceutical Chemistry Wilson & Giswold 5. Shreeves _Chemical Process Industries' 5th Edition, G. T. Oustin, McGraw Hill. 6. Industrial Chemistry- B. K. Sharma, Goyal publishing house, Mirut. 7. Riegel's Hand Book of Industral Chemistry, 9th Edition, Jems A. Kent. 8. Industrial Chemistry- E Stoch, Vol- I, Ellis Horwood Ltd. UK. 9. An Introduction to Industrial Organic Chemistry- Wiseman and Peter, —‖ 10. Unit Operations and Processes- P. H. Groggins. 11. Unit Operations I and II- P.P. Kale- Pune Vidyarthigruh Prakashan. 12. Unit Operations in Chemical Engineering by W. L. McCabe and Smith. 13. Riegel's Handbook of Industrial Chemistry, J. A. Kent, CBS Publishers, New Delhi

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester - VI

Title: Major/ Mandatory
Practicals in Industrial Chemistry - IV
Vertical 1

With effect from
Academic Year 2026 - 2027

Title: Practical in Industrial chemistry
[Course Code: CHMCHEMVI7]

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 in chemical industries. Students will learn industrial Terms 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 industrial applications.
2	**Vertical**	01
4	**Credits**	01
5	**Hours allotted**	30 Hours
6	**Marks allotted**	25 Marks
7	**Course Objectives:** The course aims to: **CO (A) 1** Develop systematic approach and understanding of principles involved in processes in chemical industries. **CO (A) 2** Provide knowledge of different manufacturing processes of important chemical reagent. **CO (A) 3** Develop skills in synthesis of commercial industrial products and determination of yield. **CO (A) 4** Provide the knowledge of techniques required for determination of important metals	
8	**Course Outcomes:** Upon completion of the course, student will be able to…. **CO1:** Synthesize commercial chemical reagents. **CO2:** Analyze ore/alloys for metal content and determine its percentage **CO3:**To determine the active ingredient in samples such as Ibuprofen, milk of magnesia and aspirin	
9	**Syllabus** • Determination of the amount of magnesium hydroxide in a commercial sample of milk of magnesia. • Estimation of commercial sample of vitamin C. • Estimation alkalinity and TDS in given water sample. • Estimation of methyl salicylate. • Estimation of acetic acid in a sample of vinegar. • Analysis of cupronickel alloy for Ni content • Analysis of hematite ore for Fe content	

<table>
<tr><td>10</td><td colspan="2">Scheme of Examination and Assessment Pattern
Paper - 25 Marks
C. External Examination: Semester End External - 15 marks Time: 2 hours
Format of Question Paper</td></tr>
<tr><td></td><td>A. Internal Continuous Assessment:
40% (10 M)</td><td>B. External, Semester End Examination
60% (15 M)</td></tr>
<tr><td></td><td>Continuous Evaluation through:
viva/project hypothesis development /
Industrial visit report</td><td>Experiment - 10 Marks
Journal - 05 Marks</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td>11</td><td colspan="2">REFERENCES:
1. Industrial Inorganic Chemistry-Buchner, Schliebs, Winter, translated by D. H. Tenell, VCH Publishers, New York.
2. Industrial Organic Chemistry- K. Welssermel, H. J. Arpe, VCH Publishers, New York.
3. B.Pearson- Speciality Chemical Innovations in Industrial Synthesis.
4. Text Book of Organic Medicinal and Pharmaceutical Chemistry Wilson & Giswold
5. Shreeves ‗Chemical Process Industries' 5th Edition, G. T. Oustin, McGraw Hill.
6. Industrial Chemistry- B. K. Sharma, Goyal publishing house, Mirut.
7. Riegel's Hand Book of Industral Chemistry, 9th Edition, Jems A. Kent.
8. Industrial Chemistry- E Stoch, Vol- I, Ellis Horwood Ltd. UK.
9. An Introduction to Industrial Organic Chemistry- Wiseman and Peter, —‖
10. Unit Operations and Processes- P. H. Groggins.
11. Unit Operations I and II- P.P. Kale- Pune Vidyarthigruh Prakashan.
12. Unit Operations in Chemical Engineering by W. L. McCabe and Smith.
13. Riegel's Handbook of Industrial Chemistry, J. A. Kent, CBS Publishers, New Delhi</td></tr>
</table>

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Chemistry)

Semester- VI

Title: Elective Chemistry
Drugs and Dyes

With effect from
Academic Year 2026-2027

Title: Elective Chemistry (Drugs and Dyes) –Theory
[Course Code: CHMCHEMVI8]

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 dyes and processes underlying dyes manufacturing is covered under the course.
2	**Vertical**	1
3	**Type** **Teaching Methodology**	Theory Classroom Discussion / Demonstration / Presentation / Real time Problem Solving
4	**Credits**	2
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** The course aims to: **CO (A) 1**: Understand the basic terms used in medicinal and dye stuff chemistry, key aspects in drug development **CO (A) 2**:To understand the various chemotherapeutic agents with respect to chemical structure, therapeutic action and uses. **CO (A) 3**: Understand the processes involved in the synthesis of dyes/drugs and their intermediate. **CO (A) 4**: To understand various applications of dyes	
8	**Course Outcomes**: Upon completion of the course, student will be able to **CO1** Explain various terms used in medicinal chemistry and dyestuff chemistry **CO2** Analyze and classify type of drugs / dyes. **CO3** Apply the knowledge of the drug in treatment of diseases. **CO4** Design and development new drug and dyes in respective industry.	
9	**Syllabus** **Module 1: Drugs (15 Hours)** **Chemotherapeutic agents (6 Hours)** A brief introduction of the following chemotherapeutic agents and their study with respect to chemical structure, chemical class, therapeutic uses and side effects. a) Antibiotics and antivirals: Definition, characteristics and properties, Amoxicillin (Penicillin's), Cefpodoxime (Cephalosporins) and role of Remdesivir in COVID-19.	

	b) Antimalarial: -Types of malaria, symptoms, Pathological detection during window period, Chloroquine (4-Amino quinolones), Artemether-Lumefentrine, combination therapy (No structure). c) Anthelmintic and Antifungals: Albendazole (Benzimidazoles), Fluconazole (Triazoles). d) Antitubercular and Antileprotic drugs: Symptoms and types of tuberculosis and leprosy, General idea of antibiotics used in their treatment. Isoniazide (Hydrazides), Dapsone (Sulfones). Synthesis of Dapsone from 4-Chloronitrobenzene. e) Antineoplastic drugs: Idea of malignancy, types of Tumors, causes of cancer, Therapy for Cancer. Anastrozole (Triazoles), Cisplatin (Chloro platinum). **Modern Drug Development (5 Hours)** Discovery of a Lead compound: Screening, Drug metabolism studies and Clinical observation, Lipinski's rule of 5 Development of drug: The Pharmacophore identification, modification of structure or functional group, Structure activity relationship (Sulphonamides). Introduction to clinical trials; Role of food and drug administration (FDA), Nanoparticles in medicinal chemistry (Gold and Silver Nanoparticles), Computer aided drug design. **Biopharmaceuticals (2 Hours)** Vaccines e.g. Covishield and Covaxin; monoclonal antibodies; recombinant DNA drugs (introductory level). **Drug Safety & Regulatory Aspects (2 Hours)** Adverse Drug Reactions (ADR); pharmacovigilance; intellectual property rights (IPR) in pharmaceuticals. **Module 2: Dyes (15 Hours)** **1 Dyes, Pigments, Optical brighteners: (3 Hours)** Definition, properties and classification of pigments, Difference between dyes and pigments. Definition, properties and classification of Optical brighteners **Non-textile uses of dyes: (5 Hours)** Dyes used in Drug formulations, Biological staining agents, Dyes as therapeutics, Food-stuff & Cosmetics, Introduction to FDA and FSSAI, Hair dyes, Security inks, Coloured smokes and camouflage colours **Synthesis of Dyes: (4 Hours)** i) Synthesis Orange IV from sulphanilic acid ii) Preparation of Indigo from aniline and monochloroacetic acid iii) Preparation of Eosin from Resorcinol and Phthalic anhydride iv) Synthesis of Bismarck brown from m-Phenylene diamine v) Synthesis of Indanthrene blue from anthaquinone **Green Chemistry approaches in Dyestuff industry (3 Hours)** Environmental impact of dye effluents; Green chemistry approaches to minimize industrial pollution. Importance of effluent treatment plant. Perspectives of India: Importance of Make in India.

10

Scheme of Examination and Assessment Pattern

C. External Examination: Semester End External - 30 marks Time: 1.0 hour

Format of Question Paper

Scheme 1 - Proposed Theory Question Paper Pattern

uestion No.	**Nature of Questions**	**Module**	**Mark**
Q1	Attempt any 03 out of 06	1	15
Q2	Attempt any3 0ut of 06	2	15
	Total		**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	**Marks**
1.	Test	10
2.	Classroom Activity Participation (worksheet/open book)	10
	Total	**20**

11

REFERENCES:

14. 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.
15. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition, 2007.
16. The Art of Drug synthesis. Johnson and Li. Wiley, 2007.
17. The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press, 2014.
18. Nanoparticle and technology for drug delivery (Drugs and pharmaceutical sciences) Ram B. Gupta & Uday B. Kompella, volume 159, Taylor and Francis group. 2006.
19. Chemistry of Synthetic Dyes, Vol I – IV, Venkatraman K., Academic Press 1972
20. The Chemistry of Synthetic Dyes and Pigments, Lubs H.A., Robert E Krieger Publishing Company, NY ,1995
21. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications, 1973
22. Environmental Studies, Joseph Benny, Tata McGraw Hill Education, 2005
23. Green Chemistry for Dyes Removal from Waste Water- Research Trends and Applications, Ed. Sharma S.K., Wiley, 2015
24. Environmental Pollution- Monitoring and Control, Khopkar S.M., New Age International (P) Ltd, New Delhi, 1982.

Title: Practicals in Drugs and Dyes
[Course Code: CHMCHEMVI9]

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**	1
3	**Type** **Teaching Methodology**	Practical Experimental \ Demonstration \ Handling of instruments
4	**Credits**	2
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** The course aims to: **CO (A) 1**: To make students involved in actual drug and dye synthesis, and learn applications. **CO (A) 2:** To learn application in textiles, and the relationship between chemical structure and color.	
8	**Course Outcomes:** Upon completion of the course, student will be able **CO1:** Gain knowledge of the synthesis of various intermediates, dyes and pharmaceutical preparations **CO2:** Understand the dyeing processes and separation processes **CO3**: Apply the knowledge in the qualitative and quantitative analysis of drugs and dyes **CO4:** Use of AI assisted experiments in the design of drugs and dyes	
9	**Syllabus** **Preparations:** • Preparation of m-Nitroaniline from m-Dinitrobenzene • Preparation of fluorescein from resorcinol & β-Naphthol. • Preparation of Antacid suspension • To prepare Neroline (o-methoxy naphthalene) from β- naphthol by methylation method • To prepare 4- nitro salicylic acid by using Ceric Ammonium Nitrate. (green method) • To prepare simple pharmaceutical syrup • To prepare ink from synthetic dye	

<table>
<tr><td></td><td colspan="2">Estimations:
• Estimation of Ibuprofen
• Estimation of Iodine from Tincture Iodine
• Estimation of Paracetamol content in the given sample
• Estimation of free acid in vegetable oil
• Estimation of Vitamin B12 by colorimetry
Dyeing processes
Dyeing of cotton fabric using Mordant dyeing</td></tr>
<tr><td>10</td><td colspan="2">Scheme of Examination and Assessment Pattern
Paper – 50 Marks</td></tr>
<tr><td></td><td>A. Internal Continuous Assessment: 40% (20Marks)
Continuous Evaluation through:
Viva, scheme hypothesis, Test, Assignment</td><td>B. External Examination: Semester End External - 30 marks Time: 2 hrs
Experiment from module1or 2 – 25 Marks
Journal – 05 Marks</td></tr>
<tr><td>11</td><td colspan="2">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, 1973
9. Environmental Studies, Joseph Benny, Tata McGraw Hill Education, 2005
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.</td></tr>
</table>

OJT

[Course Code: CHMCHEMVI10]

.....

Board of Studies (Sem – II)

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	Outside Memb
12	Dr.Smita Thosar	Representative from Industry Associate Director, Cipla	Outside Mem
13	Dr.Mukund Deshpande	Alumni Member	Outside Me
14	Dr.Rajesh Samant	Subject Expert outside the parent University	Outside Mem

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

me & Signature of the Dean: Dr. Neena Anand