Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA
PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

Ref.No.SU/BOS/Science/434 **Date: 15/07/2025**

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur.

Subject: Regarding revised syllabi of B.Sc. Part-II (Sem.III & IV) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0)

Ref: No.SU/BOS/Science/270 & 271 Date: 03/05/2025 Letter.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi, nature of question paper of B.Sc. Part-II (Sem.III & IV) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

B.Sc.Part-II (Sem. III & IV) as per NEP-2020 (2.0)			
1.	Botany	8.	Geology
2.	Statistics	9.	Zoology
3.	Mathematics	10.	Chemistry
4.	Microbiology	11.	Electronics
5.	Plant Protection	12.	Industrial Microbiology
6.	B.A./B.A.B.Ed. Geography	13.	Biotechnology(Voc/Opt)
7.	Biotechnology(Entire)		

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2025 & March/April 2026. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Encl: As above

for Information and necessary action

Copy to:

1	Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations and Evaluation	7	I.T.Cell /Computer Centre
3	Chairman, Respective Board of Studies	8	Eligibility Section
4	B.Sc.-M.Sc. Exam Section	9	Affiliation Section (T.1) (T.2)
5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

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दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्याससमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

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B.Sc.Part-II (Sem. III & IV) as per NEP-2020 (2.0)			
1.	Botany	8.	Geology
2.	Physics	9.	Zoology
3.	Statistics	10.	Chemistry
4.	Mathematics	11.	Electronics
5.	Microbiology	12.	Drug Chemistry
6.	Plant Protection	13.	Industrial Microbiology
7.	Astrophysics and Space Science	14.	Sugar Technology (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(Online Syllabus)

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By Registrar
Dr. S. M. Kubal

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Shivaji University,

Kolhapur

Accredited By NAAC with 'A^{++}' Grade

Syllabus for

Bachelor of Science Part-II

(B. Sc. II)

Chemistry (Major)

(NEP-2.0)

To be implemented from

June, 2025 onwards

SHIVAJI UNIVERSITY, KOLHAPUR
Revised Syllabus for the Bachelor of Science in Chemistry
(As per NEP- 2.0)
Applicable from the Academic Year 2025 –26

1. **Title**: B. Sc. II Chemistry, Shivaji University, Kolhapur Revised Syllabus as per NEP – 2.0
2. **Faculty**: Faculty of Science and Technology.
3. **Year of Implementation**: From June 2025
4. **Objectives of a Bachelor of Science (B.Sc.) in Chemistry Program include**:
    - Understand the fundamental principles, laws, concepts and formulas of Chemistry.
    - Develop problem-solving skills of students.
    - Gain practical experience by hands-on experience with instruments and develop laboratory skills.
    - Learn about advanced Chemistry and its applications for higher studies.
    - Learn to apply conceptual knowledge to practical work.
    - Learn to interpret chemical and physical phenomena through experimental evidence.
    - Learn to analyze and interpret data accurately through scientific reasoning and experimental hypothesis testing.
5. **Program Outcomes:**

    PO-1:- Students will gain fundamental knowledge of Chemistry which will help them for PG studies and Research.

    PO-2:- Students will be able to know good laboratory practices and lab safety.

    PO-3:- Students will become proficient in analyzing the various observations and chemical phenomena presented to him during the course.

    PO-4:- Students will be able to apply the fundamental knowledge to address the cross-cutting issues such as sustainable development.

    PO-5:- Students will be able to solve various problems by identifying the essential parts of a problem, formulate strategy for solving the problem, applying appropriate techniques to arrive at a solution, test the precision and accuracy of the solution and interpret the results.

PO-6:- Students will be able to communicate effectively i.e. being able to articulate, comprehend and write effective reports, make effective presentations and documentation and capable of expressing the subject through technical writing as well as through oral presentation.

6. **Program Specific Outcomes:**

PSO-1:- Students will be able to explain fundamental concepts of Inorganic, Physical, Organic and Analytical Chemistry.

PSO-2. Students will be able to Identify chemical formulae and solve numerical problems.

PSO-3. Students will be able to use modern chemical tools, Models, Charts and Equipment.

PSO-4. Students will be able to prepare and qualify for competitive examinations

PSO-5. Students will understand good laboratory practices and safety.

PSO-6. Students will develop research-oriented skills.

7. The B. Sc. II Course (Chemistry) (Level 5.0) will be of **Two Semesters (Sem. III and Sem IV)**.
8. Pattern of Examination: The Examinations will be conducted **semester-wise for Theory and Practical.**
9. **Fee structure**: As per Shivaji University guidelines.
10. **Eligibility Criteria for Admission to B. Sc. Part II (Level 5.0)**:

i) The students passing or ATKT the B. Sc. Part-I (or Undergraduate Certificate in Science) shall be allowed to enter upon the B. Sc. Part-II (or Undergraduate Diploma in Science).

OR

ii) An Examination of any other Statutory University or an Examining Body recognized as equivalent there to.

OR

iii) Completed 3-years diploma course with subjects allied / related to the subject at B.Sc. Part I

OR

iv) Completed first year of B.E./B. Tech. with subjects allied / related to the subject at B.Sc. Part I

11. **Medium of Instruction**: English
12. **Structure of course:** Given in Framework Chart
13. **Scheme of Teaching and Examination:**

a. Each theory course paper constitute of 4-5 units require 30 hours of teaching lectures and there shall be two lectures per theory (2 Cr) course per week.

b. B. Sc. II Chemistry Course will be of 44 Credits (1100 marks) .

c. Examination of each **theory course** shall be of **50 marks** (40 university examination + 10 internal assessment). University examination of 40 marks (1.5 hours' duration) will be conducted at the end of each Semester. Internal assessment of 10 marks will be done before the semester examination during each semester.

d. Examination of practical course shall be of 50 marks per semester.

e. Pattern and Nature, marking scheme for theory and Practical Examination for Major Specific SEC and VSC courses are included in syllabus.

f. Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus. Weightage should be provided to each unit as per the hours allotted for teaching.

14. Standard of Passing: The standard of passing shall be as per the following table.

	Semester End Exam	Internal Assessment	Course Exam (Total)
Maximum Marks	40	10	50
Minimum Marks required for passing	14	4	18

i) There shall be a separate head of passing for semester end examination and internal examination.

ii) Minimum 18 marks out of 50 are required for passing of practical examination of each course.

iii) Passing criteria for Co-Curricular Activities (CC) and community Engagement Program (CEP) as per the University guidelines.

15. Nature of Question paper and scheme of marking:

Theory question paper: Maximum marks -40

Total No. of questions – 3

All questions are compulsory. Question No.1 is MCQ type (8 Marks). Question number 2 is long answer type question Carries 16 marks. Question number 3 is short answer type question carries 16 marks. (Nature of question paper is provided at the end of syllabus.)

Shivaji University, Kolhapur

Bachelor of Science

Credit Framework

B. Sc. II-Chemistry (To be implemented from June 2025)

Level	Sem.	Subject-1 (Chemistry)	Subject-2 (Chemistry)	IDC/MDC/ OE/GE	VSC/SEC		AEC, VEC, IKS			OJT, FP, CEP, CC, RP			Total Credits	Degree/ Cum. Cr. MEME
		As Major	As Minor	OE (For Other Faculty)	VSC	SEC	AEC	VEC	IKS	CC	FP/ OJT	RP/ Dissert		
5.0	III	PCH-301 Paper-V Physical Chemistry (2 Cr)	PCHMN-301 Paper-V Applied Physical Chemistry (2 Cr)	CHOEPR-301 Practical Paper-III Food Chemistry (2 Cr)	PRCHVSC-301 Vocational Skill Course Practical Paper-I (2 Cr) (Major specific)	CHSECPR-301 Practical Skills in Chemistry Practical Paper-I (2 Cr)	AEC I (2 Cr) (English)	--	--	CC-I (2 Cr)	--	--	--	UG Diploma 88
		ACH-302 Paper-VI Analytical Chemistry (2 Cr)	ACHMN-302 Paper-VI Applied Analytical Chemistry (2 Cr)											
		PRCH-303 Practical Paper-III (2 Cr)	PRCHMN-303 Practical Paper-III (2 Cr)											
	Credits	**4(T)+2(P) =6**	**4(T)+2(P) =6**	**2 (P) =2**	**2(P)=2**	**2(P)=2**	**2(T)=2**	**--**	**--**	**2**	**--**	**--**	**22**	
	IV	ICH-401 Paper-VII Inorganic Chemistry (2 Cr)	ICHMN-401 Paper-VII Fundamentals of Inorganic Chemistry (2 Cr)	CHOEPR-401 Practical Paper-IV Chemistry in Everyday Life (2 Cr)	--	CHSECPR-401 Practical Skills in Chemistry Practical Paper-II (2 Cr)	AEC-II (2 Cr) (English)	VEC-II (2 Cr) (Environmental studies)	--	CHCEP-401 Community Engagement Programme in Chemistry (2 Cr)	--	--	--	
		OCH-402 Paper-VIII Organic Chemistry (2 Cr)	OCHMN-402 Paper-VIII Applied Organic Chemistry (2 Cr)											
		PRCH-403 Practical Paper-IV (2 Cr)	PRCHMN-403 Practical Paper-IV (2 Cr)											
	Credits	**4(T)+2(P)=6**	**4(T)+2(P) =6**	**2 (P)=2**	**--**	**2(P)=2**	**2(T)=2**	**2(T)**	**--**	**2**	**--**	**--**	**22**	
Total Credits		**12**	**12**	**4**	**2**	**4**	**4**	**2**	**--**	**4**	**--**	**--**	**44**	
		Exit Option: Exit Option:4 credits NSQF/Internship/Skill courses												

Structure of B. Sc. II Chemistry (Major)

Sr. No.	Semester	Course Code	Title of Paper
1	III	BSU0325MML207C01	PCH-301 Paper -V, Physical Chemistry (2 credits, 30 Hours)
2		BSU0325MML207C02	ACH-302 Paper -VI, Analytical Chemistry (2 credits, 30 Hours)
3		BSU0325MMP207C03	PRCH-303 Chemistry Practical Paper-III (2 credits, 60 Hours)
4		BSU0325VSP207C01	PRCHVSC-301 Vocational Skill Course-Practical Paper-I (2 credits, 60 Hours)
6	IV	BSU0325MML207D01	ICH-401 Paper-VII, Inorganic Chemistry (2 credits, 30 Hours)
7		BSU0325MML207D02	OCH-402 Paper -VIII, Organic Chemistry (2 credits, 30 Hours)
8		BSU0325MMP207D03	PRCH-403 Chemistry Practical Paper-IV (2 credits, 60 Hours)
9		BSU0325CEP207D01	CHCEP-401 Community Engagement Programme in Chemistry (2 Credits, 60 Hours)

B.Sc. Part II (NEP-2.0) Semester– III

PCH-301: Paper V (PHYSICAL CHEMISTRY)

(Credits: 02, 30 hours)

Expected Course Outcomes:

Name of the Topics	**Expected Course Outcomes**
Electrolytic Conductivity	Learning and coherent understanding of conductivity and transport number of the aqueous solutions with different applications. Experimental determination of transport number and numerical problems
Thermodynamics	Knowledge and coherent understanding of basic concepts in thermodynamics and concept of Entropy will be gained by the student.
Chemical Kinetics	Learning and understanding the knowledge about basic concepts in kinetics and third order reactions with characteristics, suitable examples and methods for determination of order of reactions and numerical problems.
States of Matter	Learning and coherent understanding of behavior of gases, ideal gas as model system and its extension to real gases. The dependence of physical state on P, V and T. Liquid crystals are essential in all common and research devices, hence they are introduced with suitable examples.
Surface Chemistry	Learning and understanding of theoretical basis of adsorption phenomenon, dynamic nature of surface and its applications.

Unit 1: Electrolytic Conductivity (6 hours)

1.1 Introduction, Migration of ions.

1.2 Hittorf's rule, Transference number, determination of transport number by moving boundary method, factors affecting transport number: nature of electrolyte, concentration, temperature, complex formation and degree of hydration.

1.3 Kohlrausch law of independent migration of ions and its applications such as relations between ionic conductance, ionic mobility and transport number, determination of equivalent conductance at infinite dilution of weak electrolytes, determination of degree of ionization of weak electrolyte.

1.4 Conductometric titrations (only acid-base titrations). Advantages of conductometric titrations.

1.5 Numerical problems.

Unit 2: Thermodynamics (6 hours)

2.1 Introduction, Concept of Entropy: Definition, mathematical expression, unit.

2.2 Physical significance of Entropy.

2.3 Entropy changes for reversible and irreversible processes in isolated systems.

2.4 Entropy changes for an ideal gas as a function of V & T and as function of P & T.

2.5 Entropy change in mixing of gases.

2.6 Entropy change in phase transformations.

2.7 Third law of thermodynamics, standard entropy, application of third law of thermodynamics in determination of absolute entropy, Entropy changes in chemical reactions

2.8 Numerical problems.

Unit 3: Chemical kinetics (4 hours)

3.1 Introduction.

3.2 Third order reactions: derivation of rate constant considering reaction with

Equal initial concentration, characteristics, and examples of third order reaction.

3.3 Determination of order of reaction by: i) Integration method, ii) Graphical method and iii) Half-life method.

3.4 Effect of temperature on rate of reaction, Arrhenius equation. Concept of energy of activation.

3.5 Numerical problems.

Unit 4: States of Matter (8 hours)

4.1 Introduction, States of matter and their properties.

A) Gaseous state:

4.2 Postulates of Kinetic Theory of Gases.

4.3 Ideal and Non ideal gases, Deviation of real gases from ideal behavior, compressibility factor, causes of deviation.

4.4 Van der Waals equation of state for real gases. Explanation of real gas behavior by Van der Waal's equation, Boyle temperature (derivation not required).

4.5 Critical Phenomena: PV-isotherms of real gases (Andrew's isotherms), Continuity of state, Critical constants and their calculation from Vander Waals equation.

B) Liquid state:

4.6 Liquid crystals: Difference between liquid crystal, solid and liquid.

4.7 Classification, structure of nematic, smectic and cholestric liquid crystal.

4.8 Numerical Problems.

Unit 5: Surface Chemistry (6 hours)

5.1 Introduction, Adsorption as a surface phenomenon, Definition of adsorption, adsorbent, adsorbate. Characteristics of adsorption.

5.2 Factors affecting adsorption, Types of adsorption, Distinction between physical and chemical adsorption,

5.3 Adsorption isotherms: Freundlich adsorption isotherm, Langmuir adsorption isotherm.

5.4 Applications of adsorption.

Reference Books:

1) Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
2) Castellan G.W. Physical Chemistry 4 th Ed. Narosa (2004).
3) Kotz, J.C. Treichel, P.M.& Townsend,J.R.General Chemistry, Cengage Learning India Pvt Ltd: New Delhi (2009).
4) Mahan ,B.H. University Chemistry, 3rd Ed. Narosa (1998).
5) Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co,: New York (1985).
6) Elements of Physical Chemistry, S., Glasstone, D. Lewis.(2010)
7) Principles of physical Chemistry, Marron and Prutton. (2007).
8) Elements of Physical Chemistry, P.W. Atkins (2017-18)
9) Essentials of Physical Chemistry, Bahl and Tuli. S. Chand, 2010.
10) Physical Chemistry, Danials and Alberty (2016)
11) University General Chemistry C.N.R.Rao (2016)
12) Principals of Physical Chemistry Puri, Sharma and Pathania 47ThEdison, Vishal Publishing Co. Daryaganj Delhi. 110002 (2017-18)
13) Physical Chemistry A. J. Mee.(2015)
14) Advanced Physical Chemistry Gurudeep Raj (2017-18)
15) Physical Chemistry R. A. Aleberty. (2017-18)
16) Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

B. Sc. II Semester III, Paper VI
ACH-302- Analytical Chemistry
(Theory Credits:02, Lectures-30 hours)

Expected Course Outcomes:

Sr. No.	Name of Topic	Expected Course Outcomes
1	Gravimetric Analysis	Learning and understanding of basic concepts in gravimetric analysis
2	Colorimetry and Spectrophotometry	Understanding, working and applications of optical methods as an analytical tool.
3	Soap and Detergents	Knowledge about the chemical nature and cleansing action of soap
4	Chromatographic Techniques, IPR	Learning and coherent understanding of column and ion exchange chromatography, copyrights and trademarks
5	Corrosion	Learning and understanding the knowledge about basic concepts in corrosion and mechanism of corrosion

Unit 1: Gravimetric Analysis [6 hours]

1.1 Introduction

1.2 Gravimetric analysis by precipitation: nucleation, crystal growth, digestion/ageing, filtration, drying, ignition, weighing

1.3 Optimum condition for good precipitation

1.4 Physical nature of precipitate,

1.5 Purity of precipitate: co-precipitation, post-precipitation

1.6 Organic precipitates and their applications.

Unit 2: Colorimetry and Spectrophotometry [6 hours]

2.1 Theory of colorimetry and spectrophotometry.

2.2 Lambert Beer's law, deviation from Beer's law.

2.3 Terms used in colorimetry and spectrophotometry.

2.4 Classification of methods of 'colour' measurement or comparison.

2.5 Photoelectric colorimeter method–Single beam photo-electric colorimeter.

2.6 Spectrophotometer method–Single beam direct reading spectrophotometer.

2.7 Determination of unknown concentration by using concentration-absorbance plot.

2.8 Applications of colorimetry and spectrophotometry.

Unit 3: Soaps and detergents [6 hours]

1.1 Introduction,

1.2 Soaps - Raw materials,

1.3 Types of soaps,

1.4 Cleansing action of soap,

1.5 Manufacture of soap - Boiled or Hot Process,

1.6 Detergents - Raw Materials,

1.7 Types of Detergents: Anionic, cationic and amphoteric,

1.8 Preparation of Teepol and Deriphat,

1.9 Comparisons between soaps and detergents.

Unit 4: Chromatographic techniques and IPR [7 hours]

4.1 Introduction to chromatography, classification.

4.2 Column chromatography:

4.2.1 Introduction, types, Principle of adsorption column chromatography, solvent system, stationary phases

4.2.2 Methodology-Column packing, applications of sample, development, detection methods, recovery of components

4.2.3 Applications.

4.3 Ion exchange chromatography:

4.3.1 Introduction, Principle, Types and properties of ion exchangers

4.3.2 Methodology Column packing, application of sample, elution, detection/analysis,

4.3.3 Applications.

4.4 **IPR-**

4.4.1 Introduction to Copyright

4.4.2 Introduction to Trademark

Unit 5: Corrosion [5 hours]

5.1 Corrosion

5.1.1 Introduction of corrosion

5.1.2 Electrochemical theory of corrosion,

5.1.3 Factors affecting on corrosion -i. Position of metals in the electrochemical series on the basis of standard reduction potential ii. Purity of metal iii. Effect of moisture iv. Effect of oxygen (differential aeration principle) v. Hydrogen overvoltage,

5.1.4 Methods of protections of metals from corrosion- alloy formation, making metal cathodic, controlling external condition, Coating-galvanising, Tinning, electroplating, metal cladding, organic coating.

Reference Books:

1) Principles of Physical Chemistry by Puri, Sharma and Pathania, Vishal Publishing company Jalindhar.

2) Vogel's Textbook of Quantitative Chemical Analysis 5th Edition, Longman Scientific & Technical Ltd. UK.

3) Modern Analytical Chemistry By David Harvey, McGRAW- Hill International Edition, 2000.

4) Industrial Chemistry by B. K. Sharma, Goel Publishing Housing, 16th edition 2011.

5) Advanced Inorganic Chemistry, Vol. No.1, by Gurudeep Raj, Krishna Prakashan Media Ltd, Goel Publication, Meerut.

6) Analytical Chemistry by B. K. Sharma, Krishna Prakashan Media Ltd, Meerut, Edition 3rd 2011.

7) Chemical Process Industries by Shreve and Brink.

8) Industrial Chemistry by Loutfy Madkor and Helen Njenga.

9)Intellectual Property- A Primer for Academia by Prof. Rupinder Tewari &Ms. Mamta Bhardwaj, Publication Bureau, Panjab University, Chandigarh.

10) Elementary Principles of Chemical Processes by Richard Felder and Ronald

Rousseau, John Wiley and Sons.
11) Essential of Physical Chemistry by Bahl B.S., Tuli G.D. and Bahl Arun, S. Chand and Company Ltd. New Delhi.
12) Analytical Chemistry, H. Kaur, A Pragati Prakashan Meerut.
13) Analytical Chemistry, Alka Gupta, A Pragati Prakashan Meerut.
14) Instrumental Methods of Chemical Analysis – Chatwal & Anand.

B.Sc. II –Semester- III

PRCH-303 – Chemistry Practical Paper -III - Credit: 02, 60 hours

A] Physical Chemistry:

Perform the following Experiments (Any 8)

1. To study the hydrolysis of methyl acetate in presence of HCl and H_2SO_4 and to determine the relative strength of acids.
2. To study the reaction between Potassium persulphate and Potassium iodide in solution with unequal concentration of the reactants.
3. To study the effect of acid strength on hydrolysis of an ester by using 0.5M HCl and 0.25M HCl.
4. Determination of the adsorption coefficient of acetic acid-charcoal system.
5. To determine the percentage composition of a given liquid mixture by viscosity method (Density data to be given).
6. To determine the degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically.
7. To determine the normality of the given strong acid by titrating it against the strong alkali coductometrically.
8. To determine the specific rotation and unknown concentration of sugar solution by Polarimeter.
9. To determine the specific and molar refractions of benzene, toluene and xylene by Abbe's Refractometer and to determine the refraction of CH_2 Group (Methylene group) (Densities should be determined by students).

B) Analytical Chemistry

Perform the following Experiments (Any 8)

1. Fertilizer analysis: To determine the percentage of nitrogen in the given sample of a nitrogenous fertilizer (ammonium sulphate).
2. Analysis of Synthetic /Commercial Sample: To estimate Magnesium from talcum powder.
3. Determination of alkali content from antacid tablet using HCl solution.
4. Estimation of Calcium from chalk: To estimate amount of calcium from the chalk by titrimetric method. (By redox titration using $KMnO_4$ solution)
5. Determination of total hardness of water using 0.01M EDTA solution. (Students should standardize the given EDTA solution by preparing 0.01M $CaCl_2$ solution. using $CaCO_3$ salt.)
6. Determination of Alkalinity of water titrimetrically using 0.02N H_2SO_4 using methyl orange and phenolphthalein indicator.
7. Estimation of acetone.
8. Estimation of Vitamin C from given tablet.
9. Estimation of Phenol by Bromination method

Reference Books:

1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson 2009.
2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co: New Delhi (2011).
3. Findlay' Practical Physical Chemistry (Longmann)2015.
4. Practical Physical Chemistry : Gurtu (S. Chand) 2014.
5. Systematic Experimental Physical Chemistry : Rajbhoj, Chandekar (Anjali Publication) 2016.
6. Advanced Practical Chemistry by J. Singh, L. D. S. Yadav, R. K. P. Singh, I. R. Siddiqui et.al, Pragati Prakashan.
7. Vogel's Text Book of Qualitative Inorganic Analysis by A. I. Vogel .3rd and 6th edition.

8. Practical Organic Chemistry by A. I. Vogel.
9. Hand Book of Organic Qualitative Analysis by H. T. Clarke.
10. Practical Organic Chemistry by F.G. Mann and B. C. Saunders. Low – priced Textbook. ELBS. Longman

B. Sc. Part II Sem IV (NEP-2.0)

ICH-401 Paper-VII Inorganic Chemistry

(Theory Credits: 02, 30 hours)

Expected Course Outcomes:

Name of the Topic	Expected Course Outcomes
1. Co-ordination Chemistry	Learning and understanding basic concepts about coordination complexes.
2. Chemistry of elements of 3d Series elements	Student will be capable of understanding the properties of 3d series elements.
3. Chemical Bonding and Molecular Structure. (VBT and MOT)	Students will understand the formation of molecules on the basis of concept of hybridization and molecular orbital theory.
4. Inorganic Semi -micro Qualitative Analysis	Students will learn the basic knowledge about the Qualitative analysis of inorganic compounds.

Unit-1: Co-ordination Chemistry (10 Hours)

1.1 Introduction-Definition and formation of co-ordinate covalent bond in BF_3–NH_3, $[NH_4]^+$ and H_2O

1. 2 Terminology- Description of the terms-ligand, co-ordination number, co- ordination sphere.

1.3 Effective atomic number rule.

1.4 Distinguish between double salt and complex salt.

1.5 Werner's theory

1.5.1 Postulates.

1.5.2 The theory as applied to cobalt amines viz. $CoCl_3.6NH_3$, $CoCl_3.5NH_3$, $CoCl_3.4NH_3$, $CoCl_3.3NH_3$

1.6 IUPAC nomenclature of coordination compounds.

1.7 Isomerism in complexes with C. N. = 4 and C. N. = 6

1.7.1 Geometrical Isomerism,

1.7.2 Optical Isomerism

1.7.3 Structural Isomerism- Ionization Isomerism, Hydrate Isomerism, Coordination Isomerism, Linkage Isomerism and Co-ordination position Isomerism

1.8 Valance bond theory of transition metal complexes with respect to, C.N. = 4, complexes of $[CuCl_4]^{2-}$ and $[Cu(CN)_4]^{2-}$ and C.N. = 6 complexes of $[FeF_6]^{3-}$ and $[Fe(CN)_6]^{3-}$

1.9 Chelation.

1.9.1 Definition and explanation of terms chelation, chelating agent, metal chelate and chelate effect.

1.9.2 Difference between metal chelate and metal complex.

1.9.3 Classification of chelating agents (with specific illustration of bidentate chelating agent)

Unit 2: Chemistry of Elements of 3d Series Elements (6 Hours)

2.1 Position of elements in periodic table

2.2 Characteristics of d-block elements with special reference to

i) Electronic structure,

ii) Oxidation states,

iii) Magnetic characters,

iv) Colored ions

Unit- 3. Chemical Bonding and Molecular Structure. (7 Hours)

A) Valence Bond Theory (VBT)

3.1 VSEPR Theory

3.2 Concept of Hybridization: Need of Hybridization, different types of hybridization and geometry of following molecules.

(i) Planar trigonal geometry- BF_3 (sp^2 hybridization)

(ii) Tetrahedral geometry- $SiCl_4$ (sp^3 hybridization)

(iii) Trigonal Bipyramidal geometry- PCl_5 (sp^3d hybridization)

B) Molecular Orbital Theory (MOT)

3.3 LCAO method, formation of bonding and anti-bonding molecular orbitals.

3.4 Bond order and its significance, Energy level sequence for molecular orbital's when n= 1 and 2.

3.5 MO diagrams for homonuclear diatomic molecules, B_2,N_2 and O_2

3.6 MO diagrams for heteronuclear diatomic molecules, CO and NO.

Unit-4. Inorganic Semi-micro Qualitative Analysis (7 Hours)

4.1 Theoretical principles involved in qualitative analysis.

4.2 Applications of solubility product and common ion effect in separation of cations into groups.

4.3 Applications of complex formation in

a) Separation of II group in to IIA and IIB sub-groups.

b) Separation of Copper from Cadmium.

c) Separation of Cobalt from Nickel.

d) Separation of Cl^-, Br^-, I^-.

e) Detection of NO_2^-, NO_3^-(Brown ring test).

4.4 Application of oxidation and reduction in

a) Separation of Cl^-, Br^-, I^- in mixture

b) Separation of NO_2^- and NO_3^- in mixture.

4.5 Spot test analysis.

Reference Books:

1. Inorganic Chemistry, Principles of Structure and Reactivity by J. E. Huheey et.al.
2. Inorganic Chemistry by Shriver and Atkins 5th edition.
3. Vogels Textbook of Qualitative Inorganic Analysis by A. I. Vogel. 3rd and 6th edition.
4. Advanced Inorganic Chemistry by Agrawal Keemtilal (Pragati Prakashan).
5. Theoretical Inorganic Chemistry by C. Day & J. Selbin IInd edition.
6. Principles of Inorganic Chemistry by Puri Sharma & Kalia.
7. Modern Inorganic Chemistry by R. D. Madan (S. Chand).
8. Inorganic Chemistry by J. D. Lee.
9. Basic Inorganic Chemistry by F. A. Cotton, G. Wilkilson & B. L. Gauswiley.
10. Chemistry for Degree Students by R. L. Madan (S. Chand Publication).
11. Concise Coordination Chemistry by Ramlingam, Ramgopalan.

B. Sc. Part II Sem IV (NEP-2.0)

OCH-402 Paper-VIII Organic Chemistry

(Theory Credits: 02, 30 hours)

Expected Course Outcomes:

Name of the topic	Expected Course Outcomes
1. Carboxylic acids and their derivatives.	To impart knowledge about the synthesis, reactivity and applications of carboxylic acids.
2. Amines and Diazonium Salts	Knowledge about classification, preparation and applications of amines and diazonium salts.
3. Carbohydrates	Understanding the classification, configuration and structure of carbohydrates.
4. Carbonyl Compounds Aldehydes and Ketones	Students will be capable of understanding the nomenclature and reactivity of aldehydes and ketones.
5. Stereochemistry	Students will learn the basic knowledge of conformational analysis of some organic compounds.

Unit 1: Carboxylic Acids and Their Derivatives. [6 hours]

1.1 Monocarboxylic acid: Introduction, Methods of Formation from Alcohols, Aldehydes, Ketones, Nitriles and Alkyl benzenes.

1.2 Halo acids:

a) Synthesis of halo acids-Mono, Di, Tri- chloro acetic acid by HVZ reaction

b) Reactions - Substitution reaction of Mono - Chloro acetic acid by Nucleophile OH^-, I^-, CN^- and NH_3

1.3 Hydroxy acids: Citric acid

a) Methods of formation of Citric acid from glycerol.

b) Chemical Reactions: Reaction of citric acid: acetylation by acetic anhydride,

reduction by HI, action of heat.

1.4 Di carboxylic acids:

1.4.1 Introduction

1.4.2 Method of formation of succinic acid from ethylene dibromide, maleic acid

1.4.3 Chemical Reactions: Action of heat, Action of $NaHCO_3$, C_2H_5OH in the presence of acid.

1.4.4 Method of formation Phthalic acid from o-xylene and Naphthalene

1.4.5 Chemical Reactions of Phthalic acid : Action of heat, reaction with sodalime, ammonia.

1.5 Carboxylic acid derivatives:

1.5.1 Introduction

1.5.2 Acid halide derivative: Acetyl chloride: i) Synthesis from acid, by action with PCl_3 and $SOCl_2$. ii) Reaction with water, alcohol (Mechanism of esterification is expected) and ammonia.

1.5.3 Acid anhydride derivative:

1.5.3.1 Synthesis of acetic anhydride by dehydration of acetic acid.

1.5.3.2 Reactions with water, alcohol and ammonia.

Unit 2: Amines and Diazonium Salts: [5 hours]

2.1 Amines

i) Introduction, Classification and Nomenclature

ii) Methods of preparation:

a) From alkyl halide by amonolysis

b) By reduction of nitriles or cyanides

c) From unsubstituted amides (Hoffmann degradation),

d) By Gabrial synthesis (From Phthalamide).

iii) Reactions: Carbylamine reaction, Schotten-Baumann reaction, Electrophilic substitution (Aniline) - Nitration, Bromination, Sulphonation.

2.2 Diazonium salt:

i) Introduction

ii) Preparation of Benzene diazonium chloride.

iii) Reactions of Benzene diazonium chloride.

a) Replacement reaction -Sandmeyers reaction.

b) Coupling reactions: Synthesis of Congo red.

Unit 3: Carbohydrates [7 hours]

3.1 Introduction.

3.2 Classification of carbohydrates, reducing and non-reducing sugars.

3.3 Physical properties of glucose and fructose.

3.4 Killiani's synthesis of Glucose from D- Arabinose.

3.5 Determination of structure of D- Glucose.

a) Open chain structure of D- Glucose.

b) Configuration of D- Glucose from D- Arabinose.

c) Ring structure of D- Glucose.

d) Size of ring in D- Glucose by methylation Method.

e) Haworth projection for D- Glucose.

3.6 Cyclic structure of Fructose

3.7 Structures of Disachharides

a) Linkage between Monosachharides

b) Open chain and Haworth cyclic structures of Sucrose, Lactose and Maltose.

3.8 Structures of Polysachharides: a) Starch b) Cellulose

Unit 4: Carbonyl Compounds- Aldehydes and Ketones [6 hours]

4.1 Introduction, Nomenclature of aliphatic and aromatic aldehydes and ketones.

4.2 Structure and reactivity of Carbonyl group.

4.3 Reactions of Carbonyl Compounds- Mechanism and applications of -

i) Aldol condensation, ii) Claisen condensation, iii) Perkins reaction, iv) Cannizaro's reaction, v) Knoevenagel condensation and vi) Reformatsky reaction.

Unit 5: Stereochemistry [6 hours]

5.1 Conformational isomerism – Introduction.

5.2 Representation of conformations of ethane by using Saw- Horse, Fischer (dotted line wedge) and Newmann's projection formulae.

5.3 Conformations and conformational analysis of ethane and n-butane by Newmann's Projection formula with the help of energy profile diagrams.

5.4 Relative stability cycloalkanes - Baeyer's strain theory and Theory of strainless rings.

5.5 Conformations and stability of Cyclohexane

5.6 Conformation and stability of Methyl Cyclohexane.

Reference Books:

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

2. Stereochemistry Conformation & Mechanism, 9th Edition, By P. S. Kalasi, Publisher: New Age International, 2017.

3. Stereochemistry of Carbon Compounds by Eliel.

4. Stereochemistry of Organic Compounds by D. Nasipuri.

5. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

6. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd.

7. Organic Chemistry. Volume I, II, III by S. M. Mukharjee, S. P. Singh and R. P. Kapoor, Wiley Eastern Limited (New Age International).

8. Advanced Organic Chemistry by, B. S. Bahl, Arun Bahl. S. Chand & Company, Ltd.

9. Chemistry by R. L. Madan, S. Chand and Company Ltd.

B.Sc. II –Semester- IV

PRCH-403 – Chemistry Practical Paper -IV - Credit: 02, 60 hours

A) Inorganic Chemistry:

Gravimetric Analysis (Any two)

i) Gravimetric estimation of iron as Fe_2O_3 from a solution containing Ferrous ammonium sulphate and free sulphuric acid.

ii) Gravimetric estimation of barium as $BaSO_4$ from a solution containing barium chloride and free hydrochloric acid.

iii) Gravimetric estimation of nickel as $Ni(DMG)_2$ from a solution containing $NiSO_4.7H_2O$ and free sulphuric acid.

Inorganic Preparations (Any Two)

i) Preparations of sodium cuprous thiosulphate

ii) Preparation of tris (ethylenediamine) nickel(II) thiosulphate

iii) Preparation of hexamine nickel(II)chloride

Semi-micro Qualitative Analysis

Analysis of binary mixtures with non interfering cations and anions (at least **4 mixtures** to be analyzed)

iv) Following anions are to be given:

Cl^-, Br^-, I^-, NO_3^-, CO_3^{--}, SO_4^{--}, S^{--}, (insoluble CO_3—may be given)

v)Following cations are to be given:

Cu^{2+}, Cd^{2+} , Al^{+3}, Fe^{+3}, Cr^{+3}, Zn^{+2}, Mn^{+2} Ni^{+2}, Co^{+2},

Ca^{+2}, Ba^{+2}. Mg^{+2}, NH^{4+}, K^+

Note:-Use of spot tests to be made whenever possible.

B) Organic Chemistry:

1) **Organic Qualitative Analysis:** Identification of **Any Six** Organic Compounds with reactions including chemical type

Acids – Succinic acid, Phthalic acid, Salicylic acid, Aspirin. (Any 2)

Phenols – Alpha-Naphthol, p-nitrophenol. (Any 1)

Bases – o - nitroaniline, p-nitroanilines, Diphenyl amine. (Any 1)

Neutrals – Urea, Acetanilide, Carbon tetrachloride, Bromobenzene, Methyl acetate, Nitrobenzene, Naphthalene, Anthracene, Ethyl methyl ketone. (Any 2)

Note: A systematic study of an organic substance involves reactions in the determination of elements and functional group.

3) Organic Preparations (Any two)

i) Preparation of p-nitro acetanilide from Acetanilide.

ii) Preparation of Acetanilide from Aniline using anhydrous $ZnCl_2$ and Zn dust.

iii) Preparation of Phthalimide from Phthalic anhydride.

iv) Preparation of Benzoic acid from Benzamide.

Reference Books:

1) Vogel's Quantitative Chemical Analysis, Pearson 2009.

2) Vogel's Textbook of Qualitative Inorganic Analysis by A. I. Vogel .3rd and 6th edition.

3) Vogel's Textbook of Quantitative Inorganic Chemistry by A. I. Vogel.

4) Physical Chemistry of Inorganic Qualitative Analysis by Kuricose & Rajaram.

5) Practical Manual in Water Analysis by Goyal & Trivedi.

6) Practical Organic Chemistry by A. I. Vogel.

7) Handbook of Organic Qualitative Analysis by H.T. Clarke.

8) A Laboratory HandBook of Organic Qualitative Analysis and Separation by V. S. Kulkarni. Dastane Ramchandra & Co.

9) Practical Organic Chemistry by F. G. Mann and B. C. Saunders. Low – priced Text Book. ELBS. Longman.

10) Advanced Practical Organic Chemistry by N. K. Vishnoi. Vikas Publishing House Private Limited.

11) Advanced Practical Chemistry by J. Singh, L. D. S. Yadav, R. K. P. Singh, I. R. Siddiqui et.al, Pragati Prakashan.

B.Sc. II Syllabus (NEP-2.0)
To be implemented from June 2025 onwards

Semester III & IV

Nature of Question paper

Total Marks 40 Time: 1.5 Hours

Q.1 Choose the correct alternative and rewrite the sentence again. 8 Marks

a)

b)

c)

d)

e)

f)

g)

h)

Q.2. Attempt any TWO of the following (Out of Three) 16 Marks

a)

b)

c)

Q.3. Answer any FOUR of the following (Out of SIX) 16 Marks

a)

b)

c)

d)

e)

f)

B.Sc. II Syllabus (NEP-2.0)
To be implemented from June 2025 onwards

Semester III & IV

Outline of Internal Assessment

Level	Semester	Activities Per Semester	Marks
5	III	Unit Test	10
	IV	Oral Examination/Group Discussion	10

B.Sc. II Syllabus (NEP-2.0)

To be implemented from June 2025 Onwards

Semester III and IV

Nature of Practical Exam

Semester-III Practical Paper-III (50 Marks)

Number of Days: 01

Experiment No-1 (20 Marks)

Experiment No. 2 (20 Marks)

Oral- 05 Marks

Journal- 05 Marks

Semester-IV Practical Paper-IV (50 Marks)

Number of Days: 01

Q. 1 Major Experiment- 25 Marks

Q. 2 Minor Experiment- 15 Marks

Q. 3 Oral- 05 Marks

Q. 4 Journal- 05 Marks

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Syllabus for

Bachelor of Science Part-II

(B. Sc. II)

VOCATIONAL SKILL COURSE

IN

CHEMISTRY

(NEP-2.0)

To be implemented from

June 2025 onwards

Structure of B. Sc. II Chemistry (Major Specific)

Vocational Skill Course in Chemistry

Sr. No.	Semester	Course Code	Title of Paper
1	III	BSU0325VSP207C01	PRCHVSC-301 Vocational Skill Course in Chemistry Practical Paper-I (2 credits, 60 Hours)

VOCATIONAL SKILL COURSES

B. Sc. II, Semester III, VSC Practical Paper-I		
BSU0325VSP207C01	**PRCHVSC-301 Vocational Skill Course in Chemistry Practical Paper-I**	**Credits:** 2 **Hours:** 60

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

CO1 Understand the concepts, principles, theories and practical applications of Chemistry
CO2 Understand the simple techniques of synthesis and analysis
CO3 Gain basic knowledge of instruments to be used for analysis.
CO4 Develop analytical skills

Practicals:

Note: An explanation and understanding of theoretical concepts, mechanisms, reactions, and instrumentation are expected.

1) Preparation of Orange II Azo dye from Sulphanilic acid.
2) Determine the amount glycine from given solution.
3) Determination of viscosity coefficient of unknown solvents using Ostwalds Viscometer.
4) Determination of surface tension of soap solution using a stalagmometer,
5) Analysis of vinegar sample using conductivity measurements.
6) Preparation of standard sodium carbonate solution, standardization of HCl solution and determination of sodium carbonate and sodium bicarbonate in the given solution.
7) Determination of C.O.D. in polluted water.
8) Determination of pH of the following biological Juices. (i) Milk (ii) Orange Juice (iii) Lime water (iv) Lemon Juice
9) Identification of aldehydes and ketones using i) Brady's Test ii) Tollen's Test iii) Schiff Test iv) Iodoform Test
10) Preparation of tetrammine copper (II) sulphate.
11) Gravimetric estimation of aluminium as Aluminium oxinate from a

solution containing aluminium sulphate or potash alum and free sulphuric acid.

12) To determine the λ_{max} of $KMnO_4$ solution using a Colorimeter.
13) Determination of sulphate from drinking water using Conductivity measurements.
14) Determination of alkali contents from antacid tablet using Conductivity measurements.
15) Determine the density and Refractive index of given unknown liquids.
16) Separation of liquid + liquid binary mixture by using distillation method.
17) Identify and differentiate the amines using functional group tests.
18) Determination of reducing sugars and non-reducing sugars.

References:

1. Fundamentals of Analytical Chemistry; Skoog, West. Holler and Crouch 9th edition; Mary Finch. (2014).
2. Vogel's Textbook of Quantitative Chemical Analysis; 6th edition, Pearson Education Limited, (2007).
3. Industrial Chemistry by B. K. Sharma.
4. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co: New Delhi (2011).
5. Findlay's Practical Physical Chemistry (Longman) 2015.
6. Practical Physical Chemistry: Gurtu (S Chand) 2014.
7. Systematic Experimental Physical Chemistry: Rajbhoj, Chandekar (Anjali Publication) 2016.
8. Advanced Practical Physical Chemistry: J.B. Yadav (Goel Publishing House) 2015.
9. Vogel's Textbook of Quantitative Inorganic Chemistry by A. I. Vogel.
10. Physical Chemistry of Inorganic Qualitative Analysis by Kuricose & Rajaram.
11. Advanced Practical Organic Chemistry by N.K. Vishnoi. Vikas Publishing House Private Limited.

B.Sc. II Syllabus (NEP-2.0)

To be implemented from June 2025 onwards

VOCATIONAL SKILL COURSE

Semester III

Nature of Practical Exam

No. of Examination Days- 01

Semester-III Practical Paper-I (50 Marks)

Q. 1 Experiment I- 20 Marks

Q. 2 Experiment II - 20 Marks

Q. 3 Oral - 5 Marks

Q. 4 Journal- 5 Marks

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Syllabus for

Bachelor of Science Part-II

(B. Sc. II)

COMMUNITY ENGAGEMENT PROGRAMME (CEP)

IN CHEMISTRY

(NEP-2.0)

To be implemented from

June 2025 onwards

Structure of B. Sc. II

Community Engagement Programme in Chemistry

Sr. No.	Semester	Course Code	Title of Paper
1	IV	**BSU0325CEP207D01**	CHCEP-401 Community Engagement Programme in Chemistry (2 credits, 60 Hours)

B. Sc. II, Semester IV		
BSU0325CEP207D01	**CHCEP-401 Community Engagement Programme in Chemistry Paper-I**	**Credits:** 2 **Hours:** 60

INTRODUCTION:

New generation of students are increasingly unaware of local rural and peri-urban realities surrounding their HEIs, as rapid urbanization has been occurring in India. A large percentage of Indian population continues to live and work in rural and peri-urban areas of the country. While various schemes and programs of community service have been undertaken by HEIs, there is no singular provision of a well- designed community engagement course that provides opportunities for immersion in rural realities. Such a course will enable students to learn about challenges faced by vulnerable households and develop an understanding of local wisdom and lifestyle in a respectful manner

OBJECTIVES:

- To promote a respect for rural culture, lifestyle, and wisdom among students.
- To learn about the present status of agricultural and development initiatives.
- Identify and address the root causes of distress and poverty among vulnerable households.
- Improve learning outcomes by applying classroom knowledge to real-world situations.

To achieve the objectives of the socio-economic development of New India, HEIs can play an important role through active community engagement. This approach will also contribute to improve the quality of both teaching and research in HEIs in India. India is a signatory to the global commitment for achieving Sustainable Development Goals (SDGs) by 2030. Achieving these 17 SDG goals requires generating locally appropriate solutions. Community engagement should not be limited to a few social science disciplines alone. It should be practiced across all disciplines and faculties of HEIs. These can take the forms of enumerations, surveys, awareness camps and campaigns, training, learning manuals/films, maps, study reports, public hearings, policy briefs, cleanliness and hygiene teachings, legal aid clinics, etc. For example, students of chemistry can conduct water and soil testing in local areas and share the results with the local community. Students of science and engineering can undertake research in partnership

with the community on solid and liquid waste disposal Therefore, students are being encouraged to foster social responsibility and community engagement in their teaching and research.

LEARNING OUTCOMES:

After completing this course, students will be able to

1. Gain an understanding of rural life, Indian culture, and social realities.
2. Develop empathy and bonds of mutuality with the local community.
3. Appreciate the significant contributions of local communities to Indian society and economy.
4. Learn to Value local knowledge and wisdom.
5. Gain valuable skills such as communication, leadership, teamwork and problem solving etc.
6. Identify opportunities to contribute to the community's socioeconomic improvement.

Credits: Two credit Course; Students are expected to complete 60 hours of participation

COURSE STRUCTURE:

Sr.	Module Title	Module Content	Teaching/ Learning/ Methodology
1	Understanding CEP	Introduction, Guidelines, Necessities	Classroom discussions, Field visit. Survey, Individual / Group conference, Report submission & VIVA
2	Identification of the topic and area	Use of survey, Field visits, communication with society	
3	Organization of Activities	Organization of Hands on Training, Exhibitions, lectures, community conferences	
4	Project	Detailed report of the outcome of the works	

Note: Faculty can make addition in the list of activities as per domain content:

Recommended field-based activities (Tentative):

A community engagement program in chemistry generally aims to increase public understanding and appreciation of chemistry. It encourages engagement with scientific

knowledge. These programs can involve activities like open days, workshops, exhibitions, awareness lectures, conducting surveys and partnerships with local schools to provide hands-on chemistry experiences.

Types of Engagement:

1. Demonstrations and Workshops:

- Showcasing Chemistry through practical demonstrations and hands-on workshops

By making Chemistry more accessible and relatable, community engagement can help the public understand its role in everyday life. For example, visits to elementary schools with Chemistry experiments.

2. Open Days and Science Festivals, exhibitions:

- Hosting open days and organization of science festivals allows the community to interact with chemists and learn about their work in an informal setting.

3. **Educational Outreach to Schools:**

- Collaborating with local schools to offer chemistry programs or demonstrations can inspire students to consider a career in science. Exposing students to the excitement of Chemistry can encourage them to pursue careers in Chemistry.

4. Community-Based Research:

- Community-based research can help identify and address environmental or social problems that affect the community.
- Engaging with the community on projects related to Chemistry, such as soil testing, waste management, drinking water analysis, use of renewable sources of energy, Adverse effects of pesticides, disadvantages of plastic, microplastic, pollution due to industry effluents etc.

5. Surveys:

- Building solar powered village
- Energy use and fuel efficiency surveys
- Raising awareness about chemical hazards
- Assessing the impact of chemical pollution on human health and the environment.
- Gathering feedback on the effectiveness of waste management programs.
- Measuring public support for stricter chemical regulations and industry standards.
- Evaluating public awareness and attitudes towards pesticide use and regulations.

- Evaluating the societal benefits of new chemical technologies, such as renewable energy sources. etc.

6. **Any other activity addressing issues related to Chemistry can be added.**

IMPORTANT RULES AND REGULATIONS FOR CEP:

Concurrent Fieldwork:

1. Students must conduct comprehensive studies on various challenges that they face in their chosen field. Every work relevant to the subject matter should be compiled and documented.
2. Students should keep separate fieldwork diary or maintain journal in order to record their fieldwork experiences i.e. reading, e- contents, tasks, planning and work hours have to be recorded in the diary. Detailed work records report on students' fieldwork experiences and activities to be submitted and should be presented.
3. In addition to the principal curriculum, the students engage in a variety of community development related activities. They are encouraged to plan and carry out programs, processions, and events for social causes. These activities seek to enhance students' personal and professional skills as well as foster self-development.

Reference

1. Guidelines on "Fostering Social Responsibility & Community Engagement in Higher Education Institutions in India 2.0 (https://www.ugc.gov.in/publication/ebook)

2. Shivaji University Guidelines regarding CEP. (https://www.unishivaji.ac.in/uploads/syllabus/2024/JULY/BOS/23-July/All%20Bachelor%20Degree%20Programmes%20CEP%202024-25.pdf)

Shivaji University, Kolhapur

B.Sc. II Syllabus (NEP-2.0)

To be implemented from June 2025 onwards

Name of College

COMMUNITY ENGAGEMENT PROGRAMME (CEP)

IN CHEMISTRY

Diary

Name of Student:	**Roll No.**
Exam Seat No:	

Sr. No.	Date	Activity	Type of Activity	Time Duration	Sign of Student	Signature of Teacher
1						
2						
3						
4						

- Total 60 Hours participation is required.

Teacher in Charge **H.o.D.** **Principal**

Shivaji University, Kolhapur

B.Sc. II Syllabus (NEP-2.0)

Name of College

COMMUNITY ENGAGEMENT PROGRAMME (CEP)

IN CHEMISTRY

Format of Report

- Front Page
- Certificate
- Index
- Introduction
- Diary
- Surveys, Field Visits
- Activities- Detail Report
- Summary, Findings and Outcomes
- References

Shivaji University, Kolhapur

B.Sc. II Syllabus (NEP-2.0)

To be implemented from June 2025 onwards

Semester IV

Evaluation/Assessment Scheme

The assessment pattern is internal and external i.e. 40+10.

Particulars	**Marks**
Internal Continuous Assessment:	
1. Participation in concurrent field visits (40%)	
a) Diary Completion, Attendance	10
b) Surveys/Field Visits	10
2)Individual/group field project conference, report/journal submission (40%)	
a) Organization/Participation in activities	10
b) Project	10
Total	**40**
External Assessment: Presentation of project findings (VIVA) (20%)	
Oral Examination	**10**
Total (Internal (40) + External Assessment (10))	**50**

Note: Oral Examination will be conducted along with the Sem. IV Practical Examination.

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Syllabus for

Bachelor of Science Part-II

(B. Sc. II)

Chemistry (Minor)

(NEP-2.0)

To be implemented from June, 2025 onwards

Structure of B. Sc. II Chemistry (Minor)

Sr. No.	Semester	Course Code	Title of Paper
1	III	BSU0325MIL207C01	PCHMN-301 Paper - V, Applied Physical Chemistry (2 credits, 30 Hours)
2		BSU0325MIL207C02	ACHMN-302 Paper -VI, Applied Analytical Chemistry (2 credits, 30 Hours)
3		BSU0325MIP207C03	PRCHMN-303 Chemistry Practical Paper-III (2 credits, 60 Hours)
4	IV	BSU0325MIL207D01	ICHMN-401 Paper-VII, Fundamentals of Inorganic Chemistry (2 credits, 30 Hours)
5		BSU0325MIL207D02	OCHMN-402 Paper -VIII, Applied Organic Chemistry (2 credits, 30 Hours)
6		BSU0325MIP207D03	PRCHMN-403 Chemistry Practical Paper-IV (2 credits, 60 Hours)

B.Sc. Part II (NEP-2.0) Semester– III

PCHMN-301: Paper V APPLIED PHYSICAL CHEMISTRY

(Credits: 02, 30 hours)

Name of the Topics	Expected Learning Outcome
1. Colloidal State	Learning and understanding the knowledge of Colloidal State, understanding of colloidal system, different types of colloidal system, preparation, properties, stability of different colloidal system, General applications of colloids.
2. Entropy	Knowledge and coherent understanding of basic concepts in thermodynamics and Entropy as state function will be gained by the student.
3. Surface Phenomena	Learning and understanding of theoretical basis of adsorption phenomenon, dynamic nature of surface and its applications.
4. Chemical Kinetics	Learning and understanding the knowledge about basic concepts in reaction kinetics and third order reaction with characteristics, suitable examples, and methods for determination of order of reactions .

Unit 1. Colloidal State (7 hours)

1.1 Introduction: Definition of Colloids, Colloidal state of matter, True solution, colloidal solution and Suspension, Dispersed phase and Dispersion medium,

1.2 Types of Colloidal systems.

1.3 Solids in liquids (Sols): preparation, purification, properties and stability

1.4 Liquids in Liquids (Emulsions): Types and Preparations.

1.5 Liquids in Solids (Gels): Types and Preparations.

1.6 General Applications of Colloids.

Unit 2: Entropy **(8 hours)**

2.1 Introduction, Entropy: Definition, mathematical expression, unit.

2.2 Physical significance of Entropy.

2.3 Entropy changes for reversible and irreversible processes in isolated systems.

2.4 Entropy changes for an ideal gas as a function of V & T and as function of P & T.

2.5 Entropy change in mixing of gases.

2.6 Entropy change in phase transformations.

2.7 Statement of Third law of thermodynamics and standard entropy,

2.8 Numerical problems.

Unit 3: Surface Phenomena **(7 hours)**

3.1 Introduction, Adsorption as a surface phenomenon, Definition of adsorption, adsorbent, adsorbate. Characteristics of adsorption.

3.2 Factors affecting adsorption, Types of adsorption, Distinction between physical and chemical adsorption.

3.3 Adsorption isotherms: Freundlich adsorption isotherm.

3.4 Applications of adsorption.

Unit 4: Chemical kinetics **(8 hours)**

4.1 Introduction.

4.2 Third order reactions: Detail derivation of rate constant considering reaction with Equal initial concentration, characteristics, and examples of third order reaction.

4.3 Determination of order of reaction by:

i) Integration method,

ii) Graphical method and

iii) Half-life method.

4.4 Effect of temperature on rate of reaction, Arrhenius equation. Concept of energy of activation.

Reference Books:

1) Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).

2) Castellan G.W. Physical Chemistry 4 th Ed. Narosa (2004).

3) Kotz, J.C. Treichel, P.M.& Townsend,J.R.General Chemistry, Cengage Learning India Pvt Ltd: New Delhi (2009).

4) Mahan ,B.H. University Chemistry, 3rd Ed. Narosa (1998).

5) Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co,: New York (1985).

6) Elements of Physical Chemistry, S., Glasstone, D. Lewis.(2010)

7) Principles of Physical Chemistry, Marron and Prutton. (2007).

8) Elements of Physical Chemistry, P.W. Atkins (2017-18)

9) Essentials of Physical Chemistry, Bahl and Tuli. S. Chand, 2010.

10) Physical Chemistry, Danials and Alberty (2016)

11) University General Chemistry C.N.R.Rao (2016)

12) Principals of Physical Chemistry Puri, Sharma and Pathania 47ThEdison, Vishal Publishing Co. Daryaganj Delhi. 110002 (2017-18).

13) Physical Chemistry A. J. Mee.(2015)

14) Advanced Physical Chemistry Gurudeep Raj (2017-18)

15) Physical Chemistry R. A. Aleberty. (2017-18)

16) Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

B.Sc. Part II (NEP-2.0) Semester– III

ACHMN-302: Paper VI APPLIED ANALYTICAL CHEMISTRY

(Credits: 02, 30 hours)

Sr. No.	Name of Topic	Expected Course Outcomes
1	Cleansing Agents : Soaps and Detergents	Knowledge about the chemical nature and cleansing action of soap and detergents
2	Optical methods of analysis	Understanding, working and applications of optical methods as an analytical tool
3	Electroplating	Learning and understanding the knowledge about basic concepts in Electroplating
4	Column and Ion Exchange Chromatography	Learning and coherent understanding of column, ion exchange chromatography

Unit 1: Cleansing Agents : Soaps and Detergents **[8 hours]**

1.1 Introduction,

1.2 Soaps - Raw materials

1.3 Types of soaps

1.4 Cleansing action of soap,

1.5 Manufacture of soap - Boiled or Hot Process,

1.6 Detergents - Raw Materials,

1.7 Type of detergents:Anionic , Cationic and Amphoteric

1.8 Preparation of Teepol and Deriphat

1.9 Comparisons between soaps and detergents.

Unit 2: Optical methods of Analysis **[8 hours]**

2.1 Theory of colorimetry and spectrophotometry.

2.2 Lambert Beer's law, deviation from Beer's law.

2.3 Terms used in colorimetry and spectrophotometry.

2.4 Photoelectric colorimeter method–Single beam photo-electric colorimeter.

2.5 Determination of unknown concentration by using concentration absorbance plot.

2.6 Applications of uv-visible spectrophotometry.

Unit 3: Electroplating [7 hours]

3.1 Electrolysis

3.2 Faraday's Laws

3.3 Cathode Current Efficiency

3.4 Basic Principles of Electroplating

3.5 Cleaning of Articles

3.6 Electroplating of Chromium

3.7 Anodising

Unit 4: Column and Ion Exchange Chromatography [7 hours]

4.1 Introduction to chromatography, classification.

4.2 Column chromatography:

4.2.1 Introduction, types, Principle of adsorption column chromatography, solvent system, stationary phases

4.2.2 Methodology-Column packing, applications of sample, development, detection methods, recovery of components

4.2.3 Applications.

4.3 Ion exchange chromatography:

4.3.1 Introduction, Principle, Types and properties of ion exchangers

4.3.2 Methodology Column packing, application of sample, elution, detection/analysis,

4.3.3 Applications.

Reference Books:

1) Principles of Physical Chemistry by Puri, Sharma and Pathania, Vishal Publishing company Jalindhar.
2) Vogel's Textbook of Quantitative Chemical Analysis 5th Edition, Longman Scientific & Technical Ltd. UK.
3) Modern Analytical Chemistry By David Harvey, McGRAW- Hill International Edition, 2000.
4) Industrial Chemistry by B. K. Sharma, Goel Publishing Housing, 16th edition 2011.
5) Advanced Inorganic Chemistry, Vol. No.1, by Gurudeep Raj, Krishna Prakashan Media Ltd, Goel Publication, Meerut.
6) Analytical Chemistry by B. K. Sharma, Krishna Prakashan Media Ltd, Meerut, Edition 3rd 2011.
7) Chemical Process Industries by Shreve and Brink.
8) Industrial Chemistry by Loutfy Madkor and Helen Njenga.
9) Intellectual Property- A Primer for Academia by Prof. Rupinder Tewari & amp; Ms. Mamta Bhardwaj, Publication Bureau, Panjab University, Chandigarh.
10) Elementary Principles of Chemical Processes by Richard Felder and Ronald Rousseau, John Wiley and Sons.
11) Essential of Physical Chemistry by Bahl B.S., Tuli G.D. and Bahl Arun, S. Chand and Company Ltd. New Delhi.
12) Analytical Chemistry, H. Kaur, A Pragati Prakashan Meerut.
13) Analytical Chemistry, Alka Gupta, A Pragati Prakashan Meerut.
14) Instrumental Methods of Chemical Analysis – Chatwal & Anand.

B.Sc. II –Semester- III

PRCHMN-303 – Chemistry Practical Paper -III

Credit: 02, 60 hours

A] Applied Physical Chemistry:

Perform the following Experiments (Any 8)

1. To study the hydrolysis of methyl acetate in presence of HCl and H_2SO_4 and to determine the relative strength of acids.
2. To study the reaction between Potassium persulphate and Potassium iodide in solution with unequal concentration of the reactants.
3. To study the effect of acid strength on hydrolysis of an ester by using 0.5M HCl and 0.25M HCl.
4. Determination of the adsorption coefficient of acetic acid-charcoal system.
5. To determine the percentage composition of a given liquid mixture by viscosity method (Density data to be given).
6. To determine the degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically.
7. To determine the normality of the given strong acid by titrating it against the strong alkali coductometrically.
8. To determine the specific rotation and unknown concentration of sugar solution by Polarimeter.
9. To determine the specific and molar refractions of benzene, toluene and xylene by Abbe's Refractometer and to determine the refraction of CH_2 Group (Methylene group) (Densities should be determined by students).

B) Applied Analytical Chemistry

Perform the following Experiments (Any 8)

1. Fertilizer analysis: To determine the percentage of nitrogen in the given sample of a nitrogenous fertilizer (ammonium sulphate).
2. Analysis of Synthetic /Commercial Sample: To estimate Magnesium from

talcum powder.

3. Determination of alkali content from antacid tablet using HCl solution.
4. Estimation of Calcium from chalk: To estimate amount of calcium from the chalk by titrimetric method. (By redox titration using $KMnO_4$ solution)
5. Determination of total hardness of water using 0.01M EDTA solution. (Students should standardize the given EDTA solution by preparing 0.01M $CaCl_2$ solution. using $CaCO_3$ salt.)
6. Determination of Alkalinity of water titrimetrically using 0.02N H_2SO_4 using methyl orange and phenolphthalein indicator.
7. Estimation of acetone.
8. Estimation of Vitamin C from given tablet.
9. Estimation of Phenol by Bromination method.

Reference Books:

1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson 2009.
2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co: New Delhi (2011).
3. Findlay' Practical Physical Chemistry (Longmann)2015.
4. Practical Physical Chemistry : Gurtu (S. Chand) 2014.
5. Systematic Experimental Physical Chemistry : Rajbhoj, Chandekar (Anjali Publication) 2016.
6. Advanced Practical Chemistry by J. Singh, L. D. S. Yadav, R. K. P. Singh, I. R. Siddiqui et.al, Pragati Prakashan.
7. Vogel's Text Book of Qualitative Inorganic Analysis by A. I. Vogel .3rd and 6th edition.
8. Practical Organic Chemistry by A. I. Vogel.
9. Hand Book of Organic Qualitative Analysis by H. T. Clarke.
10. Practical Organic Chemistry by F.G. Mann and B. C. Saunders. Low – priced Textbook. ELBS. Longman

B.Sc. Part II (NEP-2.0) Semester– IV

ICHMN-401: Paper VII FUNDAMENTALS OF INORGANIC CHEMISTRY

(Credits: 02, 30 hours)

Expected Course Outcomes:

Sr. No.	Name of the Topics	Expected Course Outcomes
1	Chemistry of Lanthanide Elements	Learning and understanding unique properties such as electronic configuration, stability of Oxidation states, colour, and separation of lanthanides and its applications.
2	Crystal Structure and Defects in Solids	Knowledge about Crystal structure and defects in Ionic solids will be gained by the students.
3	Chemistry of Non-Aqueous Solvents	Learning and understanding classification and physical properties of non-aqueous solvents
4	Catalysis	Learning and understanding classification and physical properties of catalysis and its industrial applications.

Unit 1: Chemistry of Lanthanide Elements [10 Hours]

1.1 Introduction

1.2 Occurrence of lanthanides

1.3 Properties of lanthanides with respect to

(i) Electronic configuration.

(ii) Oxidation states.

(iii) Colour and spectra.

(iv) Lanthanide contraction.

1.4 Separation of Lanthanides by Ion Exchange method.

1.5 Applications of Lanthanides.

Unit -2. Crystal Structure and Defects in Solids [08 Hours]

2.1 Introduction to ionic solids,

2.2 Crystal structures – Radius ratio, radius ratio effect on geometry and calculation of r^+/r^- for octahedral geometry,

2.2.1 NaCl crystal structure

2.2.2 CsCl crystal structure

2.2.3 ZnS, crystal structure

2.3 Defects in solids- Introduction

2.4 Types of defects in Solids

2.4.1 Stoichiometric defects – Schottky defects and Frenkel defects.

2.4.2 Non- stoichiometric defects-

(a) Metal excess defects, (i) Due to anion vacancies and

(ii) Due to interstitial cations

(b) Metal deficiency defects, (i) Due to cation vacancies and

(ii) Due to interstitial anions

2.5 Consequences of defects in solids.

Unit 3: Chemistry of Non-Aqueous Solvents [06 Hours]

3.1 Introduction

3.2 Definition and Characteristics of Solvents

3.3 Classification of Solvents

(i) Liquid, Solid and Gaseous Solvents,

(ii) Protic and Aprotic Solvents,

(iii) Ionizing and Non-ionizing Solvents,

(iv) Aqueous and Non-aqueous Solvents.

3.4 Physical properties and acid-base reactions in liquid NH_3 and liquid SO_2.

Unit 4: Catalysis **[06 Hours]**

4.1. Introduction

4.2 Classification of catalytic reactions- Homogenous and Heterogeneous

4.3 Types of Catalysis

4.4 Characteristics of catalytic reactions

4.5 Mechanism of catalysis

(i) Intermediate compound formation theory

(ii) Adsorption theory

4.6 Industrial Applications of Catalysis (Use of Catalysis in Industrial Processes)

References:

1. Inorganic Chemistry, Principles of structure and reactivity J. E. Huheey & etal.
2. Inorganic Chemistry-Shriver and Atkins, 5th Edition
3. Principles of Inorganic Chemistry by Puri, Sharma, Kalia
4. Advance Inorganic Chemistry by Agrawal, Keemtilal (Pragati Edition)
5. Theoretical Inorganic Chemistry 2nd Edition by C. Day and J. Selbin
6. Principles of Inorganic Chemistry by Puri, Sharma, Jauhar
7. Chemistry in Non – Aqueous Solvents by H. H. Sisler (Chapman and Hall Ltd.)
8. Modern Inorganic Chemistry by R. D. Madan (S. Chand)
9. Inorganic Chemistry by J. D. Lee
10. Basic Inorganic Chemistry by F. A. Cotton, G. Wilkinson and B. L. Gaus Wiley.
11. Concept and Models of Inorganic Chemistry by B. Douglas. D. Mc. Daniel and J. Alexander, John Wiley.
12. Coordination Chemistry by R. Basolo.and Pearson.

B.Sc. Part II (NEP-2.0) Semester– IV

OCHMN-402: Paper VIII APPLIED ORGANIC CHEMISTRY

(Credits: 02, 30 hours)

Expected Learning Outcomes:

Name of Topic	Expected Learning Outcomes
Biomolecules	• Understanding the sources, classification, structure and functions of major biomolecules: Amino Acids, Peptides, and Proteins. • Students should also be able to understand biological processes like metabolism, energy transformation, and the functions of enzymes.
Chemistry of Carbohydrates	Learning and understanding of classification, Configuration, and structures of carbohydrates.
Synthetic Dyes	Students will get knowledge about classification, preparation, structure, and applications of synthetic dyes.
Organic Chemistry in Agriculture	• Understanding the chemistry of fertilizers and pesticides for sustainable agriculture. • Students get knowledge about chemical structures and the mechanism of action of various fertilizers and pesticides, with their environmental impact

Unit 1: Biomolecules [7 Hours]

1.1 Introduction, nomenclature & sources of Amino acids.

1.2 Classification of Amino Acids: Based on polarity, charge.

1.3 Acid-Base Properties and Zwitterion Concept

1,4 Isoelectric Point (pI) and Electrophoresis

1.5 Ninhydrin test, and Biurate test

1.6 Biological Functions and Importance of Amino Acids

1.7 Synthesis of Amino Acids (Alanine & Phenylalanine)

1.8 Introduction, nomenclature & sources of Peptides

1.9 Structure and Properties of Simple Peptides

1.10 Biological Functions and Importance of Peptides

1.11 Introduction, nomenclature & sources of Proteins

1.12 Biological Functions and Importance of Proteins.

Unit 2: Chemistry of Carbohydrates [8 Hours]

2.1 Introduction to Carbohydrates: Definition and general formula ($C_nH_{2n}O_n$)

2.2 Sources, importance, and biological role of carbohydrates.

2.3 Classification: Monosaccharides, Disaccharides, Oligosaccharides, Polysaccharides,

2.4 Monosaccharides: Structure and nomenclature (aldoses & ketoses)

2.5 Open and cyclic structure of Glucose, Fructose: D- and L-configuration

2.6 Mutarotation of glucose.

2.7 Disaccharides: Properties and Haworth structures of Sucrose, Lactose, and Maltose

2.8 Polysaccharides: Properties and Structures of Starch, Cellulose

Unit 3: Synthetic Dyes [7 Hours]

3.1 Introduction to Dyes:

3.2 Classification of dyes (based on application)

3.3 Terms used in dyes (Chromophores and auxochromes with examples).

3.4 Witt's theory of dye.

3.5 Diazotization of benzene.

3.6 Synthesis and applications of Methyl Orange and Indigo dye.

3.7 Dyeing of cotton, silk, wool.

Unit 4: Organic Chemistry in Agriculture [8 Hours]

4.1 Agrochemicals: Introduction, Definition, and Importance.

4.2 Types of agrochemicals (fertilizers, pesticides, herbicides, insecticides, fungicides, plant growth regulators).

4.3 Synthesis and applications of Carbaryl and Indol-3-Acetic Acid (IAA).

4.4 Biopesticides: Preparation of neem-based pesticides.

4.5 Mechanism of action of Fertilizers & Pesticides.

4.6 Advantages of Agrochemicals

4.7 Limitations of Agrochemicals

Reference Books:

1. Lehninger Principles of Biochemistry, 6th edition by David L. Nelson, Michael M. Cox
2. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.
3. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd.
4. Organic Chemistry. Volume I, II, III by S.M. Mukharjee, S.P. Singh, and R.P. Kapoor. Wiley Eastern Limited (New Age International)
5. Advanced Organic Chemistry by B.S. Bahl, Arun Bahl. S. Chand & Company, Ltd.
6. Chemistry by R. L. Madan, S. Chand and Company Ltd.
7. Indian Council of Agricultural Research (ICAR) Reports (2022).
8. Agricultural Chemistry by Dr. L. Rakesh Sharma.

B.Sc. II –Semester- IV

PRCHMN-403 – Chemistry Practical Paper -IV - Credit: 02, 60 hours

A) Fundamentals of Inorganic Chemistry:

Gravimetric Analysis (Any two)

i) Gravimetric estimation of iron as Fe_2O_3 from a solution containing Ferrous ammonium sulphate and free sulphuric acid.

ii) Gravimetric estimation of barium as $BaSO_4$ from a solution containing barium chloride and free hydrochloric acid.

iii) Gravimetric estimation of nickel as $Ni(DMG)_2$ from a solution containing $NiSO_4.7H_2O$ and free sulphuric acid.

Inorganic Preparations (Any Two)

i) Preparations of sodium cuprous thiosulphate.

ii) Preparation of tris (ethylenediamine) nickel(II) thiosulphate

iii) Preparation of hexamine nickel(II)chloride

Semi-micro Qualitative Analysis

Analysis of binary mixtures with non interfering cations and anions (at least **4 mixtures** to be analyzed)

iv) Following anions are to be given:

Cl^-, Br^-, I^-, NO_3^-, CO_3^{--}, SO_4^{--}, S^{--}, (insoluble CO_3—may be given)

v)Following cations are to be given:

Cu^{2+}, Cd^{2+} , Al^{+3}, Fe^{+3}, Cr^{+3}, Zn^{+2}, Mn^{+2} Ni^{+2}, Co^{+2},

Ca^{+2}, Ba^{+2}. Mg^{+2}, NH^{4+}, K^+

Note:-Use of spot tests to be made whenever possible.

B) Applied Organic Chemistry:

1) Organic Qualitative Analysis: Identification of **Any Six** Organic Compounds with reactions including chemical type

Acids – Succinic acid, Phthalic acid, Salicylic acid, Aspirin. (Any 2)

Phenols – Alpha-Naphthol, p-nitrophenol. (Any 1)

Bases – o - nitroaniline, p-nitroanilines, Diphenyl amine. (Any 1)

Neutrals – Urea, Acetanilide, Carbon tetrachloride, Bromobenzene, Methyl acetate, Nitrobenzene, Naphthalene, Anthracene, Ethyl methyl ketone. (Any 2)

Note: A systematic study of an organic substance involves reactions in the determination of elements and functional group.

3) Organic Preparations (Any two)

i) Preparation of p-nitro acetanilide from Acetanilide.

ii) Preparation of Acetanilide from Aniline using anhydrous $ZnCl_2$ and Zn dust.

iii) Preparation of Phthalimide from Phthalic anhydride.

iv) Preparation of Benzoic acid from Benzamide.

4) To determine the total sugar content in honey by Fehling's solution.

5) Synthesis of para red from m-nitro aniline and 2-napthol by diazotization reaction.

6) Ninhydrin test and Biuret test for the detection of maltose.

Reference Books:

1) Vogel's Quantitative Chemical Analysis, Pearson 2009.

2) Vogel's Textbook of Qualitative Inorganic Analysis by A. I. Vogel .3rd and 6th edition.

3) Vogel's Textbook of Quantitative Inorganic Chemistry by A. I. Vogel.

4) Physical Chemistry of Inorganic Qualitative Analysis by Kuricose & Rajaram.

5) Practical Manual in Water Analysis by Goyal & Trivedi.

6) Practical Organic Chemistry by A. I. Vogel.

7) Handbook of Organic Qualitative Analysis by H.T. Clarke.

8) A Laboratory HandBook of Organic Qualitative Analysis and Separation by V. S. Kulkarni. Dastane Ramchandra & Co.

9) Practical Organic Chemistry by F. G. Mann and B. C. Saunders. Low – priced

Text Book. ELBS. Longman.

10) Advanced Practical Organic Chemistry by N. K. Vishnoi. Vikas Publishing House Private Limited.

11) Advanced Practical Chemistry by J. Singh, L. D. S. Yadav, R. K. P. Singh, I. R. Siddiqui et.al, Pragati Prakashan.

B.Sc. II Syllabus (NEP-2.0)

To be implemented from June 2025 onwards

Semester III & IV

Nature of Question paper

Total Marks 40 **Time: 1.5 Hours**

Q.1 Choose the correct alternative and rewrite the sentence again. 8 Marks

a)

b)

c)

d)

e)

f)

g)

h)

Q.2. Attempt any TWO of the following (Out of Three) 16 Marks

a)

b)

c)

Q.3. Answer any FOUR of the following (Out of SIX) 16 Marks

a)

b)

c)

d)

e)

f)

B.Sc. II Syllabus (NEP-2.0)

Chemistry (Minor)

To be implemented from June 2025 onwards

Semester III & IV

Outline of Internal Assessment

Level	Semester	Activities Per Semester	Marks
5	III	Unit Test	10
	IV	Oral Examination/Group Discussion	10

B.Sc. II Syllabus (NEP-2.0)

Chemistry (Minor)

To be implemented from June 2025 Onwards

Semester III and IV

Nature of Practical Exam

Semester-III Practical Paper-I (50 Marks)

Number of Days: 01

Experiment No-1 (20 Marks)

Experiment No. 2 (20 Marks)

Oral- 05 Marks

Journal- 05 Marks

Semester-IV Practical Paper-II (50 Marks)

Number of Days: 01

Q.1 Major Experiment- 25 Marks

Q.2 Minor Experiment- 15 Marks

Q.3 Oral- 05 Marks

Q.4 Journal- 05 Marks

Shivaji University,

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Syllabus for

Bachelor of Science Part-II

(B. Sc. II)

SKILL ENHANCEMENT COURSES

IN CHEMISTRY

(NEP-2.0)

To be implemented from

June 2025 onwards

Structure of B. Sc. II

Skill Enhancement Courses in Chemistry

Sr. No.	Semester	Course Code	Title of Paper
1	III	BSU0325SEP207C01	CHSECPR-301 Practical Skills in Chemistry-Practical Paper-I (2 credits, 60 Hours)
2	IV	BSU0325SEP207D01	CHSECPR-401 Practical Skills in Chemistry-Practical Paper-II (2 credits, 60 Hours)

B. Sc. II, Semester III SKILL ENHANCEMENT COURSE- Practical Papers		
BSU0325SEP207C01	**CHSECPR-301 Practical Skills in Chemistry-Practical Paper-I**	**Credits:** 2 **Hours:** 60

Course Outcomes:
completion of the course, the students will be able to:
CO1: Understand the principles of GLP and safety in the laboratory.
CO2: Interpret the safety data sheets to categorize chemicals according to their hazards.
CO3: Enhance their overall knowledge of handling Glassware and apparatus used in the laboratory.
CO4: Enhance their overall skills of preparation of various reagents used in the laboratory.

Practicals:

Note: An explanation and understanding of theoretical concepts, mechanisms, reactions, and instrumentation are expected.

1. Identify the Safety symbol on the labels of a pack of chemicals and its meaning.
2. Study precautions in handling hazardous substances like Conc. acids, ammonia, organic solvents, etc.
3. Understand the toxicity of the compounds used in the Chemistry laboratory and classification of toxicity.
   a) MSDS sheets, points in MSDS Find out MSDS sheets of at least hazardous chemicals ($K_2Cr_2O_7$, Benzene, Cadmium Nitrate, sodium metal, etc.)
   b) Prepare charts for Laboratory Safety Rules.
   c) Prepare SOP for laboratory.
4. Demonstrative Experiment: Use of Fire Extinguisher.
5. Calibration of Volumetric apparatus.
6. Preparation of Indicators and their uses in different titrations. (Phenolphthalein, Methyl Orange, Diphenyl amine, Starch, Eriochrome Black-T etc.)
7. Preparation of commonly used lab solutions and reagents. (10% NaOH, Sat. $NaHCO_3$, 1:1 NH_3, Bromine water, Ferric Chloride solution, Iodine solution, $NaNO_2$ solution, 2,4-DNP, Tollens, Nesselers, Schiffs, Fehling and Benedict reagents etc).

8. Preparation of Buffer solutions. (pH 4 buffer, pH 10 ammonical buffer, acetate buffer)
9. Separation of two miscible solvents by distillation.
10. Separation of immiscible solvents by separating funnel.
11. Demonstrative Experiment: Preparation of H_2S gas using Keep's Apparatus.

References:

1. Laboratory Safety for Chemistry Students, Second edition, Robert H. Hill, Jr. David C. Finster,John Wiley & Sons.
2. Handbook of Good Laboratory Practice (GLP), UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (TDR) https://fctc.who.int/publications/i/item/handbook-good-laboratory-practice-%28-glp%29
3. Solid Waste Management, Principles and Practice, Ramesha Chandrappa, Diganta Bhusan Das, Springer.
4. Production-Integrated Environmental Protection and Waste Management in the Chemical Industry, Claus Christ, WILEY-VCH.
5. Fundamentals of Industrial Safety and Health Dr. K.U. Mistry, Siddharth Prakashan.
6. VOGELS QUALITATIVE INORGANIC ANALYSIS, 7TH EDN by G. Svehla and B. Shivshankar.
7. Hazardous Waste Management Rules-2016, 1st editon, Ministry of environment, forest & climate change, govt. of India.
8. Vogel's Quantitative Chemical Analysis, 6th Edition by J Mendham.

B. Sc. II, Semester IV, SKILL ENHANCEMENT COURSE- Practical Paper Course		
BSU0325SEP207D01	**CHSECPR-401 Practical Skills in Chemistry-Practical Paper-II**	**Credits:** 2 **Hours:** 60

Course Outcomes:
completion of the course, the students will be able to:
CO1: Gain the knowledge of preparation and standardization of solutions.
CO2: Gain knowledge of separation techniques.
CO3: Enhance their knowledge of the calibration of instruments.
CO4: Enhance their knowledge of maintenance of electrodes and equipment.

Practicals:

Note: An explanation and understanding of theoretical concepts, mechanisms, reactions, and instrumentation are expected.

1. Preparation of TLC plates using silica gel, identifying suitable solvent systems and applications in the separation of amino acids.
2. Preparation of Column, identifying suitable solvent system and applications in separating organic components.
3. Preparation of Ion exchange resin columns and applications in separating cations/anions.
4. Preparation of potassium hydrogen phthalate and its use as a primary standard for standardization of NaOH/KOH solution.
5. Preparation and standardization of HCl/HNO_3, H_2SO_4 solution. (Molar and Normal).
6. Preparation and standardization of sodium thiosulphate solution.
7. Demonstrative Experiment: Preparation of KCl and KNO_3 salt bridges.
8. Draw the structure of organic molecules using software like CHEM Draw/ISIS draw/ChemSketch.
9. Plot experimental results (Graphs) using Excel and Origin software.
10. Calibration of electronic Balance and Maintenance of electrodes in the laboratory

(Glass, Calomel etc).

11. Standardization of i) pH meter by using pH 4 buffer (Buffer to be prepared by students), ii) conductivity meter and iii) potentiometer.
12. Recrystallization of organic compounds using suitable solvents.
13. Purification of compounds by sublimation.
14. Extraction of DNA from mashed onion.
15. **Activity:** Preparation of charts to learn the Periodic table innovatively.

References:

1. Fundamentals of Analytical Chemistry; Skoog, West. Holler and Crouch 9th edition; Mary Finch. (2014).
2. Principles of Instrumental Methods of Analysis; Skoog, Holler and Nieman, 5th edition, Saunders College Publishing, International Limited (1999).
3. Analytical Chemistry; Gary D Christian; 6th edition; John Wiley and Sons (2010).
4. Modern Analytical Chemistry; David Harvey; McGraw Hill Higher education publishers, (2000).
5. Analytical Chemistry Principles; John H Kennnedy, 2nd edition, Published by Cengage Delmar Learning India Pvt (2011).
6. Vogel's Text book of Quantitative Chemical Analysis; 6th edition, Pearson Education Limited (2007).
7. Industrial Chemistry by B. K. Sharma.

Shivaji University, Kolhapur

B.Sc. II Syllabus (NEP-2.0)

To be implemented from June 2025 onwards

SKILL ENHANCEMENT COURSE

Semester III & IV

Nature of Practical Exam

Semester-III Practical Paper-I (50 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Experiment- 20 Marks

Q. 3 Oral - 5 Marks

Q. 4 Journal- 5 Marks

Semester-IV Practical Paper-II (50 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Experiment- 20 Marks

Q. 3 Oral- 5 Marks

Q. 4 Journal- 5 Marks

Shivaji University,

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Syllabus for

Bachelor of Arts/ Bachelor of Commerce Part-II

(B. A. II/B. Com. II)

Open Elective Course in Chemistry

(NEP-2.0)

To be implemented from

June 2025 onwards

Open Elective Courses in Chemistry

Open Elective Papers for B. A. II and B. Com. II

Sr. No.	Semester	Course Code	Title of Paper
1	III	BSU0325OEP207C01	CHOEPR-301 Food Chemistry-Practical Paper-III (2 credits, 60 Hours)
2	IV	BSU0325OEP207D01	CHOEPR-401 Chemistry in Everyday Life-Practical Paper-IV (2 credits, 60 Hours)

B. A. II/B.Com. II, Semester III Open Elective Course- Practical Paper in Chemistry		
BSU0325OEP207C03	**CHOEPR-301 Food Chemistry** **Practical Paper-III**	**Credits:** 2 **Hours:** 60

Food Chemistry: Practicals

Course Outcomes:

Completion of the course, the students will be able to:

CO1: Understand the various forms and causes of food adulteration, including mixing, substitution, and misbranding.

CO2: Recognize the health risks associated with adulterated food products.

CO3: Interpret experimental data to assess the purity and quality of food samples.

CO4: Understand the ethical implications of food adulteration and the importance of maintaining food integrity.

Practicals:

Note: As the students undertaking the current course are from Arts and Commerce faculty, an explanation of the theoretical background, mechanism, instrumentation, and reactions is expected.

1. Detection of Urea in the given three milk samples.
2. Detection of Starch in the given three milk samples.
3. Detection of Hydrogen Peroxide from Milk samples.
4. Detection of Sodium Chloride in the given three milk samples.
5. Detection of Nitrate in the given three milk samples.
6. Determination of pH of buffalo and cow milk samples.
7. To measure pH of some acidic food samples such as Lassi, Lemon Juice, Vinegar, Orange Juice etc.
8. Detection of sugar /dextrose from honey samples.
9. Detection of adulterants in the given three different tea powder samples.
10. Detection of adulterants in oil /vanspati ghee samples.
11. Detection of Metanil Yellow in the given three turmeric powder samples.
12. Detection of adulterants in the given three chilli powder samples.

13. To observe the effect of heating baking soda and baking powder on a food sample and study their role in baking.
14. To detect the proteins present in the albumin (egg white) of an egg.
15. To detect the fat present in given seeds.
16. To isolate beta-carotene from carrots.

कोर्स परिणाम:

कोर्स पूर्ण केल्यानंतर विद्यार्थी खालील गोष्टी समजू शकतील:

CO1: रसायनशास्त्रच्या माध्यमातून विविध प्रकारची अन्न भेसळ ओळखणे.
CO2: भेसळयुक्त अन्न उत्पादनांशी संबंधित आरोग्यविषयक धोके ओळखणे.
CO3: प्रयोगात्मक माहितीच्या आधारे विश्लेषण करून अन्न नमुन्यांची शुद्धता आणि गुणवत्ता मूल्यांकन करणे.
CO4: अन्न भेसळीच्या नैतिक परिणामांचे आकलन करणे आणि अन्नाची शुद्धता टिकवून ठेवण्याचे महत्त्व समजून घेणे.

प्रात्येक्षिके (प्रायोगिक कार्य) :

टीप: सदर कोर्स साठी प्रवेशित विद्यार्थी प्रामुख्याने कला व वाणिज्य शाखेचे असलेने सैद्धांतिक पार्श्वभूमी, यंत्रणा, उपकरणे आणि प्रतिक्रियांचे स्पष्टीकरण अपेक्षित आहे.

1. दिलेल्या तीन दुधाच्या नमुन्यांमधील युरिया शोधणे.
2. दिलेल्या तीन दुधाच्या नमुन्यांमधील स्टार्च शोधणे.
3. दुधाच्या नमुन्यांमधून हायड्रोजन पेरॉक्साइड शोधणे.
4. दिलेल्या तीन दुधाच्या नमुन्यांमधील सोडियम क्लोराईड शोधणे.
5. दिलेल्या तीन दुधाच्या नमुन्यांमधील नायट्रेट शोधणे.
6. म्हैस आणि गायीच्या दुधाच्या नमुन्यांचा pH मोजणे.
7. लस्सी, लिंबू रस, व्हिनेगर, संत्र्याचा रस इत्यादी आम्लीय अन्न नमुन्यांचा pH मोजणे.
8. मधाच्या नमुन्यांमधून साखरडेक्स्ट्रोज शोधणे/
9. दिलेल्या तीन वेगवेगळ्या चहा पावडरच्या नमुन्यांमधील भेसळ शोधणे.
10. तेलव/नस्पती तुपाच्या नमुन्यांमधील भेसळ शोधणे.
11. दिलेल्या तीन हळद पावडरच्या नमुन्यांमधील मेटानिल यलो शोधणे.
12. दिलेल्या तीन मिरची पावडरच्या नमुन्यांमधील भेसळ शोधणे.
13. बेकिंग सोडा आणि बेकिंग पावडर गरम केल्यावर अन्न नमुन्यावर होणारा परिणाम निरीक्षण

करणे आणि त्यांच्या बेकिंगमधील उपयोगाचा अभ्यास करणे.

14. अंड्यातील अल्ब्युमिन (पांढराद्रव) मधील असलेली प्रथिने शोधणे.
15. दिलेल्या बियांमधील चरबी शोधणे.
16. गाजरांमधून बीटा.कॅरोटीन वेगळे करणे-

References:

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2. Bureau of Indian Standards (BIS) Guidelines for Food Adulteration Testing.
3. World Health Organization (WHO) Guidelines on Food Safety.
4. Food Adulteration Tests – NCERT Science Lab Manual.
5. ICMR Guidelines on Adulteration Testing.
6. Analysis of Foods – H.E. Cox: 13. Chemical Analysis of Foods – H.E.Cox and pearson.
7. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New Age International (1998) 6
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B. A. II/B. Com. II Semester IV Open Elective Course- Practical Paper Course in Chemistry		
BSU0325OEP207D04	**CHOEPR-401 Chemistry in Everyday Life Practical Paper IV**	**Credits:** 2 **Hours:** 60

Chemistry in Everyday Life

Course Outcomes:

By studying these experiments, students can acquire the following skills and knowledge:

CO1: Understand fundamental principles of various chemical processes, such as fermentation using yeast, properties of organic and inorganic acids, and the actions of soaps and detergents.

CO2: Develop skills in chemical analysis.

CO3: Comprehend the applications of chemistry in daily life.

CO4: Students can develop skills in adhering to laboratory safety protocols, proper use of equipment, and accurate observation of chemical processes.

Practicals:

Note: As the students undertaking the current course are from Arts and Commerce faculty, an explanation of the theoretical background, mechanism, instrumentation, and reactions is expected.

1. To study the fermentation process using yeast.
2. To detect the presence of Calcium and its salt present in toothpaste.
3. To test the foaming activity of soap and detergent in hard and soft water.
4. To test the solubility of three different substances in polar and non-polar solvents.
5. To study the difference in organic acid (Lemon Juice or Vinegar) and inorganic acid (Commercial HCl).
6. To identify chemical composition of Talcum powder.
7. To study the chemical composition of Aspirin tablet.
8. To study the contents present in Antacid tablet and its action on acid.
9. Preparation of hand-wash or hand-sanitizer.
10. Preparation of Nail Polish Remover.
11. Preparation of Shampoo.

12. Preparation of Ink.
13. Preparation of Chalk.
14. Preparation of Casein (Plastic) from milk.
15. Preparation of liquid soap using Castor oil.

कोर्स परिणाम :

सदर प्रयोगांच्या अभ्यासाद्वारे, विद्यार्थी खालील कौशल्ये आणि ज्ञान प्राप्त करू शकतात:

CO1: यीस्टचा वापर करून आंबण्याची प्रक्रिया, सेंद्रिय आणि असेंद्रिय आम्लांचे गुणधर्म, तसेच साबण आणि डिटर्जंटच्या क्रिया यांसारख्या प्रयोगांद्वारे विद्यार्थी विविध रासायनिक प्रक्रियांचे मूलभूत तत्त्वे समजू शकतात.

CO2: रासायनिक विश्लेषणाची कौशल्ये विकसित करू शकतात.

CO3: विद्यार्थी रसायनशास्त्राचे दैनिक जीवनातील अनुप्रयोग समजू शकतात.

CO4: विविध रासायनिक पदार्थांशी कार्य करताना विद्यार्थी प्रयोगशाळेतील सुरक्षा नियमांचे पालन, उपकरणांचे योग्य वापर, आणि रासायनिक प्रक्रियांचे अचूक निरीक्षण करण्याची कौशल्ये विकसित करू शकतात.

प्रात्येक्षिके (प्रायोगिक कार्य) :

टीप: सदर कोर्स साठी प्रवेशित विद्यार्थी प्रामुख्याने कला व वाणिज्य शाखेचे असलेने सैद्धांतिक पार्श्वभूमी, यंत्रणा, उपकरणे आणि प्रतिक्रियांचे स्पष्टीकरण अपेक्षित आहे.

1. यीस्टचा वापर करून आंबण्याची प्रक्रिया अभ्यासणे.
2. दात घासण्याच्या पेस्टमधील कॅल्शियम व क्षार तपासणे.
3. कठीण आणि मृदू पाण्यात साबण व डिटर्जंटच्या फेस येण्याच्या क्रियेसंबंधी चाचणी करणे.
4. तीन वेगवेगळ्या पदार्थांची ध्रुवीय द्रावकांमधील (पोलर-नॉन) आणि अध्रुवीय (पोलर) .विरघळण्याची क्षमता तपासणे
5. सेंद्रिय आम्ल लिंबू)रस किंवा व्हिनेगर व्यावसायिक) आणि असेंद्रिय आम्ल (HCl) यांच्यातील फरक अभ्यासणे.
6. त्वचेसाठी वापरणाऱ्या पावडरच्या (Talcum Powder) रासायनिक संरचनेची ओळख करणे.
7. ॲस्पिरिन गोळीच्या रासायनिक घटकांचा अभ्यास करणे.
8. ॲंटॅसिड गोळीतील घटकांचा अभ्यास करणे आणि आम्लावर त्याच्या प्रभावाचा अभ्यास करणे.
9. हात धुण्याचे किंवा स्वच्छ करण्याचे द्रावण तयार करणे.

10. नाखांवरील रंग (Nail polish) काढण्याचे द्रावण तयार करणे.
11. केस धुण्यासाठीचे द्रावण तयार करणे.
12. शाई तयार करणे.
13. खडू तयार करणे.
14. दुधामधून केसिन .तयार करणे (प्लास्टिकसदृश पदार्थ)
15. एरंडेल तेलाचा वापर करून द्रव स्वरूपातील साबण तयार करणे.

References:

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3. Elementary Practical Organic Chemistry – Arthur I. Vogel.
4. Food Chemistry – L. H. Meyer.
5. Pharmaceutical Chemistry – K. A. Connors.
6. Laboratory Manual of Organic Chemistry – R. K. Bansal.
7. A Textbook of Applied Chemistry – Dr. A. K. Shrivastava.
8. Formulation and Development of Liquid Hand Wash and Sanitizer – *International Journal of Pharmaceutical Sciences & Research.*
9. Nail Polish Remover: Chemical Composition and Solvent Properties – *Cosmetic Science Review.*
10. Shampoo Formulation and Testing for Commercial Use – *International Journal of Cosmetic Science.*
11. Ink Composition and Manufacturing Techniques – *Journal of Industrial Chemistry.*
12. Chalk Composition and Methods of Preparation – *Material Science Research Journal.*
13. Casein Plastic Formation from Milk: A Sustainable Approach – *Journal of Polymer Science.*
14. Castor Oil-Based Liquid Soap: A Green Chemistry Approach – *Green Chemistry Journal.*

Open Elective Course in Chemistry (NEP-2.0)

B. A. II/ B. Com. II

To be implemented from June 2025 onwards Semester III & IV

Nature of Practical Exam

OE Practical Paper - III/IV **(50 Marks)**

Number of Exam Days: 01

First Session:

Section- A

Q. 1 Experiment-I – 20 Marks

Q. 2 Certified Journal – 05 Marks.

Second Session:

Section- B

Q. 1 Experiment-II – 20 Marks

Q. 2 Certified Journal – 05 Marks.