

 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 दूरध्वनी ०२३१-२६०९०९४ ०२३१-२६०९४८७	 
---	---	---

Ref.No.SU/BOS/Science/150

Date: 26/05/2026.

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

The Head/Co-ordinator/Director
 All Concerned Department (Science)
 Shivaji University, Kolhapur.

Subject: Regarding revised syllabi of degree programme under the Faculty of Science and Technology as per NEP-2020.

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 revised syllabi, nature of question paper and equivalence of degree programme under the Faculty of Science and Technology as per NEP-2020.

1.	B.Sc. Part II Medicinal Chemistry (Entire) (2.0)	6.	BCA Part III
2.	B.A./B.A.B.Ed Part III Geography (2.0)	7.	B.Sc. Part II Data Science
3.	B.Sc. Part II Artificial Intelligence	8.	B.Sc.-M.Sc. Part III AI & ML
4.	B.Sc.-M.Sc. Part IV Nano Science and Technology (1.0)	9.	MCA Part II (YCSRD)
5.	B.Sc.-M.Sc. Part III Nano Science and Technology (2.0)	10.	MCA Part II

This syllabus, nature of question and equivalence shall be implemented from the academic year 2026-2027 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in>Syllabus>Syllabus as per NEP2020.

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2026 & March/April 2027. 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,

Yours faithfully,



Dy Registrar

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.A.,OE-II & 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

Shivaji University, Kolhapur



Accredited By NAAC with 'A++' Grade

Syllabus for

Bachelor of Science Part-II

Medicinal Chemistry Entire

(NEP-2.0)

To be implemented from June, 2026 onwards

SHIVAJI UNIVERSITY, KOLHAPUR

Revised Syllabus for the Bachelor of Science in Medicinal Chemistry

(As per NEP- 2.0)

Applicable from the Academic Year 2026 –27

- 1 **Title:** B. Sc. II Medicinal Chemistry, Shivaji University, Kolhapur Revised Syllabus as per NEP – 2.0
- 2 **Faculty:** Faculty of Science and Technology.
- 3 **Year of Implementation:** From June 2026
- 4 **Objectives of a Bachelor of Science (B.Sc.) in Medicinal Chemistry Program include:**
 - Understand the fundamental principles, laws, concepts and formulas of Medicinal Chemistry.
 - Develop problem-solving skills of students.
 - Gain practical experience by hands-on experience with instruments and develop laboratory skills.
 - Learn about advanced Medicinal 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.
- 5 **Program Outcomes:**

PO-1:- Students will gain fundamental knowledge of Medicinal Chemistry which will help them for higher 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 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 Medicinal Chemistry.

PSO-2. Students will be able to use modern chemical tools, Models, Charts and Equipment.

PSO-3. Students will understand good laboratory practices and safety.

PSO-4. Students will develop research-oriented skills.

7. The B. Sc. II Course (Medicinal 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

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 Medicinal Chemistry Course will be of 44 Credits (1100 marks) .
- c) Examination of each **theory course** shall be of **50 marks** (30 university examination + 20 internal assessment). University examination of 30 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.

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

Semester End Exam	Internal Assessment		Course Exam (Total)
Maximum Marks	30	20	50
Minimum Marks required for passing	12	8	20

- 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 (10 Marks). Question number 2 is long answer type question Carries 10 marks. Question number 3 is short answer type question carries 10 marks. (Nature of question paper is provided at the end of syllabus.)

B.Sc. Part II (NEP-2.0) Semester– III
Paper V -301 Biomolecules-I
(Credits: 02, 30 hours)

Expected Course Outcomes:

Unit No.	Name of the Topics	Periods allocated	Expected Course Outcomes
1	Carbohydrates	08	1. To promote understanding of basic concepts in biomolecules among students. 2. To enable the students to learn the concepts of carbohydrates, amino acids, proteins etc. 3. To understand basics in reactions of enzymes, carbohydrates, vitamins etc. 4. To get basic knowledge about medicinal Chemistry.
2	Amino acids, Polypeptides and Proteins	08	
3	Vitamins	07	
4	Enzymes	07	

Unit I-Carbohydrates

08 L

- 1.1 Classification, Sources, Reducing and nonreducing sugars,
- 1.2 DL notation and commercial importance of carbohydrates.
- 1.3 Configuration of D (+) Glucose - Analytical evidences for open chain structure and ring structure.
- 1.4 Synthesis and stereoisomerism, Anomers and epimers, mutarotation.

Unit-II– Amino acids, Polypeptides and Proteins

08 L

- 2.1 Amino acids-classification and their properties.
- 2.2 α -amino acids- structure, configuration, essential amino acids, classification, properties and methods of synthesis.
- 2.3 Polypeptides-Peptide bond, nomenclature and examples of polypeptides.
- 2.4 Proteins-types, sources, separation-electrophoresis, functions of proteins

Unit-III– Vitamins

07 L

- 3.1 Introduction, composition, classification-water soluble and fat-soluble vitamins.

3.2 Sources, structure, properties and functions of Vitamins: A, B₁, B₂, B₆, B₁₂, folic acid, C, biotin, D, E, K, and H.

3.3 Benefits and deficiency diseases.

Unit-IV-Enzymes

07 L

4.1 Naming and classification of enzymes

4.2 Enzyme cofactors

4.3 Examples of enzyme catalyzed reactions

4.4 Effect of pH on enzyme activity

4.5 Effect of temperature on enzymatic reactions, enzyme inhibition.

Learning Outcomes:

1. Recapitulate the knowledge about enzymes, carbohydrates, vitamins.
2. Study of glucose and fructose.
3. Introduction reaction and synthesis of amino acid, nucleic acid and protein.
1. Studies Functions of Vitamin, enzymes

Reference Books:

1. Smith, C.M., Marks, A.D., Lieberman, M.A., Marks, D.B., & Marks, D.B. (2005). Marks' basic medical biochemistry: A clinical approach. Philadelphia: Lippincott Williams & Wilkins.
2. Jain JL, Jain S, and Jain N (2005). Fundamentals of Biochemistry. S. Chand and Company.
3. Nelson DL and Cox MM. Lehninger Principles of Biochemistry. Fourth Edition.
4. Berg J Metal.(2012)Biochemistry. Seventh Edition. W.H Freeman and Company.
5. (a) Biochemistry – Nelson & Cox; (b) Biochemistry – Stryer; (c) Biochemistry - Powar and Chatwal; (d) Protein Purification- Harris and Angel; (e) Principles of Biochemistry - T. N. Pattabiraman; (f) Biochemistry 3rd Edition – Hames & Hopper; (g) General Biochemistry – J. H. Well; (h) Biochemistry – J. H. Ottaway & D. K. Apps; (i) Biochemistry–Trchan; (j)Text Book of Biochemistry-R.A. Joshi;(k) Biochemistry–U. Satyanarayanan.

B.Sc. Part II (NEP-2.0) Semester– III

Paper VI -302 Chemical Analysis

(Credits: 02, 30 hours)

Expected Course Outcomes:

Unit No.	Title of unit	Periods allocated	Expected Course Outcomes
1	Introduction to Chemical Analysis	07	1. To develop interdisciplinary approach of the subjects for students opting for specialization in other subjects at latter stages of graduation.
2	Basic Concepts in Analysis	08	
3	Gravimetric analysis and Volumetric analysis	08	
4	Chemical analysis of blood	07	2.To expose the students to various emerging new areas of Chemistry and their applications in various spheres of chemical sciences.

Unit 1: Chemical Analysis

07 L

- 1.1 Introduction, Role of analytical chemistry,
- 1.2 Types of analysis, Classification of analytical methods
- 1.3 Selecting an analytical method, Steps involved in quantitative analysis
- 1.4 Neatness and cleanliness in laboratory, Selecting and handling of reagents
- 1.5 Safety in analytical laboratory, Sample preparation for analysis
- 1.6 Weighing and dissolving the sample
- 1.7 Methods for decomposition of organic and inorganic substances

Unit 2: Basic Concepts in Chemical Analysis

08 L

- 2.1 Introduction,
- 2.2 Chemical Analysis terms: Solute, Solvent, Solution, Polar solvent, non-Polar solvent, Saturated solution, Unsaturated solution, Supersaturated solution, Standard solutions, Normality, Equivalent weight, Molecular weight, Molarity.

2.3 Chemical Analysis terms: Acidity of base, Basicity of acid, Percentage solution, ppt, ppm, ppb solutions, Mole Fraction, Weight fraction, Percentage composition by W/W, W/V, V/V

2.4 Problems based on Normality, Molarity, mole fraction, mixed solution, etc.

Unit 3: Gravimetric analysis and Volumetric analysis

08L

3A-Gravimetric analysis

3.1 Introduction of Gravimetry

3.2 Precipitation: Steps involved in precipitation, Characteristics and Conditions of precipitate.

3.3 Physical nature of precipitate

3.4 Coprecipitation and post precipitation

3.5 Precipitants in gravimetric analysis

3B Volumetric analysis

3.6 Introduction, Terms in Volumetric analysis.

3.7 Acid-base indicators.

3.8 Theory of indicators: Ostwald's ionization theory and quinoid theory.

Unit 4: Chemical analysis of Blood

07 L

4.1 Composition of blood, Functions of blood,

4.2 Collection and preservation of sample,

4.3 Estimation of chloride, calcium, bicarbonate, glucose, urea, uric acid, protein, albumin and globin, acid phosphate and alkaline phosphate.

Learning Outcomes:

1. Student should understand the basics of chemical analysis.
2. Students should know about preparation of solutions.
3. The students must understand about quantitative analysis.
4. The students should know about the composition and functions of blood.

Reference Books:

1. A Text book of quantitative Inorganic analysis: A. I. Vogel
2. Basic Concepts of analytical Chemistry: S. M. Khopkar
3. Instrumental methods of Chemical analysis: H. Kaur
4. Analytical Chemistry: Alka Gupta (Pragati Prakashan)
5. Instrumental methods of Chemical analysis: B. K. Sharma
6. Instrumental methods of Chemical analysis: Chatwal Anand
7. Fundamental of analytical Chemistry: Skoog and West

B.Sc. II –Semester- III

PRBM-303 – Medicinal Chemistry Practical Paper -VI - Credit: 02, 60 hours

Biological Sciences and Chemical Analysis Practical

Marks-50

A) Biological Sciences Practical

1. Qualitative Analysis of Carbohydrates

- a) Xylose
- b) Glucose
- c) Fructose
- d) Sucrose
- e) Maltose
- f) Starch

2. Detection of amino acids

- a) Ninhydrin Test
- b) Xanthoproteic Test
- c) Sodium nitro preside Test
- d) Pauly's diazo test

3. Qualitative test of enzyme

- a) Amylase (Starch Hydrolysis Test)
- b) Invertase (Urea Hydrolysis Test)
- c) Urease (Sucrose Hydrolysis Test)

4. To isolate the starch from the given potato sample.

5. Estimation of Glucose by 3,5 Dinitro salicylic acid method

B) Chemical Analysis Practical

- 1. Gravimetric estimation of iron as ferric oxide from the given solution of ferrous ammonium sulphate and free sulphuric acid
- 2. Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride and free hydrochloric acid
- 3. To standardize supplied EDTA solution by titrating with 0.01M ZnSO₄ solution and to estimate amount of calcium from given solution by using Erio-T as an indicator.
- 4. Quality control: To determine percentage purity of the given sample of soda ash
- 5. To determine total hardness of water using 0.01 MEDTA solution.

B. Sc. Part II (NEP-2.0) Semester–III
Paper V- 301 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.

Unit1: Electrolytic Conductivity

(8 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.

Unit2: Thermodynamics

(8 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.

Unit3: Chemical kinetics

(6 hours)

3.1 Introduction.

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

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

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

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

3.6 Numerical problems.

Unit4: States of Matter

(8hours)

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 Vander Waals equation of state for real gases. Explanation of real gas behavior by Vander 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.

5.1 Numerical Problems. Adsorption isotherms: Freundlich adsorption isotherm, Langmuir adsorption isotherm

5.2 Applications of adsorption.

Reference Books:

- 1) Barrow, G.M. Physical Chemistry Tata McGraw-Hill(2007).
- 2) Castellan G.W. Physical Chemistry 4thEd. Narosa(2004).
- 3) Kotz,J.C. Treichel, P.M.& Townsend, J.R.General Chemistry,CengageLearning India Pvt Ltd: New Delhi (2009).
- 4) Mahan, B.H.University Chemistry,3rdEd.Narosa(1998).
- 5) Petrucci, R.H.General Chemistry,5th Ed.,Macmillan PublishingCo,: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 47Th Edison, 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 PublishingCo.: New York (1985).

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

Expected Course Outcomes:

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

Unit1: Colorimetry and Spectrophotometry

[8 hours]

- 1.1 Theory of colorimetry and spectrophotometry.
- 1.2 Lambert Beer's law, deviation from Beer's law.
- 1.3 Terms used in colorimetry and spectrophotometry.
- 1.4 Classification of methods of 'colour' measurement or comparison.
- 1.5 Photoelectric colorimeter method–Single beam photo-electric colorimeter.
- 1.6 Spectrophotometer method–Single beam direct reading spectrophotometer.
- 1.7 Determination of unknown concentration by using concentration-absorbance plot.
- 1.8 Applications of colorimetry and spectrophotometry.

Unit 2: Soaps and detergents

[8hours]

- 2.1 Introduction,
- 2.2 Soaps-Raw materials,
- 2.3 Types of soaps,
- 2.4 Cleansing action of soap,
- 2.5 Manufacture of soap-Boiled or Hot Process,
- 2.6 Detergents-Raw Materials,

- 2.7 Types of Detergents: Anionic, cationic and amphoteric,
- 2.8 Preparation of Teepol and Deriphat,
- 2.9 Comparisons between soaps and detergents.

Unit 3: Chromatographic techniques and IPR

[8hours]

- 3.1 Introduction to chromatography, classification.
- 3.2 Column chromatography:
 - Introduction, types, Principle of adsorption column chromatography, solvent system, stationary phases
 - Methodology-Column packing, applications of sample, development, detection methods, recovery of components Applications.
- 3.3 Ion exchange chromatography:
 - Introduction, Principle, Types and properties of ion exchangers Methodology Column packing, application of sample, elution, detection/analysis, applications.
- 3.4 IPR-Introduction to Copyright, Introduction to Trademark

Unit4: Corrosion

[6 hours]

- 4.1 Introduction of corrosion
- 4.2 Electrochemical theory of corrosion,
- 4.3 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,
- 4.4 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 GurudeepRaj, 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

Practical Paper-Credit: 02, 60 hours

303 Physical Chemistry and Analytical Chemistry

Perform the following Experiments (Any 8)

A) Physical Chemistry

1. To study the hydrolysis of methyl acetate in presence of HCl and H₂SO₄ 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 conductometrically.
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 CH₂ 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 VitaminC 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.

VOCATIONAL SKILL COURSES

VSC Practical

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

Practical's:

- 1) Preparation of Orange II Azodye 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 $\lambda_{\max}$ 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.

Reference Book

1. Fundamentals of Analytical Chemistry; Skoog, West. Holler and Crouch 9th edition; Mary Finch. (2014).
2. Vogel's Text book 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 Limit.

B. Sc. II Semester III
VOCATIONAL SKILL COURSE

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

Reference Books

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 edition, Ministry of environment, forest & climate change, govt. of India.

Skill Enhancement Courses in Medicinal 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. NaHCO₃, 1:1 NH₃, Bromine water, Ferric Chloride solution, Iodine solution, NaNO₂ solution, 2,4-DNP, Tollens, Nesselers, Schiffs, Fehling and Benedict reagents etc).
8. Preparation of Buffer solutions. (pH4 buffer, pH10 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 H₂S 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 edition, Ministry of environment, forest & climate change, govt. of India.
8. Vogel's Quantitative Chemical Analysis, 6th Edition by J Mendham.

AEC English-I

Marks: 50

Subject	Unit No.	Title of unit	Periods allocated	Credits
Chemical Analysis	Unit 1:	MODULEI	10	02
	Unit2:	MODULEII	10	
	Unit 3:	MODULEIII	10	
Total Periods allocated			30	

MODULEI

10L

- A. Interview Skills
- B. Enterprise-Nissim Ezekiel

MODULEII

10L

- A. English for Competitive Examinations
- B. The Look-Out Man-Nicholas Bentley

MODULEIII

10L

- A. Forgetting Our Own History–Sudha Murty B.
- B. i. The Butterfly–Arun Kolatkar
- ii. For Your Lanes, My Country—Faiz Ahmed Faiz

Reference Books:

1. Sudha Murty, Wise and Otherwise: A Salute to Life, Penguin Books India, 2006
2. Ability Enhancement Compulsory Course (Cbcs) For B. Sc. Part III English For Communication (Compulsory English) Shivaji University Press. 2020.
3. The Oxford India Anthology of Twelve Modern Indian Poets (1992) ed. by Arvind Krishna Mehrotra and published by Oxford University Press, New Delhi

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-401Chemistry 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: रसायनशास्त्राच्या 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 असलेले 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. म्हास आणि गायीच्या दुधाच्या नमुन्यांचा pH मोजणे.
7. लस्सी, लिंबू रस, विहनेगर, संत्र्याचा रस इत्यादी आम्लीय अन्न नमुन्यांचा pH मोजणे.
8. मधाच्या नमुन्यांमधून साखरडेक्स्ट्रोस शोधणे/
9. दिलेल्या तीन वेगवेगळ्या चहा पावडरच्या नमुन्यांमधील भेसळ शोधणे.
10. तेलव/नस्पती तूप्याच्या 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:

1. Food Safety and Standards Authority of India (FSSAI) – Official Methods for Food Testing (www.fssai.gov.in).
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
8. Lillian Hoagland Meyer, Food Chemistry, 1st Edn., CBS Publishers & Distributors, New Delhi, 2004.
9. B. A. Fox, A. G. Cameron, E. Arnold, Food Science, Nutrition and Health, 5 6th Edn., Edward Arnold, London, 1995.
10. H. S. Ramaswamy, M. Marcotte, Food Processing: Principles and Applications, CRC Press, 2005.
11. A. F. Smith, Encyclopedia of Junk Food and Fast Food, Green wood Publishing Group, 2006.

Environmental Studies (VEC)

Course Learning Objectives:

The objectives of the course are to:

1. Understand the scope and multidisciplinary nature of Environmental Science.
2. Recognize the structure and function of Ecosystems and understand the importance. of biodiversity.
3. Get acquainted with the problems associated with natural resources and their conservation.
4. Familiarize the global environmental problems like climate change.

Course Outcomes:

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

CO1: Get acquainted with the scope and multidisciplinary nature of environmental science with the overall aim of sustainable development.

CO2: Understand the importance of ecosystems in the view of its conservation.

CO3: Know the values of natural resources with associated problems for sustainable lifestyles.

CO4: Familiarize the basics of Biodiversity and concerned issues in the context of Western Ghats.

CO5: Make aware of the pollution issues with its mitigation measures.

Semester-III (TH)

Total Hours–30

Unit 1. Nature of Environmental Science, Ecosystem, Natural Resources and Biodiversity conservation: (15Hrs)

a) Nature of Environmental Science:

- Definition, scope, and importance
- Multidisciplinary nature of environmental studies
- Sustainable Development Goals (SDGs), Concept of sustainable development

b) Ecosystem:

- Structure and function of an ecosystem,
- Energy flow in the ecosystem, Food chains, food webs, ecological pyramids
- Ecological succession. Forest ecosystem, Grassland ecosystem,

Desert ecosystem, Aquatic ecosystems Degradation of ecosystems and its impacts.

c) Natural Resources:

- Classification of natural resources
- Forest resources: Use and over-exploitation, deforestation, forests and tribal people.
- Water resources: Use of surface and ground water, Water scarcity and stress
- Water conservation: rain water harvesting, water shed management
- Soil and Mineral resources: Soil as a resource and its degradation, Environmental effects of extracting and using mineral resources.
 - Energy resources: Growing energy needs, Energy crisis, use of alternate energy sources, Role of Indian traditions and culture in conservation of the environment

d) Biodiversity and its conservation:

- Types: genetic, species, and ecosystem diversity,
- Bio-geographical classification of India,
- Value of biodiversity:
- India as a mega- diversity nation. Hot-spots of biodiversity, Western Ghats as a biodiversity region.

Unit 2. Environmental Pollution, Climate change and Environmental legislation

(10Hrs)

a) Environmental Pollution:

- Air pollution: Causes, effects and control measures
- Water pollution: Causes, effects and control measures, Marine pollution,
- Soil pollution: Causes, effects and control measures,
- Noise pollution: Causes, effects and control measures
- Solid waste Management: Causes, effects and control

b) Climate change: Causes, effects and mitigation

- Greenhouse gases, phenomenon of greenhouse effect and climate change,
- Impacts of climate change: on life, on ocean and land systems; Sea level rise, On forests and natural ecosystems; On agriculture, on Human health Mitigation of climate change: IPCC, Carbon foot print, Green House Gas(GHG) reduction, net zero targets for the future
- Energy efficiency measures; Renewable energy sources for carbon reduction

- **Nature Visits / Field Work /Field Tour/ Industrial visits / Campus environmental management Activities (5hrs)**

B.Sc. Part II (NEP-2.0) Semester– IV

BM-401: Paper VII (Biomolecules-II)

(Credits: 02, 30 hours)

Expected Course Outcomes:

Unit No.	Title of unit	Periods allocated	Expected Course Outcomes:
1	Nucleic Acids and Peptides	08	1. The course is designed to impart the knowledge in the field of biomolecules. 2. The topics which are present in biosynthesis are very much useful which increases the knowledge in medicinal chemistry.
2	Fats and Oils	08	
3	Lipids	07	
4	Flavonoids and coumarins	07	

Unit I: Nucleic Acids and Peptides

08L

- 1.1 Nucleic acids-Introduction, definition,
- 1.2 Types of nucleic acids, structure, composition and properties of nucleic acids, functions
- 1.3 DNA replication, De-NOVO synthesis of purines and pyrimidine nucleotides and its regulation.
- 1.4 Peptides- Introduction, Characteristics of peptide bonds, examples, peptide classes,
- 1.5 Physical properties of peptides, applications of peptides

Unit II: Fats and Oils

08 L

- 2.1 Introduction, structure of fats and oils,
- 2.2 physical and chemical properties of fats and oils, functions,
- 2.3 biological importance, reactions of fats and oils- hydrolysis, saponification, hydrogenation, halogenation, reversion and rancidity,
- 2.4 Methods of analysis of fats and oils- determination of moisture content, specific gravity, Refractive index, saponification value, acid value, iodine value, determination of Reichert Meissl and Polenske value, acetyl value.

Unit-III: Lipids**07L**

- 3.1 Definition, structure, examples, functions, types and properties
- 3.2 Nomenclature, metabolism of lipids, lipolysis, oxidation of fatty acids
- 3.3 Ketogenesis, ketolysis and diseases related to abnormal metabolism of lipids
- 3.4 Ketoacidosis, fatty liver Compound lipids-Phospholipids, glycolipids, lipoproteins, sulpholipids and amino lipids Health effects of lipids

Unit-IV: Flavonoids and coumarins**07L**

- 4.1 Flavonoids- Classification, occurrence, isolation and separation, total synthesis- Robinson's synthesis, Baker-Venkatraman synthesis
- 4.2 Coumarins-Introduction, classification, isolation, examples, Pechmann coumarin synthesis.

Learning Outcomes:

After completing the credits students should gain knowledge about:

- 1. Basic concepts of foundation of medicinal chemistry.
- 2. Be able to demonstrate the structure and functional role of biomolecules
- 3. Enlist the chemical and biological difference between DNA and RNA.
- 4. Chemistry of biomolecules such as Lipids, Fats, oils, nucleic acids, peptides, flavonoids and coumarins.

Reference Book:

- 1 Smith, C.M., Marks, A.D., Lieberman, M.A., Marks, D.B., & Marks, D.B. (2005). Marks' basic medical biochemistry: A clinical approach. Philadelphia: Lippincott Williams & Wilkins.
- 2 Jain JL, Jain S, and Jain N (2005). Fundamentals of Biochemistry. S. Chand and Company.
- 3 Nelson DL and Cox MM. Lehninger Principles of Biochemistry. Fourth Edition.
- 4 Berg J Metal. (2012) Biochemistry. Seventh Edition. W. H. Freeman and Company.
- 5 (a) Biochemistry – Nelson & Cox; (b) Biochemistry – Stryer; (c) Biochemistry Powar and Chatwal; (d) Protein Purification-Harris and Angel; (e) Principles of Biochemistry-T. N. Pattabiraman; (f) Biochemistry 3rd Edition – Hames & Hopper; (g) General Biochemistry – J. H. Well; (h) Biochemistry – J. H. Ottaway & D. K. Apps; (i) Biochemistry-Trchan; (j) Text Book of Biochemistry-R.A. Joshi; (k) Biochemistry– U. Satyanarayanan

B.Sc. Part II (NEP-2.0) Semester– IV
BM-402: Paper VIII (Analytical Instruments)
(Credits: 02, 30 hours)

Expected Course Outcomes

Unit No.	Title of unit	Periods allocated	Expected Course Outcomes
1	UV-Visible Spectroscopy	06	1. Students understand principle and working UV-Visible Spectroscopy 2. Students learn principle and working ATR Spectroscopy 3. Students study principle and working Fluorescence Spectroscopy 4. Students understand principle and working Absorption Spectroscopy
2	ATR Spectroscopy	06	
3	Fluorescence Spectroscopy	06	
4	A) Thermogravimetry B) Atomic absorption Spectroscopy	12	

Unit I: UV-Visible Spectroscopy

06L

- 1.1 Introduction, Principle, Instrumentation
- 1.2 Construction and working of UV-Visible spectroscopy and its application.

Unit II: ATR Spectroscopy

06L

- 2.1 Introduction, Principle, Instrumentation,
- 2.2 Construction and working of ATR spectroscopy and its application.

Unit III: Fluorescence Spectroscopy

06L

- 3.1 Introduction, Principle, Instrumentation
- 3.2 Construction and working of Fluorescence spectroscopy and its application.

Unit IV: Thermogravimetry and Atomic Absorption Spectroscopy

12L

4A) Thermogravimetry-

- 4.1 Introduction, Principle, Instrumentation

4.2 Construction and working of Thermogravimetric analysis and its application.

4B) Atomic Absorption Spectroscopy

4.3 Introduction, Principle, Instrumentation,

4.4 Construction and working of Fluorescence spectroscopy and its application.

Learning Outcomes:

1. Students able to understand UV-Visible, ATR, Fluorescence spectroscopy and thermogravimetric analysis

Practical: 403 Hands on training

Subject	Unit No.	Title of unit	Periods allocated	Credits
Hands on Training	Unit I:	UV-Visible Spectroscopy	02	02
	Unit II:	ATR Spectroscopy	02	
	Unit III:	Fluorescence Spectroscopy	02	
	Unit IV:	A) Thermogravimetry B) Atomic absorption Spectroscopy	04	
Total Practical's allocated			10	02

Learning Objectives:

1. To handle and understand the operation of UV-Visible, ATR, Fluorescence, Atomic absorption spectroscopy and thermogravimetric analysis.

Chapter I: UV-Visible Spectroscopy

02L

Understanding operation, principle, sampling and actual working of UV-Visible spectroscopy, and actual measurements.

Chapter II: ATR Spectroscopy

02L

Understanding operation, principle, sampling and actual working of ATR spectroscopy and

its application.

Chapter III: Fluorescence Spectroscopy

02L

Understanding operation, principle, sampling and actual working of Fluorescence spectroscopy and actual measurements.

Chapter IV: Thermogravimetry and Atomic Absorption Spectroscopy

04L

Understanding operation, principle, sampling and actual working of Thermogravimetric analysis and actual measurements.

Atomic Absorption Spectroscopy-

Understanding operation, principle, sampling and actual working of Thermogravimetric analysis and actual measurements

Learning Objectives:

1. Students understand how to handle sophisticated analytical instruments.
2. Students understand safe operation of sophisticated instruments.
3. Students know actual measurements of UV-Visible, ATR, Fluorescence, Atomic absorption spectroscopy and thermogravimetric analysis.

B.Sc. Part II Sem IV (NEP-2.0)
401 Inorganic Chemistry
(Theory Credits: 02, 30 hours)

Expected Course Outcomes:

Name of the Topic	Expected Course Outcomes
1.Co-ordinationChemistry	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. (VBTand MOT)	Students will understand the formation of molecules on the basis of concept of hybridization And molecular orbital theory.
4.InorganicSemi-micro Qualitative Analysis	Students will earn the basic knowledge about the Qualitative analysis of inorganic compounds.

Unit-1: Co-ordinationChemistry

(10Hours)

- 1.1 Introduction-Definition and formation of co-ordinate covalent bond in $\text{BF}_3\text{--NH}_3$, $[\text{NH}_4]^+$ 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. $\text{CoCl}_3.6\text{NH}_3$, $\text{CoCl}_3.5\text{NH}_3$, $\text{CoCl}_3.4\text{NH}_3$, $\text{CoCl}_3. 3\text{NH}_3$
- 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
- 1.8 Structural Isomerism- Ionization Isomerism, Hydrate Isomerism, Coordination Isomerism, Linkage Isomerism and Co-ordination position Isomerism

- 1.9 Valence bond theory of transition metal complexes with respect to,
C.N.=4, complexes of $[\text{CuCl}_4]^{2-}$ and $[\text{Cu}(\text{CN})_4]^{2-}$ and C.N.=6 complexes of $[\text{FeF}_6]^{3-}$ and $[\text{Fe}(\text{CN})_6]^{3-}$

Unit2: Chemistry of Elements of 3d Series Elements

(6Hours)

- 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.

(7Hours)

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 levels 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

(7Hours)

- 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 into 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. Vogel's 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. Wilkinson & 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)

402 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.

Unit1: Carboxylic Acids and Their Derivatives.

[6 hours]

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

1.2 Haloacids:

- a) Synthesis of haloacids-Mono, Di, Tri-chloroacetic acid by HVZ reaction
- b) Reactions-Substitution reaction of Mono-Chloroacetic 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 Dicarboxylic 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 , $\text{C}_2\text{H}_5\text{OH}$ in the presence of acid.

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

Unit2: 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: Carbyl amine reaction, Schotten-Baumann reaction, Electrophilic substitution (Aniline) - Nitration, Sulphonation.

2.2 Diazonium salt:

- i) Introduction
- ii) Preparation of Benzene diazonium chloride.
- iii) Reactions of Benzene diazonium chloride.
- iv) Replacement reaction-Sandmeyers reaction.
- v) Coupling reactions: Synthesis of Congo red.

Unit 3: Carbohydrates

[8 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 Monosaccharides

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

Unit4: Carbonyl Compounds-Aldehydes and Ketones

[5 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,

vi) Cannizaro's reaction, v) Knoevenagel condensation and.

Unit5: 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

5.4 Newmann's Projection formula with the help of energy profile diagrams.

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

5.6 Conformations and stability of 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

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 $\text{Ni}(\text{DMG})_2$ from a solution containing $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$ and free sulphuric acid.

Inorganic Preparations (Any Two)

- i) Preparations of sodium cuprous thiosulphate
- ii) Preparation of tris(ethylene diamine) 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)

- i) Following anions are to be given:
 Cl^- , Br^- , I^- , NO_3^- , CO_3^{2-} , SO_4^{2-} , S^{2-} , (insoluble CO_3 —may be given)
- ii) 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. (Any1)

Bases—o-nitroaniline, p-nitroanilines, Diphenylamine. (Any1)

Neutrals—Urea, Acetanilide, Carbontetrachloride, Bromobenzene, Methyl acetate, Nitrobenzene, Naphthalene, Anthracene, Ethylmethylketone. (Any2)

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-nitroacetanilide 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.
- v)

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 Hand Book 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 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 तत्वे 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 असलेले 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. अँस्पिरिन गोळीच्या रासायनिक घटकांचा अभ्यास करणे.
8. अँटॅसिड 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 (प्लास्टिक्सदृश पदार्थ)
15. एरंडेल तेलाचा वापर करून द्रव स्वरूपातील साबण तयार करणे.

References:

1. Vogel's Text book of Practical Organic Chemistry–Arthur I. Vogel.
2. Comprehensive Practical Organic Chemistry –V. K. Ahluwalia & Rakesh Kumar Parashar.
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.Sc.-II

To be implemented from June 2026 onwards Semester III & IV

Nature of Practical Exam

OE Practical Paper - III/IV (50Marks) Number of Exam Days: 01

First Session:

Section-A

Experiment-I	–20Marks
Certified Journal	–05 Marks.

Second Session:

Section-B

Experiment-II	–20Marks
Certified Journal	–05 Marks.

B. Sc. II, Semester IV (NEP-2.0)

Community Engagement Programmed in Chemistry

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.

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	

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:

- Show casing 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 Field work:

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>)

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>)

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/HNO₃, H₂SO₄ solution. (Molar and Normal).
6. Preparation and standardization of sodium thiosulphate solution.
7. Demonstrative Experiment: Preparation of KCl and KNO₃ salt bridges.
8. Draw the structure of organic molecules using software like CHEMD raw/ISIS draw/Chem Sketch.
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 pH4 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 9thedition; 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;6thedition; John Wiley and Sons(2010).
4. Modern Analytical Chemistry; David Harvey; McGraw Hill Higher education publishers, (2000).
5. Analytical Chemistry Principles; John H Kennnedy, 2ndedition, Published by Cengage Delmar Learning India Pvt (2011).
6. Vogel's Text book of Quantitative Chemical Analysis; 6thedition, 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 (50Marks)

Experiment-20Marks

Experiment-20Marks

Oral-5Marks

Journal-5Marks

Semester-IV Practical Paper-II (50Marks)

Experiment-20Marks

Experiment-20Marks

Oral-5Marks

Journal-5Marks

Environmental Studies (VEC)

PROJECT CREDIT 2

B.Sc. II Medicinal Chemistry Syllabus (NEP-2.0)

To be implemented from June 2026 onwards Semester III & IV

Nature of Question paper

Total Marks 30

Time: 1.5 Hours

Q.1 Choose the correct alternative and rewrite the sentence again. 10 Marks

- a)
- b)
- c)
- d)
- e)
- f)
- g)
- h)
- i)
- j)

Q.2. Attempt any ONE of the following (Out of Three) 10 Marks

- a)
- b)
- c)

Q.3. Answer any TWO of the following (Out of Four) 10 Marks

- a)
- b)
- c)
- d)