



SU/BOS/Science/350

Date: 24/06/2024

To,

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

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

**Ref:** SU/BOS/Science/876/ Date: 26/12/2023 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 Minor Change syllabi, nature of question paper of B.Sc. Part-I (Sem.I & II ) as per NEP-2020 (2.0) degree programme under the Faculty of Science and Technology.

B.Sc.Part-I (Sem. I & II ) as per NEP-2020 (2.0)			
1.	Botany	9.	Geology
2.	Physics	10.	Zoology
3.	Statistics	11.	Chemistry
4.	Astrophysics	12.	Geography
5.	Mathematics	13.	Electronics
6.	Microbiology	14.	Drug Chemistry
7.	Plant Protection	15.	Industrial Microbiology
8.	Astrophysics and Space Science	16.	Sugar Technology (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website [www.unishivaji.ac.in](http://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 2024 & March/April 2025. 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

**Copy to:**

1	The Dean, Faculty of Science & Technology	4	B.Sc. Exam/ Appointment Section
2	Director, Board of Examinations and Evaluation	5	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	6	Affiliation Section (U.G.) (P.G.)

# Shivaji University

## Kolhapur



**Accredited By NAAC with 'A++' Grade**

Syllabus for Bachelor of Science

Part-I

Chemistry

**DSC**

(NEP-2.0)

To be implemented from

June, 2024 onwards

**Shivaji University, Kolhapur**  
**Bachelor of Science**  
**Credit Framework**  
**First-Year (B. Sc. I-Chemistry)**

Level	Sem.	Subject-1 (Chemistry)	Subject-2	Subject-3	IDC/MDC/OE/GE	SEC	AEC, VEC, IKS			OJT, FP, CEP, CC, RP			Total Credits
		DSC	DSC	DSC	OE	SEC	AEC	VEC	IKS	CC	FP/OJT	RP/ Dissert.	
4.5	I	ICH-101 Paper-I Inorganic Chemistry (2 Cr)	DSC-I (2 Cr)	DSC-I (2 Cr)	CHOEPR-101 Practical Paper-I Water Analysis (2 Cr)	--	--	--	IKS-I (2 Cr) Introducti on to IKS	--	--	--	--
		OCH-102 Paper-II Organic Chemistry (2 Cr)	DSC-II (2 Cr)	DSC-II (2 Cr)		--	--	--		--	--		
		PRCH-103 Practical Paper-I (2 Cr)	DSC-P-I (2 Cr)	DSC-P-I (2 Cr)		--	--	--		--	--		
	<b>Credits</b>	<b>4(T)+2(P) =6</b>	<b>4(T)+2(P) =6</b>	<b>4(T)+2(P) =6</b>	<b>2 (P) =2</b>	--	--	--	<b>2(T)</b>	--	--	--	<b>22</b>
II	PCH-201 Paper-III Physical Chemistry (2 Cr)	DSC-III (2 Cr)	DSC-I (2 Cr)	CHOEPR-201 Practical Paper-II Soil Analysis (2 Cr)	--	--	VEC-I (2 Cr) Democracy, Election and Constitution	--	--	--	--	--	--
	ACH-202 Paper-IV Analytical Chemistry (2 Cr)	DSC-IV (2 Cr)	DSC-II (2 Cr)		--	--		--	--	--			
	PRCH-203 Practical Paper-II (2 Cr)	DSC-P-II (2 Cr)	DSC-P-II (2 Cr)		--	--		--	--	--			
<b>Credits</b>	<b>4(T)+2(P)=6</b>	<b>4(T)+2(P) =6</b>	<b>4(T)+2(P) =6</b>	<b>2 (P)=2</b>	--	--	<b>2(T)</b>	--	--	--	--	<b>22</b>	
<b>Total Credits</b>		<b>12</b>	<b>12</b>	<b>12</b>	<b>4</b>	--	--	<b>2</b>	<b>2</b>	--	--	--	<b>44</b>
<b>Exit Option: Award of UG Certificate in Major with 44 Credits and an additional 4 credits core NSQF course/ Internship/Skill Courses OR Continue</b>													

### Structure of B. Sc. I Chemistry

Sr. No.	Semester	Title of Paper
1	I	ICH-101 Paper-I, Inorganic Chemistry (2 credits, 30 Hours)
2		OCH-102 Paper -II, Organic Chemistry (2 credits, 30 Hours)
3		PRCH-103 Practical Paper-I (2 credits, 60 Hours)
4	II	PCH-201 Paper -III, Physical Chemistry (2 credits, 30 Hours)
5		ACH-202 Paper -IV, Analytical Chemistry (2 credits, 30 Hours)
6		PRCH-203 Practical Paper-II (2 credits, 60 Hours)

## **Program Outcomes:**

PO-1:- Students will gain fundamental knowledge of chemistry which will help them with PG Studies and Research

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

PO-3:- To make the learner 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 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, formulating a strategy for solving the problem, applying appropriate techniques to arrive at a solution, testing the precision and accuracy of the solution and interpreting the results.

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

## **Program Specific Outcomes:**

PSO-1:- Students will be able to explain fundamental concepts of inorganic, physical, organic, industrial and analytical chemistry.

PSO-2. Identify chemical formulae and solve numerical problems.

PSO-3. Students can 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.

## B. Sc. I (NEP-2.0) Semester I, PAPER-I

### ICH-101- Inorganic Chemistry

(Theory Credits-02, 30 hours)

Name of the topic	Expected Course outcomes
1. Atomic Structure and Periodicity of Elements.	To learn and understand basic knowledge of inorganic chemistry. To understand size, shape and electronic distribution in shells and sub- shells of an atom.
2. P-block Elements.	To learn and understand the properties and uses of the compounds of Boron, Carbon and Nitrogen from p-block elements.
3. Chemical Bonding and Molecular Structure: Ionic Bonding.	To learn different types of bonds and nature of bonding in inorganic compounds. Calculations of different energies associated with ionic bonding.
4. Acids and Bases.	To Understand the role of acids and bases in chemistry. The study is useful in all chemical areas.

#### Unit I: Atomic Structure and Periodicity of Elements

(10 hours)

1.1 Bohr's theory of hydrogen atom and its limitations

1.2 Wave particle duality

1.3 Heisenberg uncertainty principle

1.4 Quantum numbers and their significance

1.5 Shapes of s, p and d atomic orbital's

1.6 Electrons filling rules in various orbitals: a) Aufbau's principle b) Hund's rule of maximum multiplicity c) Pauli's exclusion principle.

1.7 Electronic configuration of elements. Stability of empty, half-filled and completely filled orbitals.

1.8 Periodicity of the elements: General discussion of the following properties of the elements with reference to S- block elements: a) Electronic configuration b) Atomic radii c) Ionic radii d) Ionization energy e) Electron affinity f) Electronegativity g) Metallic characters h) Reactivity i) Oxidation state j) Melting and boiling points k) Chemical properties.

## **Unit II: P-Block Elements (Group 13, 14, 15)**

**(9 hours)**

- 2.1 Position of elements in periodic table.
- 2.2 Characteristics of group 13<sup>th</sup>, 14<sup>th</sup> and 15<sup>th</sup> elements with special reference to electronic configuration and periodic properties.
- 2.3 Compounds of group 13<sup>th</sup>, 14<sup>th</sup> and 15<sup>th</sup> elements.
  - 2.3.1 Boron – Diborane (only structure).
  - 2.3.2 Allotropes of Carbon and Phosphorus.
  - 2.3.3 Oxyacids of Nitrogen (HNO<sub>2</sub>, HNO<sub>3</sub>).

## **Unit III: Chemical Bonding and Molecular Structure: Ionic Bonding (7 hours)**

- 3.1 Types of Chemical Bonds: a) Ionic Bond b) Covalent Bond c) Co-ordinate bond d) Metallic bond e) Hydrogen Bond f) Van-der Waals force.
- 3.2 Definition and formation of ionic bond. General characteristics of ionic bonding
- 3.3 Energetic in Ionic bond formation.
- 3.4 Born-Haber cycle for NaCl and its applications.
- 3.5 Fajan's Rule and its applications.

## **Unit IV: Acids and Bases**

**(4 hours)**

- 4.1 Theories of Acids and Bases – Arrhenius concept, Bronsted –Lowry concept, Lewis concept, Lux-Flood concept. (Definition and examples only).
- 4.2 Hard and Soft Acids and Bases (HSAB concept).

4.2.1 Classification of Acids and Bases as hard soft and borderline.

4.2.2 Pearson's HSAB concept.

4.2.3 Applications and limitations of HSAB concept.

**Reference Books:**

- 1) Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.
- 2) Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
- 3) Douglas, B. E., McDaniel, D. H. & Alexander, J. J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
- 4) Huheey, J. E., Keiter, E. A., Keiter, R. L. & Medhi, O. K. Inorganic Chemistry:
- 5) Principles of Structure and Reactivity, Pearson Education India, 2006.
- 6) Puri, Sharma, Kalia. Principles of Inorganic Chemistry
- 7) Madan R. L. Chemistry for Degree Students (B. Sc. First year), S. Chand



**B.Sc. Part I (NEP-2.0) SEMESTER-I, PAPER-II****0CH-102- Organic Chemistry****(Theory Credits: 02, 30 hours)**

Name of the topic	Expected Course outcomes
1. Fundamentals of Organic Chemistry	The students are expected to understand the fundamentals and basic principles involved in organic chemistry.
2. Stereochemistry	Understanding the spatial arrangement of atoms of organic molecule and types of stereoisomers.
3. Aromaticity	Knowledge of general properties and fundamental reactions of aromatic compounds.
4. Heterocyclic Compounds	To understand the basic knowledge of heterocyclic compounds. To get knowledge of methods to preparation, physical and chemical properties of some heterocyclic compounds with five and six membered heterocycles containing N as the hetero atom ( Pyrrole and Pyridine).

**Unit I: Basic Concepts in Organic Chemistry****(9 hours)**

Introduction, Curved arrow notations, Cleavage of Bonds: Homolysis and Heterolysis. Organic molecular species: Nucleophiles and electrophiles. Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyper conjugation effect, Reactive Intermediates: Generation, Structure, Stability and Reactions of Carbocations, Carbanions, Carbon free radicals, Carbene and Nitrene.

**Unit II: Stereochemistry****(9 hours)**

Introduction, Types of Stereoisomerism, Representation of organic molecules using Wedge, Fischer, Sawhorse and Newman formula, Optical Isomerism: Concept of Chirality, Elements of Symmetry, Optical Isomerism in tartaric acid, 2, 3 Dihydroxy butanoic acid, Enantiomerism, Diastereomerism and Meso compounds, Geometrical isomerism in C=C, C=N and alicyclic compounds. Nomenclature of stereoisomers: D and L, Erythro and Threo, R and S, E and Z.

**Unit III: Aromaticity****(6 hours)**

Introduction, Characteristics properties of aromatic compounds, Meaning of terms: Aromatic, Non aromatic, Antiaromatic, Pseudoaromatic, Classification of aromatic compounds, Structure of Benzene: Kekule structure, Resonance structure, M.O. picture, Modern theory of Aromaticity, Mechanism of Electrophilic substitution reactions: Nitration, Sulphonation, Halogenation and Friedel - Crafts reaction.

**Unit IV: Heterocyclic Compounds****(6 hours)**

Introduction, Classification and Nomenclature of heterocyclic compounds.

Nitrogen Heterocycles:

- a) Pyrrole:- Introduction, Synthesis, Physical and chemical properties.
- b) Pyridine:- Introduction, Synthesis, Physical and chemical properties.

**Reference Books:**

- 1) Graham Solomon, T. W., Fryhle, C. B. & Snyder, S. A. Organic Chemistry, John Wiley & Sons (2014).
- 2) McMurry, J. E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Pvt Ltd, Edition, 2013.
- 3) Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).

- 4) Eliel, E. L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
- 5) Finar, I. L. Organic Chemistry (Vol. I & II), E.L.B.S.
- 6) Morrison, R. T. & Boyd, R. N. Organic Chemistry, Pearson, 2010.
- 7) Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010.
- 8) Nasipuri, D. Stereochemistry of Organic compounds: Principles and Applications.
- 9) Madan, R. L. Chemistry for Degree Students (B. Sc. First Year), S. Chand Publication.
- 10) Heterocyclic chemistry, J.A. Joule and K. Mills, 4th ed., Blackwell Publishing 2000
- 11) John A. Joule, Keith Mills.; Heterocyclic Chemistry, 5th Edition, April 2010, ©2010, Wiley Blackwell,
- 12) Gilchrist, T. L. Heterocyclic chemistry; 3rd ed.; Addison Wesley Longman: Edinburgh Gate, 1997.
- 13) Joule, J. A.; Mills, K.; Heterocyclic chemistry; 4th ed.; Blackwell Science: Oxford, 2000.

**B. Sc. I Semester I, Practical Course  
PRCH-103-PRACTICAL PAPER-I  
(Credits-02, 60 hours)**

**A] Inorganic Chemistry:**

- 1) To prepare standard 0.1 N  $\text{KMnO}_4$  solution and to determine the strength of given oxalic acid solution.
- 2) To determine quantity of Fe (II) ions from the given solutions by titrating it with 0.1N  $\text{K}_2\text{Cr}_2\text{O}_7$  solution by using internal indicator
- 3) To estimate amount of Cu (II) ions by iodometric titration by using  $\text{Na}_2\text{S}_2\text{O}_3$  solution.
- 4) To standardize supplied EDTA solution by titrating with 0.01 M  $\text{ZnSO}_4$  solution and to estimate amount of calcium from given solution by using Eriochrome Black- T as an indicator.
- 5) Quality control -To determine percentage purity of the given

sample of soda ash ( $\text{Na}_2\text{CO}_3$ ) by titrimetric method.

- 6) Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
- 7) Chromatography : Separation and identification of cations by Paper Chromatography technique from the following mixtures :
  - a)  $\text{Ni}^{2+} + \text{Cu}^{2+}$
  - b)  $\text{Ni}^{2+} + \text{Co}^{2+}$
  - c)  $\text{Cu}^{2+} + \text{Co}^{2+}$
- 8) Spot Test : Identify the following metal ions by spot test method  
 $\text{Cu}^{2+}, \text{Ni}^{2+}, \text{Co}^{2+}, \text{Fe}^{3+}, \text{Al}^{3+}, \text{Pb}^{2+}, \text{Zn}^{2+}, \text{Hg}^{+2}, \text{Mg}^{+2}, \text{Mn}^{+2}$

### References

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009

### B) Organic Chemistry

1) Estimations:

- i) Estimation of Aniline. (by Bromination method)
- ii) Estimation of Acetamide.

2) Organic Qualitative Analysis: Detection of physical constant, type, elements, functional group, and Confirmatory test. Identification of Organic Compounds (at least eight) (four containing at least one extra element- N, S, Cl)

- a) Acids: Oxalic acid, Benzoic acid, Cinnamic acid
- b) Phenols: Beta-Naphthol, p-Nitrophenol
- c) Base: Aniline, p-Nitroaniline
- d) Neutral: Acetone, Acetanilide, Chloroform, m-Dinitrobenzene, Thiourea, Bromobenzene

3) Purification of organic compounds by crystallization (from water and alcohol) and distillation.

**References:**

- 1) Vogel's Text Book of Quantitative Chemical Analysis. (Longmann) ELBS Edition.
- 2) Hand book of Organic Qualitative Analysis: Clarke.
- 3) Comprehensive Practical Organic Chemistry - Qualitative Analysis by V. K. Ahluwalia, Sunita Dhingra. University Press. Distributor - Orient Longman Ltd.
- 4) Comprehensive Practical Organic Chemistry preparation and Quantitative Analysis: V. K. Ahluwalia, Renu Aggarwal. University Press. Distributor - Orient Longman Ltd.
- 5) A Laboratory Hand - Book of Organic Qualitative Analysis and Separation: V. S. Kulkarni. Dastane Ramchandra & Co. Pune

## B. Sc. I (NEP-2.0) Semester II, Paper -III

### PCH-201-Physical Chemistry

Credits: 02, 30 hours

Name of the Topic	Expected Course Outcomes
1. Basic Mathematical Concepts	Learning and coherent understanding of basic concepts and rules of logarithms, graphs, derivative and integrations.
2. Thermodynamics	Knowledge and coherent understanding of basic concepts in thermodynamics will be gained by the student.
3. Chemical Kinetics	Learning and understanding the knowledge about basic concepts in kinetics and first order, second order reactions with characteristics and suitable examples.
4. Physical properties of liquids	Learning and coherent understanding of surface tension, viscosity and refractive index with suitable examples.
5. Electrochemistry	Learning and coherent understanding of basic concepts in electrochemistry, conductors and conductivity cells, measurement of conductance with suitable examples and numerical problems.

#### Unit I: Basic Mathematical Concepts

(3 hours)

1.1 Logarithm: Basic rules and calculations.

1.2 Graph - Quadrants, drawing of linear graph, Slopes and Intercept.

1.3 Derivative and Integration: Basic rules.

#### Unit II: Thermodynamics

(5 hours)

2.1 Introduction, Basic terms used in thermodynamics, Zeroth law of thermodynamics.

2.2 First law of thermodynamics: Mathematical equation, sign conventions, statements of first law and its limitations.

2.3 Spontaneous and non-spontaneous processes, Second law of thermodynamics.

2.4 Heat engine, Carnot's Cycle and efficiency of heat engine.

2.5 Numerical Problems.

### **Unit III: Chemical Kinetics**

**(8 hours)**

3.1 Introduction, rate of reaction, definition, and units of rate constant.

3.2 Factors affecting rate of reaction.

3.3 Order and Molecularity of reaction.

3.4 First order reaction: Derivation of rate constant. Characteristics of the first order reaction.

3.5 Pseudo- first order reactions –i) Hydrolysis of methyl acetate in presence of acid, ii) Inversion of cane sugar.

3.6 Second order reaction: Derivation of rate constant for equal and unequal concentration of the reactants.

3.7 Examples of Second order reaction: i) Reaction between  $K_2S_2O_8$  and KI and ii) Saponification of ethyl acetate.

3.8 Characteristics of Second order reactions.

3.9 Numerical problems.

### **Unit IV: Physical properties of liquids**

**(6 hours)**

4.1 Introduction to states of matter, qualitative description of intermolecular forces in liquids, structure of liquids, classification of physical properties.

4.2 Surface tension and its determination using stalagmometer and differential rise method.

4.3 Viscosity and its determination using Ostwald's viscometer.

4.4 Refractive index (Snell's law) specific and molecular refractivities and its determination using Abbe's refractometer.

4.5 Numerical Problems.

## **Unit V: Electrochemistry**

**(8 hours)**

- 5.1 Introduction, types of cell, phenomenon of electrolysis, Faradays Laws of electrolysis.
- 5.2 Types of conductors.
- 5.3 Explanations of Conductance, specific conductance, equivalence and molecular conductance.
- 5.4 Variation of specific conductance, equivalence and molecular conductance with dilution, equivalent conductance at infinite dilution.
- 5.5 Dipping type of conductivity cell, modifications in the technique used before measurement of conductance w.r.to use of alternating current, use of conductivity water, conductivity cell and temperature control.
- 5.6 Measurement of conductance by Wheatstone bridge.
- 5.7 Cell constant and its determination.
- 5.8 Numerical problems.

### **Reference Books:**

- 1) Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- 2) Castellan G.W. Physical Chemistry 4<sup>th</sup> 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 Daniels and Alberty (2016)
- 11) University General Chemistry C. N. R. Rao (2016)
- 12) Principles of Physical Chemistry, Puri, Sharma and Pathania 47th Edition,



VishalPublishing Co.

13) Physical Chemistry, A. J. Mee

14) Advanced Physical Chemistry, Guru Deep Raj

15) Physical Chemistry, R. A. Alberty

16) General Chemistry, 5th Edition, Macmillan Publishing Co., New York (1985)

### **B. Sc. I Semester II, Paper IV**

#### **ACH-202- Analytical Chemistry**

**(Theory Credits:02, Lectures-30 hours)**

#### **Expected learning Outcomes:**

<b>Name of the topic</b>	<b>Expected Course Outcome</b>
1. Introduction to Analytical Chemistry	Learning various analytical procedures and importance also sampling, accuracy and precision
2. Fundamentals of Industrial Chemistry and IPR	a. Distinguish between classical and industrial chemistry b. Learning and Understanding basic concepts and concentration terms c. Knowledge of IPR
3. Chromatography	Knowledge of chromatographic separation technique and terms involved in it. Learning paper chromatography and thin layer chromatography
4. Theory of titrimetric Analysis	Knowledge of various type of titrations, neutralization curves, indicators used in various titrations

#### **Unit I: Introduction to Analytical Chemistry**

**(7 hours)**

1.1 Introduction

1.2 Importance of analysis

1.3 Analytical processes (Qualitative and Quantitative)

1.4 Methods of analysis (Only classification)

1.5 Sampling of solids, liquids and gases

1.6 Errors, types of errors (determinate and indeterminate), methods of expressing accuracy (Absolute and relative error)

1.7 Significant figures, mean, median, standard deviation (Numerical problems expected)

## **Unit II: Fundamentals of Industrial Chemistry and IPR (7 hours)**

2.1 Difference between classical and industrial chemistry, Raw materials for chemical industry, Material safety data sheets (MSDS)

2.2 Definition and Explanation of terms - Molecular weight, Equivalent weight, Molarity, Normality, Molality, Molarity of mixed solution, Acidity of base, Basicity of acid, ppt, ppm, ppb solutions, Mole Fraction, Weight fraction, Percentage composition by W/W, W/V, V/V, Problems based on Normality, Molarity, mole fraction, mixed solution, etc.

2.3 IPR- Introduction to IPR and its significance in presence scenario

## **Unit III: Chromatography (7 hours)**

3.1 Introduction, Basic Principle of Chromatography, Basic terms, Classification of Chromatography

3.2 Paper Chromatography- Principle, Methodology-types of papers and treatment, sample loading, choice of solvent, development-ascending, descending, circular, location of spots, determination of  $R_f$  value, Applications, advantages and disadvantages

3.3 Thin layer chromatography- Principle, Solvent system, stationary phases, preparation of TLC plate, Detecting reagents, methodology-sample loading, development, detection of spot,  $R_f$  value, Applications, advantages and disadvantages

## **Unit IV: Theory of Titrimetric Analysis (9 hours)**

4.1 Introduction

4.2 Acid-base indicators

4.3 Theory of indicators w.r.t. Ostwald's ionization theory

4.4 Neutralization curves and choice of indicators for

- a. Strong acid-strong base
  - b. Strong acid-weak base
  - c. Strong base-weak acid
- 4.5 Complexometric titrations
- a. Introduction
  - b. Types EDTA titrations
  - c. Metallochromic indicators-Eriochrome black- T
  - d. Indicator Action of Eriochrome black- T
- 4.6 Redox Titrations
- a. Introduction
  - b.  $\text{KMnO}_4$  Vs Oxalic acid titration; theory of  $\text{KMnO}_4$  as self indicator.
- 4.7 Precipitation Titrations
- a. Introduction
  - b. Silver nitrate Vs NaCl solution using Potassium chromate indicator

## References

1. Text Book of Quantitative Inorganic analysis – A. I. Vogel
2. Instrumental methods of Chemical analysis –Willard, Merit & Dean
3. Instrumentals methods of Chemical analysis – Chatwal & Anand
4. Vogel's textbook of qualitative Inorganic analysis – Bassett, Denny etc.
5. Textbook of qualitative Inorganic analysis – Kolthoff and Sandel
6. Fundamentals of analytical chemistry – Skoog and West
7. Basic concepts of analytical chemistry – S. M. Khopkar
8. Text book of qualitative organic analysis – A. I. Vogel
9. Qualitative organic chemistry – A. I. Vogel
10. Instrumental methods of chemical analysis – H. Kaur
11. A text book of Quantitative chemical analysis Vogel's by J. Mendham, R. C. Denney
12. Quantitative Chemical Analysis – Daniel C. Harris
13. Chemical process industries – Shrieve & Brink
14. Industrial Chemistry – B. K. Sharma

15. Industrial Chemistry – R. K. Das
16. Text book of qualitative organic analysis – A. I. Vogel

**B. Sc. I Semester II Practical Course**  
**PRCH-203 Practical Paper-II**  
**(Credits-02, 60 hours)**

**A) Physical Chemistry:**

- 1) Determination of viscosity of given liquids A and B (Density data of liquids, viscosity of water to be given) [Any two liquids from Acetone, Carbon tetra chloride, Chloroform, Ethyl alcohol, Benzyl alcohol, Ethylene glycol and n- propyl alcohol]
- 2) To study the velocity constant of hydrolysis of methyl acetate in presence HCl.
- 3) To study the velocity constant of hydrolysis of methyl acetate in presence  $H_2SO_4$ .
- 4) To study the reaction between Potassium persulphate and Potassium iodide kinetically (equal concentration).
- 5) Determination of heat of ionization of weak acid by using polythene bottle.
- 6) Determination of Surface tension of the given liquids by Stalagmometer.
- 7) Determination of heat of solution of salt KCl.
- 8) Determination of equivalent weight of Mg by eudiometer.

**B) Analytical Chemistry:**

- 1) Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
- 2) Estimation of Aspirin tablet.
- 3) Estimation of Vitamin C from fruit juice.
- 4) Determination of Cell constant of given conductivity cell using KCl solution. (N/10 and N/50 KCl) (Solutions should be prepared by the students).
- 5) Preparation and standardization of HCl/ $H_2SO_4$  solution from the bulk.
- 6) Separation and identification of amino acids by paper chromatography.
- 7) Estimation of Ca from pharma tablets by complexometric method.

**References:**

- 1) Practical book of Physical Chemistry: Nadkarni, Kothari & Lawande.
- 2) Experimental Physical Chemistry: A. Findlay.
- 3) Systematic Experimental Physical Chemistry: S. W. Rajbhoj, Chondhekar. (Anjali Publication.)
- 4) Experiments in Physical Chemistry: R. C. Das and B. Behra. (Tata McGraw Hill)
- 5) Advanced Practical Physical Chemistry: J. B. Yadav (Goel Publishing House.)
- 6) Practical Physical Chemistry: B. D. Khosala. (R. Chand & Sons)
- 7) Experiments in Chemistry: D. V. Jahagirdar.
- 8) A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed) (ELBS)
- 9) Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009

**B.Sc. I Syllabus (NEP-2.0)**

**To be implemented from June 2024 onwards Semester I & II**

**Nature of Question paper**

**Total Marks 40**

**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. I Syllabus (NEP-2.0)**  
**To be implemented from June 2024 onwards**  
**Semester I**  
**Nature of Practical Exam**

**Semester-I Practical Paper-I (50 Marks)**

**Number of Days: 01**

**First Session:**

Section-I- Inorganic (25 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Journal- 05 Marks

**Second Session:**

Section-II Organic (25 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Journal- 05 Marks

**Semester-II Practical Paper-II (50 Marks)**

**First Session:**

Section-I- Physical (25 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Journal- 05 Marks

**Second Session:**

Section-II Analytical (25 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Journal- 05 Marks

# Shivaji University

## Kolhapur



**Accredited By NAAC with 'A++' Grade**

Syllabus for Bachelor of Science

Part-I

Chemistry

**Open Elective (OE)**

(NEP-2.0)

To be implemented from

June, 2024 onwards



**Shivaji University, Kolhapur**  
**Bachelor of Science**  
**Credit Framework**  
**First-Year (B. Sc. I-Chemistry)**

Level	Sem.	Subject-1 (Chemistry)	Subject-2	Subject-3	IDC/MDC/OE/GE	SEC	AEC, VEC, IKS			OJT, FP, CEP, CC, RP			Total Credits
		DSC	DSC	DSC	OE	SEC	AEC	VEC	IKS	CC	FP/OJT	RP/ Dissert.	
4.5	I	ICH-101 Paper-I Inorganic Chemistry (2 Cr)	DSC-I (2 Cr)	DSC-I (2 Cr)	CHOEPR-101 Practical Paper-I Water Analysis (2 Cr)	--	--	--	IKS-I (2 Cr) Introducti on to IKS	--	--	--	--
		OCH-102 Paper-II Organic Chemistry (2 Cr)	DSC-II (2 Cr)	DSC-II (2 Cr)									
		PRCH-103 Practical Paper-I (2 Cr)	DSC-P-I (2 Cr)	DSC-P-I (2 Cr)									
	<b>Credits</b>	<b>4(T)+2(P) =6</b>	<b>4(T)+2(P) =6</b>	<b>4(T)+2(P) =6</b>	<b>2 (P) =2</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>2(T)</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>22</b>
II	PCH-201 Paper-III Physical Chemistry (2 Cr)	DSC-III (2 Cr)	DSC-I (2 Cr)	CHOEPR-201 Practical Paper-II Soil Analysis (2 Cr)	--	--	VEC-I (2 Cr) Democracy, Election and Constitution	--	--	--	--	--	--
	ACH-202 Paper-IV Analytical Chemistry (2 Cr)	DSC-IV (2 Cr)	DSC-II (2 Cr)										
	PRCH-203 Practical Paper-II (2 Cr)	DSC-P-II (2 Cr)	DSC-P-II (2 Cr)										
<b>Credits</b>	<b>4(T)+2(P)=6</b>	<b>4(T)+2(P) =6</b>	<b>4(T)+2(P) =6</b>	<b>2 (P)=2</b>	<b>--</b>	<b>--</b>	<b>2(T)</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>22</b>	
<b>Total Credits</b>		<b>12</b>	<b>12</b>	<b>12</b>	<b>4</b>	<b>--</b>	<b>--</b>	<b>2</b>	<b>2</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>44</b>
Exit Option: Award of UG Certificate in Major with 44 Credits and an additional 4 credits core NSQF course/ Internship/Skill Courses OR Continue													

**Structure of B. Sc. I  
OE (CHEMISTRY)**

<b>Sr. No.</b>	<b>Semester</b>	<b>Title of Paper</b>
1	<b>I</b>	CHOEPR-101 Practical Paper-I Water Analysis (2 Cr) (2 credits, 60 Hours)
2	<b>II</b>	CHOEPR-201 Practical Paper-II Soil Analysis (2 Cr) (2 credits, 60 Hours)

## **B. Sc. I (NEP-2.0) Semester I, OE PRACTICAL COURSE PAPER - I**

### **CHOEPR-101 – OPEN ELECTIVE (OE) CHEMISTRY**

**(Credits-02, 60 hours)**

#### **B. Sc. I Semester I, Practical Course**

#### **CHOEPR-101 -PRACTICAL PAPER- I**

**(Credits-02, 60 hours)**

#### **Expected Course Outcomes:**

To learn and understand basic knowledge of physico-chemical properties of water.

To learn about general water quality analysis techniques.

To acquire hands-on skills to perform actual practical analysis in the laboratory.

#### **अपेक्षित शिक्षण परिणाम :**

पाण्याच्या भौतिक-रासायनिक गुणधर्मांचे मूलभूत ज्ञान जाणून घेणे.

सामान्य पाण्याच्या गुणवत्तेचे विश्लेषण तंत्र जाणून घेणे.

प्रयोगशाळेत प्रत्यक्ष व्यावहारिक विश्लेषण करण्यासाठी कौशल्ये आत्मसात करणे.

#### **Water Analysis:**

##### **Practicals**

**(Credits-02, 60 hours)**

1. Collection of various water samples.
2. Determination of temperature of water.
3. Determination of pH of various samples using pH meter or pH paper.
4. Determination of electrical conductivity using conductivity meter.
5. Determination of Acidity of water given samples.
6. Determination of Alkalinity of water.
7. Determination of Hardness of water.
8. To measure the dissolved oxygen content in water using a dissolved oxygen test kit.
9. Determination of Chemical Oxygen Demand (COD).
10. Determination of Biological Oxygen Demand (BOD).
11. Determination of refractive index of given sample using Refractometer.

12. **Water Quality Assessment:** Guiding students through the process of assessing overall water quality based on the results of their tests. They can compare their findings to water quality standards and discuss the implications for human health and the environment.
13. **Field Trips:** Organizing field trips to local water bodies for hands-on observation and testing.

## पाणी विश्लेषण (Water Analysis)

### प्रात्येक्षिके (Practicals)

(क्रेडिट २, ६० तास)

1. विविध पाण्याचे नमुने गोळा करणे.
2. पाण्याचे तापमान निश्चित करणे.
3. pH मीटर किंवा pH पट्टी वापरून विविध नमुन्यांचे pH निश्चित करणे.
4. चालकता मीटर (conductivity meter) वापरून विद्युत चालकता (electrical conductivity) निश्चित करणे.
5. दिलेल्या पाण्याच्या नमुन्यांचे आंबटपणाचे निर्धारण करणे (Acidity).
6. पाण्याची क्षारता निश्चित करणे (Alkalinity).
7. पाण्याच्या कठीणपणाचे निर्धारण करणे (Hardness).
8. पाण्यात विरघळलेल्या ऑक्सिजनचे (Dissolved oxygen) प्रमाण चाचणी किट वापर करून मोजणे.
9. रासायनिक ऑक्सिजन मागणीचे निर्धारण करणे (COD).
10. जैविक ऑक्सिजन मागणीचे निर्धारण करणे (BOD).
11. रिफ्रॅक्टोमीटर वापरून दिलेल्या नमुन्याच्या अपवर्तक निर्देशांकाचे निर्धारण करणे.
12. पाण्याच्या गुणवत्तेचे मूल्यांकन: विद्यार्थ्यांना त्यांच्या चाचण्यांच्या निकालांवर आधारित एकूण पाण्याच्या गुणवत्तेचे मूल्यांकन करण्याच्या प्रक्रियेद्वारे मार्गदर्शन करणे. ते त्यांच्या निष्कर्षांची पाण्याच्या गुणवत्तेच्या मानकांशी तुलना करू शकतात

आणि मानवी आरोग्य आणि पर्यावरणावरील परिणामांवर चर्चा करू शकतात.

13. फील्ड ट्रिप (क्षेत्र सहल) : प्रत्यक्ष निरीक्षण आणि चाचणीसाठी स्थानिक पाणवट्यांवर फील्ड ट्रिप आयोजित करणे.

**Reference Books:**

1. Chemical and biological method for water pollution; R. K. Trivedi and P. K. Geol, Environ. Pub.
2. Methodology of water analysis; M. S. Kondarkar, IAAB Publication, Hyderabad.
3. Environmental studies; Dr. K. Mukkanti, S. Chand & Camp Ltd.
4. Standard Methods for Examination of water & waste water APHA- AWWA- WPCE.
5. Manual of water & waste water analysis, NEERI, Nagpur.
6. Text book of water and waste water engineering by H. K. Hussien.
7. Water supply & sanitary engineering by Birdie.
8. Practical methods in ecology & Environmental science by R. K. Trivedi, P. K. Goel, C. L. Trisal.

## **B. Sc. I (NEP-2.0) Semester II, OE PRACTICAL COURSE PAPER- II**

### **CHOEPR-201 – OPEN ELECTIVE (OE) CHEMISTRY**

**(Credits-02, 60 hours)**

**B. Sc. I Semester II, Practical Course  
CHOEPR-201 -PRACTICAL PAPER- II  
(Credits-02, 60 hours)**

#### **Expected Course Outcomes**

To learn and understand basic knowledge of physico-chemical properties of soil.

To learn about general soil quality analysis techniques.

To acquire hands-on skills to perform actual practical analysis in the laboratory.

#### **अपेक्षित शिक्षण परिणाम :**

मातीच्या भौतिक-रासायनिक गुणधर्मांचे मूलभूत ज्ञान जाणून घेणे.

सामान्य मातीच्या गुणवत्तेचे विश्लेषण तंत्र जाणून घेणे.

प्रयोगशाळेत प्रत्यक्ष व्यावहारिक विश्लेषण करण्यासाठी कौशल्ये आत्मसात करणे.

#### **Soil Analysis**

##### **Practicals:**

**(Credits-02, 60 hours)**

1. Sampling of soil using various soil sampling methods.
2. Determining the acid-base index of various soil samples using a pH meter or pH paper.
3. Determination of electrical conductivity using conductivity meter.
4. To determine the acidity of the given soil samples. (Acidity)
5. Extraction of coarse sand, fine sand, clay soil etc.
6. Removal of soluble salts from soil
7. Removal of free lime from soil.
8. To check the amount of nutrients such as nitrogen, phosphorus and phosphorus in a given soil sample. .

9. Examination of calcium from soil.
10. Soil Quality Assessment: To guide students through the process of assessing overall soil quality based on the results of their tests. They can compare their findings to soil quality standards and discuss the implications for human health and the environment.
11. Field Trips : Conducting field trips to farms for direct observation and testing.

## माती विश्लेषण Soil Analysis

(Credits-02, 60 hours)

1. विविध मातीचे नमुने गोळा करण्याच्या पद्धति वापरून मातीचे नमुने घेणे.
2. pH मीटर किंवा pH पट्टी वापरून मातीच्या विविध नमुन्यांचे आम्ल-विम्ल निर्देशांक निश्चित करणे.
3. चालकता मीटर (conductivity meter) वापरून विद्युत चालकता (electrical conductivity) निश्चित करणे.
4. दिलेले मातीच्या नमुन्यांचे आंबटपणाचे निर्धारण करणे. (Acidity)
5. मातीत असलेल्या जाड रेती, बारीक रेती, चिक्कण माती आदी घटकांचे शेकडा प्रमाण काढणे.
6. मातीतील विद्राव्य क्षार काढणे.
7. मातीतील मुक्त चुना काढणे.
8. नत्र, पालाश व स्फुरद या पोषक द्रव्यांचा दिलेल्या मातीच्या नमुन्यात किती प्रमाण आहे हे पाहणे.
9. मातीतील कॅल्शियम तपासणी करणे.
10. **मातीच्या गुणवत्तेचे मूल्यांकन** : विद्यार्थ्यांना त्यांच्या चाचण्यांच्या निकालांवर आधारित एकूणमातीच्या गुणवत्तेचे मूल्यांकन करण्याच्या प्रक्रियेद्वारे मार्गदर्शन करणे. ते त्यांच्या निष्कर्षांची मातीच्या गुणवत्तेच्या मानकांशी तुलना करू शकतात आणि मानवी आरोग्य आणि पर्यावरणावरील परिणामांवर चर्चा करू शकतात.
11. **फील्ड ट्रिप (क्षेत्र सहल)**: प्रत्यक्ष निरीक्षण आणि चाचणीसाठी शेतावर फील्ड ट्रिप आयोजित करणे.

**Reference Books:**

1. Analytical Chemistry-Alka Gupta (Pragati Prakashan)
2. Soil chemicals Analysis - P.R. Hesse
3. Soil testing manual by department of agriculture and cooperation, India
4. Fundamentals of Soil --- V.N.Sahai
5. Text book of Soil science—R.K.Mehra



**B.Sc. I OE CHEMISTRY (NEP-2.0)**

**To be implemented from June 2024 onwards Semester I & II**

**Nature of Practical Exam**

**OE Practical Paper-I/II (50 Marks)**

**Number of Days: 01**

**First Session:**

Section-I

Q.1 Experiment-I - 20 Marks

**Second Session:**

Section-II

Q.2 Experiment-II - 20 Marks

Q.3 Journal- 10 Marks