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

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

Ref.No.SU/BOS/Science/452 **Date: 25/07/2025**

To,

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

Subject: Regarding Structure and syllabus of **B.Sc. Part I** under the Faculty of Science and Technology as per **Apprenticeship Embedded Degree Programme (AEDP).**

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 structure and syllabi, Nature of Question paper of **B.Sc. Part I** under the Faculty of Science & Technology as per **Apprenticeship Embedded Degree Programme (AEDP).**

B.Sc. Part-I (Sem. I & II) as per AEDP			
1.	Physics	2.	Chemistry

This Structure and Syllabus shall be implemented from the academic year 2025- 2026 onwards. A soft copy containing structure and syllabus is attached herewith and it is also available on university website **www.unishivaji.ac.in>Syllabus>Syllabus As per NEP2020.** This programme is introduce subject to approval of university authority for converted.

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

Thanking you,

Yours faithfully,

Dr. S. M. Kubal
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.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

Apprenticeship Embedded Degree Programme

(AEDP)

in

Chemistry

B. Sc. Part-I

(NEP-2.0)

To be implemented from

June, 2025 onwards

SHIVAJI UNIVERSITY, KOLHAPUR
Revised Syllabus for the Bachelor of Science in Chemistry
Apprenticeship Embedded Degree Programme (AEDP)

(As per NEP- 2.0)
Applicable from the Academic Year 2025 –26

1. **Title**: B. Sc. I Chemistry Apprenticeship Embedded Degree Programme (AEDP), Shivaji University, Kolhapur Revised Syllabus as per NEP – 2.0
2. **Faculty**: Faculty of Science and Technology.
3. **Year of Implementation**: From June 2025
4. **Objectives of a Bachelor of Science (B.Sc.) in Chemistry Program include**:
    - Understand the fundamental principles, laws, concepts and formulas of Chemistry.
    - Develop problem-solving skills of students.
    - Enhance employability and bridge the gap between education and industry needs
    - Gain practical experience by hands-on experience with instruments and develop laboratory skills.
    - Students benefit from practical, hands-on experience alongside their academic studies, leading to increased job readiness and a smoother transition into the workforce
    - Learn about advanced Chemistry and its applications for higher studies.
    - Learn to apply conceptual knowledge to practical work.
    - Learn to interpret chemical and physical phenomena through experimental evidence.
    - Learn to analyze and interpret data accurately through scientific reasoning and experimental hypothesis testing.
5. **Program Outcomes:**

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

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

    PO-3:- AEDP in Chemistry focus on developing specific, measurable skills and proficiencies that are highly valued by employers.

PO-4:- The integration of theoretical and practical training provides a well-rounded education, preparing students for the complexities of the modern workplace.

PO-5:- It can offer strong pathways to employment after graduation.

PO-6:- Students gain valuable experience in real-world work environments, applying theoretical knowledge in practical settings.

6. **Program Specific Outcomes:**

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

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

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

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

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

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

7. The B. Sc. I Course (Chemistry) AEDP (Level 4.5) will be of **Two Semesters (Sem. I and Sem II)**.
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 I AEDP (Level 4.5)**:

i. The students passing the Higher Secondary School Certificate Examination with Science stream or Vocational subjects with science stream conducted by the Maharashtra State Board of Higher Secondary Education shall be allowed to enter upon the B. Sc. Part-I (or Undergraduate Certificate in Science).

OR

ii. An Examination of any other Statutory Board or an examining Body recognized as equivalent thereto.

OR

iii. Completed 2nd year of the 3-year diploma after 10th.

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. I Chemistry AEDP 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 20 marks will be done before the semester examination during each semester.

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

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

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

	Semester End Exam	Internal Assessment	Course Exam (Total)
Maximum Marks	30	20	50
Minimum Marks required for passing	11	7	18

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

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

15. Nature of Question paper and scheme of marking:

Theory question paper: Maximum marks -30

Total No. of questions – 3

All questions are compulsory. Question No.1 is MCQ type (6 Marks). Question number 2 is long answer type question Carries 12 marks. Question number 3 is short answer type question carries 12 marks. (Nature of question paper is provided at the end of syllabus.)

SHIVAJIUNIVERSITY,KOLHAPUR

NEP-2020: Credit Framework for UG (B.Sc.) Apprenticeship Embedded Degree Programme (AEDP)

SEM (Level)	COURSES			OE	VSC/SEC	AEC/VEC/IKS	CEP/CC/AEDP	Total Credits	Degree/Cum. Cr MEME
	Course-1	Course-2	Course-3						
SEMI (4.5)	DSC-I(2) DSC-II(2) DSC P-I(2)	DSC-I(2) DSC-II(2) DSC P-I(2)	DSC-I(2) DSC-II(2) DSC P-I(2)	OE-1(2) (T/P)	--	IKS-I(2)	--	22	UG Certificate 44
SEMII (4.5)	DSC-III(2) DSC-IV(2) DSCP-II(2)	DSC-III(2) DSC-IV(2) DSC P-II(2)	DSC-III(2) DSC-IV(2) DSC P-II(2)	OE-2(2) (T/P)	--	VEC-I(2) (Democracy, Election and Constitution)	--	22	
Credits	8(T)+4(P)=12	8(T)+4(P)=12	8(T)+4(P)=12	2+2=4 (T/P)	--	2+2=4	--	44	Exit Option:4 credits NSQF/Internship/ Skill courses
	MAJOR		MINOR						
SEMIII (5.0)	Major V(2) Major VI(2) Major P III (2)	--	Minor V(2) Minor VI(2) Minor P III(2)	OE-3(2) (T/P)	VSC I (2) (P) (Major specific) SEC I(2) (T/P)	AEC I(2) (English)	CC-I (2)	22	UG Diploma 88
SEMIV (5.0)	Major VII(2) Major VIII (2) Major P IV (2)	--	Minor VII(2) Minor VIII (2) Minor P IV (2)	OE-4(2) (T/P)	SEC-II(2) (T/P)	AEC-II(2) (English) VEC-II(2) (Environmental studies)	CEP-I(2)	22	
Credits	8(T)+4(P)=12		8(T)+4(P)=12	2+2=4(T/P)	4(T/P)+2(P)=6	2+4=6	2+2=4	44	Exit Option:4 credits NSQF/Internship/ Skill courses
SEMV (5.5)	Major IX(2) Major X (2) Major P V (2)	Major I (ELEC)(2) Major P-I (ELEC) (2)	--	OE-5(2) (T/P)	VSC II (4) (Major specific)(P)	AEC III(4) (English) IKS II (Major specific) (2)	--	22	UG Degree 132
SEMVI (5.5)	--	--	--	--	SEC III(2) (T/P)	--	Apprenticeship Training (20)	22	
Credits	4(T)+2(P)=6	2(T)+2(P)=4	-	2(T/P)	2(T/P)+4(P)=6	4+2=6	20	44	
Total Credits	30+16=46		24	10	12	16	24	132	

Shivaji University, Kolhapur
Bachelor of Science Apprenticeship Embedded Degree Programme (AEDP)
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)									
	Credits	**4(T)+2(P) =6**	**4(T)+2(P) =6**	**4(T)+2(P) =6**	**2 (P) =2**	**--**	**--**	**--**	**2(T)**	**--**	**--**	**--**	**22**
	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)									
	Credits	**4(T)+2(P)=6**	**4(T)+2(P) =6**	**4(T)+2(P) =6**	**2 (P)=2**	**--**	**--**	**2(T)**	**--**	**--**	**--**	**--**	**22**
Total Credits		**12**	**12**	**12**	**4**	**--**	**--**	**2**	**2**	**--**	**--**	**--**	**44**
		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 Chemistry AEDP

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)

B. Sc. I AEDP (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) Hunds 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^{th}, 14^{th} and 15^{th} elements with special reference to electronic configuration and periodic properties.

2.3 Compounds of group13^{th}, 14^{th} and 15^{th} elements.

2.3.1 Boron – Diborane (only structure).

2.3.2 Allotropes of Carbon and Phosphorus.

2.3.3 Oxyacids of Nitrogen (HNO_2, HNO_3).

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 walls 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 AEDP (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 $KMnO_4$ 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 $K_2Cr_2O_7$ solution by using internal indicator
3) To estimate amount of Cu (II) ions by iodometric titration by using $Na_2S_2O_3$ solution.
4) To standardize supplied EDTA solution by titrating with 0.01 M $ZnSO_4$ 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 (Na_2CO_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) $Ni^{2+} + Cu^{2+}$ b) $Ni^{2+} + Co^{2+}$ c) $Cu^{2+} + Co^{2+}$

8) Spot Test : Identify the following metal ions by spot test method

Cu^{2+}, Ni^{2+}, Co^{2+}, Fe^{3+}, Al^{3+}, Pb^{2+}, Zn^{2+}, Hg^{+2}, Mg^{+2}, 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 AEDP (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 4th Ed. Narosa (2004).

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

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

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

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

7) Principles of physical Chemistry Marron and Prutton. (2007).

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

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

10) Physical Chemistry Danials and Alberty (2016)

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

12) Principles of Physical Chemistry, Puri, Sharma and Pathania 47th Edison,

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 AEDP Semester II, Paper IV

ACH-202- Analytical Chemistry

(Theory Credits:02, Lectures-30 hours)

Expected learning Outcomes:

Name of the topic	Expected Course Outcome
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 Rf 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, Rf 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. $KMnO_4$ Vs Oxalic acid titration; theory of $KMnO_4$ 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 AEDP 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 AEDP Syllabus (NEP-2.0)

To be implemented from June 2025 onwards Semester I & II

Nature of Question paper

Total Marks 30

Q.1 Choose the correct alternative and rewrite the sentence again. 6 Marks

a)

b)

c)

d)

e)

f)

Q.2. Attempt any TWO of the following (Out of Three) 12 Marks

a)

b)

c)

Q.3. Answer any Three of the following (Out of Five) 12 Marks

a)

b)

c)

d)

e)

f)

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

To be implemented from June 2025 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