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

SU/BOS/Science & Technology / 158 **Date:11/03/2024**

To,

The Principal,
All affiliated colleges,
Shivaji University, Kolhapur.

Subject: Regarding minor changes in the syllabi of B.Sc.Part-I Chemistry as Per NEP-2020 under the Faculty of Science & Technology.

Sir/Madam,

With reference to the subject mentioned here above, I am directed to inform you that the university authorities have accepted and granted approval to the minor changes in the syllabi of B.Sc.Part-I Chemistry under the Faculty of Science & Technology.

This minor change in said Syllabus of will be implemented from the academic year 2024-25.

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

Thanking you,

Yours faithfully,

Dy. Registrar
Dr. S.M.Kubal

Copy to :-

1	The Dean, Faculty of Science & Technology	8	Appointment Section
2	The Chairman, Respective, BOS	9	Centre for Distance Education
3	Exam Section	10	Computer Centre
4	Eligibility Section	11	Affiliation Section (U.G.)
5	O.E. I Section	12	Affiliation Section (P.G.)
6	O.E. II Section	13	P.G.Admission Section
7	O.E. III Section	14	P.G.Seminar Section

Shivaji University

Kolhapur

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

Syllabus for Bachelor of Science

Part-I

Chemistry

(Major)

(NEP-2.0)

To be implemented from

June, 2024 onwards

First-Year Structure (B. Sc. I-Chemistry)

Level	Sem.	1 Major		2 Minor	3 IDC/MDC/OE/GE	4 SEC	5 AEC, VEC, IKS			6 OJT, FP, CEP, CC, RP			Total Credits
		DSC	DSE	Minor	OE	SEC	AEC	VEC	IKS	CC	FP/OJT	RP/Dissert.	
4.5	I	ICH-101 Paper-I Inorganic Chemistry (2 Cr)	---	MCH-101 Paper-I Inorganic Chemistry (2 Cr)	CHOE-101 Paper-I Chemistry in Daily Life (2 Cr)	CHSEC-101 Paper-I Good Laboratory Practices and Methods (2 Cr)	--	--	IKS-I (2 Cr)	--	--	--	--
		OCH-102 Paper-II Organic Chemistry (2 Cr)		MCH-102 Paper-II Organic Chemistry (2 Cr)	CHOE-102 Paper- II Molecules of Life (2 Cr)	CHSECPR-102 Practical Paper-I (2 Cr)							
		PRCH-103 Practical Paper-I (2 Cr)		MPRCH-103 Practical Paper-I (2 Cr)									
	Credits	**4(T)+2(P) =6**	**--**	**4(T)+2(P) =6**	**4 (T) =4**	**2(T)+2(P) =4**	**--**	**--**	**2(T)**	**--**	**--**	**--**	**22**
	II	PCH-101 Paper-III Physical Chemistry (2 Cr)	--	MCH-101 Paper-III Physical Chemistry (2 Cr)	CHOE-201 Paper-III Chemistry of Soil and Water (2 Cr)	CHSEC-201 Paper-II Basic Analytical and Industrial Skills (2 Cr)	--	VEC-I (2 Cr) Demo-cracy	--	--	--	--	--
		OCH-102 Paper-IV Analytical Chemistry (2 Cr)		MCH-102 Paper-IV Analytical Chemistry (2 Cr)	CHOE-202 Paper-IV Material and Industrial Chemistry (2 Cr)	CHSECPR-202 Practical Paper-II (2 Cr)							
		PRCH-103 Practical Paper-II (2 Cr)		MPRCH-103 Practical Paper-II (2 Cr)									
	Credits	**4(T)+2(P) =6**		**4(T)+2(P) =6**	**4(T) =4**	**2(T)+2(P) =4**	**--**	**2(T)**	**--**	**--**	**--**	**--**	**22**
Total Credits		**12**		**12**	**8**	**8**	**--**	**2**	**2**	**--**	**--**	**--**	**44**
Exit Option: Award of UG Certificate in Major with 44 Credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor													

Structure of B. Sc. I Chemistry
(Major)

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 (NEP-2.0) Semester I, PAPER-I

ICH-101- Inorganic Chemistry

(Theory Credits-02, 30 hours)

Name of the topic	Expected learning 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 (NEP-2.0) SEMESTER-I, PAPER-II

0CH-102- Organic Chemistry

(Theory Credits: 02, 30 hours)

Name of the topic	Expected learning 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 (NEP-2.0) Semester II, Paper -III

PCH-201-Physical Chemistry

Credits: 02, 30 hours

Name of the Topic	Expected Learning Outcome
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 Semester II, Paper IV

ACH-202- Analytical Chemistry

(Theory Credits:02, Lectures-30 hours)

Expected learning Outcomes:

Name of the topic	Expected Learning 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 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)

Section-I- Inorganic (25 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Journal- 05 Marks

Section-II Organic (25 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Journal- 05 Marks

Semester-II Practical Paper-II (50 Marks)

Section-I- Physical (25 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Journal- 05 Marks

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

(Minor)

(NEP-2.0)

To be implemented from

June, 2024 onwards

First- First-Year Structure (B. Sc. I-Chemistry)

Level	Sem.	1 Major		2 Minor	3 IDC/MDC/OE/GE	4 SEC	5 AEC, VEC, IKS			6 OJT, FP, CEP, CC, RP			Total Credits
		DSC	DSE	Minor	OE	SEC	AEC	VEC	IKS	CC	FP/OJT	RP/Dissert.	
4.5	I	ICH-101 Paper-I Inorganic Chemistry (2 Cr)	---	MCH-101 Paper-I Inorganic Chemistry (2 Cr)	CHOE-101 Paper-I Chemistry in Daily Life (2 Cr)	CHSEC-101 Paper-I Good Laboratory Practices and Methods (2 Cr)	--	--	IKS-I (2 Cr)	--	--	--	--
		OCH-102 Paper-II Organic Chemistry (2 Cr)		MCH-102 Paper-II Organic Chemistry (2 Cr)	CHOE-102 Paper- II Molecules of Life (2 Cr)	CHSECPR-102 Practical Paper-I (2 Cr)							
		PRCH-103 Practical Paper-I (2 Cr)		MPRCH-103 Practical Paper-I (2 Cr)									
	Credits	**4(T)+2(P) =6**	**--**	**4(T)+2(P) =6**	**4 (T) =4**	**2(T)+2(P) =4**	**--**	**--**	**2(T)**	**--**	**--**	**--**	**22**
	II	PCH-101 Paper-III Physical Chemistry (2 Cr)	--	MCH-101 Paper-III Physical Chemistry (2 Cr)	CHOE-201 Paper-III Chemistry of Soil and Water (2 Cr)	CHSEC-201 Paper-II Basic Analytical and Industrial Skills (2 Cr)	--	VEC-I (2 Cr) Demo-cracy	--	--	--	--	--
		OCH-102 Paper-IV Analytical Chemistry (2 Cr)		MCH-102 Paper-IV Analytical Chemistry (2 Cr)	CHOE-202 Paper-IV Material and Industrial Chemistry (2 Cr)	CHSECPR-202 Practical Paper-II (2 Cr)							
		PRCH-103 Practical Paper-II (2 Cr)		MPRCH-103 Practical Paper-II (2 Cr)									
	Credits	**4(T)+2(P) =6**		**4(T)+2(P) =6**	**4(T) =4**	**2(T)+2(P) =4**	**--**	**2(T)**	**--**	**--**	**--**	**--**	**22**
Total Credits		**12**		**12**	**8**	**8**	**--**	**2**	**2**	**--**	**--**	**--**	**44**
Exit Option: Award of UG Certificate in Major with 44 Credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor													

Structure of B. Sc. I Chemistry
(Minor)

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

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

MCH-101- Inorganic Chemistry

(Theory Credits-02, 30 hours)

Name of the topic	Expected learning 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)

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) (09)

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 (07)

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 (04)

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

MCH-102- Organic Chemistry(Theory Credits: 02,

30 hours)

Name of the topic	Expected learning 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: Fundamentals of 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 Dihydroxybutanoic 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
MPRCH-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 (NEP-2.0) Semester II, Paper -III

MCH-201- Physical Chemistry

Credits: 02, 30 hours

Name of the Topic	Expected Learning Outcome
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)

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

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

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

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

2.4 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)

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

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

4.4 Viscosity and its determination using Ostwald's viscometer.

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

4.6 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 Semester II, Paper IV

MCH-202- Analytical Chemistry

(Theory Credits:02, Lectures-30 hours)

Expected learning Outcomes:

Name of the topic	Expected Learning 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 Semester II Practical Course
MPRCH-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 & II

Nature of Practical Exam

Semester-I Practical Paper-I (50 Marks)

Section-I- Inorganic (25 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Journal- 05 Marks

Section-II Organic (25 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Journal- 05 Marks

Semester-II Practical Paper-II (50 Marks)

Section-I- Physical (25 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Journal- 05 Marks

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

(SKILL ENHANCEMENT COURSE)

(NEP-2.0)

To be implemented from June 2024 onwards

SKILL ENHANCEMENT COURSES

B. Sc. I, Semester I, Paper-I		
CHSEC-101	**Good Laboratory Practices and Methods**	**Credits:** 2 **Hours:** 30

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

CO1 Outline and understand the principles of GLP and safety in laboratory.
CO2 Interpret the safety data sheets to categorize chemicals according to their hazards.
CO3 Classify, illustrate and implement the methods to manage hazards, Compare and integrate the methods to handle chemical waste
CO4 Apprise the safety measures and apply to chemical waste management.
CO5 Identify, modify and construct a plan for safe laboratory operations (SOP) and laboratory waste management.
CO6 Identify suitable methods, handle balances and choose appropriate glasswares.

Unit	Content	No. of hours
I	**Principles, Ethics and Practices** Introduction to Good Laboratory Practices (GLP): History, Scope, fundamental Points of GLP **Laboratory Safety:** Four Principles of safety-RAMP, The Student Safety, Ethics, Safety rules, Role as a Student, Critical analysis of Lab incidents (include reactions), Standard Operating Procedures (SOP) in the laboratory.	**6**
II	**Laboratory Hazards:** Understanding: Hazard recognition through understanding labels, signs, symbols, terms, and other sources of information, Potential pathways of exposure and blocking these pathways to prevent exposure, Safe handling and interpreting the material safety data sheet (MSDS), overview of GHS Safety Data Sheets and GHS labelling. **Different Types of Hazards:** **Chemical Hazards**: corrosive acids, bases, gases, oxidizers, flammables, fire triangle, water reactive compounds, pyrophoric chemicals and reactions, peroxides, cryogens. **Radiation Hazards**: ionizing, nonionizing radiations and electric and magnetic field. **Biological Hazards:** and Biosafety - hazards of biological agents and some general approaches to prevent exposures. **Introduction to Toxicology**: Basic principles of toxicology, Factors	**12**

	Influence Toxicity, Acute and Chronic Toxicity, Mercury toxicity, Carcinogens, Mutagens. **Responses**: Chemical spills (acids, bases and other chemicals) and fire, classes of fires and types of fire extinguishers. First aid in chemical lab, emergency safety equipment.	
III	**Handling chemicals and Minimizing hazards in the laboratory** Introduction to handling hazardous chemical waste, storing flammable and corrosive liquids, maintaining a safe and secure laboratory, managing chemicals in the laboratory. Safety measures for common laboratory operations: Managing risk-decision about safety, eye and face, skin protection- clothes, gloves and tools, chemical hoods, contamination and ventilation, safety measures for common laboratory operations, radiation, laser and biological safety cabinet	**8**
IV	**Development of Analytical Skills:** Choice of suitable heating and cooling methods. Choice of suitable concentrations. Safe use of vacuum lines and gas cylinders Safehandling of cryogenic liquids and solids. Correct use and care of balances. Choice of appropriate glassware, including required precision, use of pipettes, burettes,	**4**

B. Sc. I, Semester I Practical Course		
CHSECPR-102	**Practical Paper-I**	**Credits:** 2 **Hours:** 60

Practicals:

a) **Chemical and Lab Safety**

1. Safety symbol on labels of pack of chemicals and its meaning.
2. Precautions in handling of hazardous substances like Conc. acids, ammonia, organicsolvents, etc.
3. Toxicity of the compounds used in chemistry laboratory and classification of toxicity.
4. MSDS sheets, points in MSDS Find out MSDS sheets of at least hazardous chemicals ($K_2Cr_2O_7$, Benzene, cadmium nitrate, sodium metal, etc.)
5. Prepare charts for Laboratory safety Rules.
6. Prepare SOP for laboratory.

b) Demonstrative Experiment:

Use of Fire Extinguisher.

c) Skill enhancement practicals:

- Determination of pH of soil.
- Determination of electrical conductivity of soil.
- Determination of pH of water.
- Determination of electrical conductivity of water.

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, DigantaBhusan Das, Springer.
4. Production-Integrated Environmental Protection and Waste Management in the Chemical Industry, Claus Christ, WILEY-VCH.
5. Fundamentals of Industrial Safety and Health Dr. K.U. Mistry, Siddharth Prakashan.
6. VOGELS QUALITATIVE INORGANIC ANALYSIS, 7TH EDN by G. Svehla and B. Shivshankar
7. Hazardous waste management rules-2016, 1st editon, Ministry of environment, forest & climate change, govt. of India
8. Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition by J Mendham

B. Sc. I, Semester II, Paper- II		
CHSEC-201	**THEORY- Basic Analytical and Industrial Skills**	**Credits:** 2 **Hours:** 30

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

CO1 Outline and understand the principles of chemical analysis
CO2 Gain knowledge of Glasswares and apparatus used in laboratory
CO3 Classify, illustrate and implement the methods to separate the chemical mixtures
CO4 Prepare the essential chemicals and standardize the same
CO5 acquire the basic technical knowledge and skills to become chemist

Unit	Content	No. of hours
I	**Introduction to Chemical Analysis** Applications, sampling, types of analysis, different techniques including instrumental methods, Factors affecting the choice of analytical methods, Interferences, data acquisition and treatment	**4**
II	**Common Glasswares and Apparatus** Graduated Glasswares, Calibration of Volumetric apparatus, Water for laboratory use- Purified water, distilled water, General apparatus used in laboratory such as metal apparatus, heating apparatus, desiccators, stirring apparatus, Melting point apparatus, weighing bottles, filtration apparatus	**4**
III	**Analytical Methods:** Qualitative and Quantitative analysis, Gravimetric and volumetric analysis **Methods used for separation in chemistry:** filtration, centrifugation, decantation, precipitation, dialysis, separating funnel, distillation, and chromatography. Purification and recrystallisation of compounds	**6**

IV	**Preparation and standardization of laboratory solutions** Basic concept of preparation of solution, preparation of ppm, molar, normal, volume percent, and mass/volume solutions, dilution of solutions, methods for solution filtration, preparation and storage of standard solutions, preparation of simple inorganic salt solutions, preparation of acid and base solutions, recipes for biological, histological and chemical solutions. Preparation of indicators (Starch, methyl orange, phenolphthalein, eriochrome black T), preparation of buffers (pH10 and 4). Preparation of chromic acid, preparation of Fehling solutions. Primary and Secondary standards, Indicators, standardization of acid and base solutions.	**10**
V	**Industrial Skills** Introduction to various chemical industries, requirements to become an industrial chemist, **Skills-** technical knowledge, mathematics, communication, Problem-solving, Analytical, Critical thinking, Teamwork, Interpersonal, Leadership, legal and regulatory knowledge, Multitasking, Laboratory safety knowledge, and Interprofessional skills. Personal Protective Equipment (PPE).	**6**

B. Sc. I, Semester II, Practical Course		
CHSECPR-202	**Practical Paper-II**	**Credits:** 2 **Hours:** 60

A] Practicals:

1. Calibration of Volumetric apparatus.
2. Preparation and standardization of HCl/HNO_3 solution. (Molar and Normal).
3. Preparation and standardization of H_2SO_4 solution. (Molar and Normal)
4. Preparation and standardization of NaOH/KOH solution.
5. Preparation of KHP and its use as primary standard.
6. Preparation and Standardization of $KMnO_4$ solution.
7. Separation two miscible solvents by distillation.
8. Preparation and standardization of sodium thiosulphate solution.
9. Separation of immiscible solvent by separating funnel.
10. Suitable practical for problem solving methodology. (e. g. extraction of medicinal plants)

B) Industrial/Laboratory Visit is compulsory. The report of the visit should be assessed at the time of Practical Examination.

References:

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

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

onwardsSemester I & II

Nature of Practical Exam

Semester-I Practical Paper-I (50 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Experiment- 20 Marks

Q. 3 Journal- 10 Marks

Semester-II Practical Paper-II (50 Marks)

Q. 1 Experiment- 20 Marks

Q. 2 Experiment- 20 Marks

Q. 3 Journal- 05 Marks

Q.4 Tour Report- 05 Marks

Shivaji University

Kolhapur

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

Syllabus for Bachelor of Science Part-I

Chemistry

(OPEN ELECTIVE)

(NEP-2.0)

To be implemented from

June, 2024 onwards

Structure of B. Sc. I Chemistry
(OPEN ELECTIVE)

Sr. No.	Semester	Title of Paper
1	I	CHOE-101 Paper-I, CHEMISTRY IN DAILY LIFE (2 credits, 30 Hours)
2		CHOE-102 Paper -II, MOLECULES OF LIFE (2 credits, 30 Hours)
4	II	CHOE-201 Paper -III, CHEMISTRY OF SOIL AND WATER (2 credits, 30 Hours)
5		CHOE-202 Paper -IV, MATERIAL AND INDUSTRIAL CHEMISTRY (2 credits, 30 Hours)

OPEN ELECTIVE COURSE

B. Sc. I, Semester I, Paper-I		
CHOE-101	**Chemistry in Daily Life**	**Credits:** 2 **Hours:** 30

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

CO1 Understand basic composition of dairy products
CO2 Gain knowledge of additives, adulteration and contamination in food
CO3 Understand composition of household chemicals and toxicity
CO4 Understand composition and cleaning action of soaps and detergents
CO5 Gain knowledge of polymers and its application in daily life

Unit	Content	No. of hours
I	**Dairy products:** composition of milk and milk product, analysis of fat content, minerals in milk and butter, estimation of added water in milk, Beverages: analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages.	**07**
II	**Food additives, adulterants, and contaminants**- Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate. **Artificial food colorants:** Coal tar dyes and non-permitted colors and metallic salts. Analysis of pesticide residues in food.	**09**
III	**Household chemicals:** Common chemicals used at home. **Tooth paste** – Contents of toothpaste, chemical name, ingredients, flavor and its role. **Cosmetics** – Contents and uses of Face powder, snow, lipsticks and perfumes. Toxic household chemicals and their effects (antifreeze, bleach, drain cleaners, carpet cleaners, ammonia, air fresheners). **Soaps and detergents**- Types of soaps, synthetic detergents (neutral, anionic and cationic), cleansing action of detergents. Advantages and disadvantages of detergents over soaps.	**08**

IV	**Polymers:** Basic concept of polymers, classification and characteristics of polymers. Applications of polymers as plastics in electronic, automobile components, medical fields, and aerospace materials. Problems of plastic waste management. Strategies for the development of environment-friendly polymers.	**06**

References Text Books

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry- Ashutosh Kar.
3. Analysis of Foods – H.E. Cox: 13.
4. Chemical Analysis of Foods – H.E. Cox and Pearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4thed. New Age International (1998)
6. Physical Chemistry – P l Atkins and J. de Paula – 7thEd. 2002, Oxford University Press.
5. Chemistry in Daily Life: Third Edition Paperback – 1 January 2012 by Singh K.

B. Sc. I, Semester I Paper-II		
CHOE-102	**Molecules of Life**	**Credits:** 2 **Hours:** 30

Course Outcomes:

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

CO1 Understand classifications of carbohydrates and importance
CO2 Gain knowledge of classification of proteins
CO3 Understand components and structure of nucleic acids
CO4 Understand Classification and biological significance of vitamins and hormones
CO5 Gain knowledge of oils and fats, its composition

Unit	**Content**	**No. of hours**
I	**Carbohydrates** Sugars, non-sugars, reducing and non-reducing sugars. Occurrence and general properties of glucose and fructose. Open chain and Haworth ring structures of glucose and fructose. Epimers, mutarotation and anomers. Disaccaharides: Occurance of disaacharides (Sucrose, Maltose and Lactose). Glycosidic linkage in disaccharides. Ring	**8**

	structures of sucrose, maltose and lactose. Polysaccharides: Starch – monomer units, glycosidic linkage, components-difference in their structure (explanation only) and solubility in water. Cellulose and glycogen– monosaccharide, glycosidic linkage, structure (explanation only). Biological importance of carbohydrates.	
II	**Amino Acids, Peptides and Proteins** α- amino acids , general formula, zwitter ion form of α- amino acid, general formula. Isoelectric point and its importance. Classification of amino acids as essential and nonessential-examples. Configuration of optically active α-amino acids (found in proteins). Peptide bond. Proteins: classification based molecular shape –fibrous and globular, examples. Structure of protein – qualitative idea about primary, secondary, tertiary, and quaternary structures (diagrams not required). Denaturation of protein.	**6**
III	**Nucleic Acids** Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.	**6**
IV	**Vitamins and Hormones** Classification and biological significance, source and structure of Vitamin A, B1(thiamine), B2(riboflavin), B6(pyridoxine), a-tocopherol, K1 (phylloquinone), C(ascorbic acid). Deficiency diseases of vitamins, **Hormones:** definition, classification with examples, functions and deficiency diseases of hormones.	**5**
V	**Oils and fats** Biological Importance of oils and fats. Fatty acids (saturated, unsaturated fatty acids, formation of triglycerides and general formula of triglycerides. Chemical nature of oils and fats-saponification, acid hydrolysis, rancidity and its prevention methods, refining of oils, hydrogenation of oils, drying of oils. Iodine value. Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).	**5**

Reference Books:

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

2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed.,
4. W. H. Freeman. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, 2002.

B. Sc. I, Semester II, Paper- III		
CHOE-201	**CHEMISTRY OF SOIL AND WATER**	**Credits:** 2 **Hours:** 30

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

CO1 Understand nature of soil and physical properties
CO2 Gain knowledge of soil fertility
CO3 Understand soil erosion
CO4 Understand chemistry of water

Unit	Content	No. of hours
I	**Soil Analysis:** Introduction, Origin and nature of soils. Types of soil, Soil components- Mineral component, organic matter or humus, soil atmosphere, soil water, soil microorganism. Physical properties of soil; soil colour. texture, structure, pore size, bulk density, water holding capacity. Soil types and their distribution. soil temperature, soil density, porosity of soil. Chemical properties of soil - Soil reactions, importance of soil reaction, factors controlling soil reactions	**5**
	Soil chemistry and fertility Soil colloids, cation exchange, organic carbon, Carbon - Nitrogen ratio, soil fertility. Soil reaction: acidity, alkalinity, conductivity, redox - potential.	**5**
	Soil erosion Definition, Control of erosion, Soil conservation practices, Soil pollution causes and remedies. Soil pollutants, role of soil testing, Collection of soil sample for testing, determination of soil parameters viz., pH, EC, Organic carbon, NPK, soil testing for micronutrients, Gypsum requirement of soil, Lime requirement of soil, Uses of soil analysis	**5**

	Chemistry of water The water molecule, properties of pure water, fresh water and sea water. Composition of waters: surface water, ground water and sea water. Dissolved gasses: Factors affecting natural waters. Acid, base, salts: Hydrogen ions, modern concept of pH and buffer. water quality parameters viz., pH, electrical conductivity, chlorides, sulphates, calcium, magnesium, sodium, potassium, Water quality indices and suitability.	**5**
V	**Water pollution and Purification** Definition of water pollution, types of water pollutants, sources of water pollutants, trace elements in water, water quality parameters and standards **Purification of water-**Drinking water, Treatment of domestic and industrial water.	**10**

References:

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
6. Mark M. Benjamin, 2015, Water chemistry, Waveland Press, second edition
7. Water Chemistry,Vernon L. Snoeyink and David Jenkins, John Wiley & Sons, 1980.

B. Sc. I, Semester II, Paper-IV		
CHOE-202	**Material and Industrial Chemistry**	**Credits:** 2 **Hours: 3**0

Course Outcomes:

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

CO1 Gain knowledge of refractories, Glass and Cements
CO2 Understand composition of petroleum products
CO3 Learn nanochemistry
CO4 Understand characteristics of fuels

Unit	**Content**	**No. of hours**
I	**Industrial materials:** Refractories: Properties, classification, determination of PCE values. Abrasives: Classification and application. Glass: Composition, raw materials, varities of glass-borosilicates, optical and safety glass-composition and uses. Cement: Raw materials, setting of cement.	**7**

II	**Petroleum and petrochemicals:** Origin of petroleum, composition, octane number, petrol, diesel, kerosene, naphtha, lubricants, LPG, synthetic petrol, petrochemicals.	**5**
III	**Nanomaterials:** Definition, nano domain, properties of nanomaterial Applications of nanomaterials (i) Medicine-Gold sol (ii) Photo Voltaic cell (in solar cells) (iii) Self-cleaning glasses-ZnO, SnO, TiO (iv) Antibacterial materials-AgO (v) Catalytic material (vi) Super capacitors	**8**
IV	**Fuels:** Characteristics, Calorific value, coal varities, reserves, coke, gaseous fuels, biofuels.	**6**
V	**Explosives and propellants:** Explosives- Classification and applications Propellants- Characteristics, classification and application.	**4**

Recommended books:

1. E. Stocchi: Industrial Chemistry, Vol 1, Ellis Horwood Ltd. UK Sharma B.K & Gaur H, Industrial Chemistry, Goel Publishing House, Meerut (1996)

2. Industrial Chemistry—B. K. Sharma

B.Sc. I Syllabus (NEP-2.0) Open Elective

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)

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f)

g)

h)

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

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b)

c)

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

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b)

c)

d)

e)

f)