Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

Syllabus

(2022-2023)

Under CBCS

Three Year Degree Programme in Chemistry

(Six Semester Course)

Name of Department

Chemistry

Name of Course

Core Courses

B. Sc. First Year

Semester I & II

Syllabus Approved by the Board of Studies in Chemistry
With Effect from June, 2022

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
BoS in Chemistry

1. Introduction:

The syllabus of B.Sc. Chemistry is prepared to give sound knowledge and understanding of Chemistry to undergraduate students of the B.Sc. Degree course. The goal of the syllabus is to make the study of Chemistry as stimulating, interesting and relevant as possible. The syllabus is prepared by keeping in mind the aim to make the students capable of studying Chemistry in academic and industrial courses. Also, to expose the students to Chemistry and to built up their interest in various fields of Chemistry. The new and updated syllabus is based on disciplinary approach with vigor and depth, taking care that the syllabus is not heavy not the same time it is comparable to the syllabi of other Universities at the same level. The syllabus is prepared after discussions with number of faculty members of the subject and by considering the syllabi of NET, SET, GATE examinations, UGC model curriculum, syllabi of different entrance examinations and syllabi of other Universities.

2. Title of the Programme: B.Sc. Chemistry

3. Learning Objectives of the Programme:

The programme aims to:

- Instill a sense of enthusiasm for learning in students which may lead to continuing professional development or pathways for lifelong learning.
- Produce graduates equipped with the skills to play an enhanced role in the Chemical Sciences nationally.
- Educate students in the theoretical (subject specific knowledge) and practical (laboratory based) aspects of the chemical sciences which relate to current and future employment needs.
- Provide students with the skills to adapt and respond positively to new developments in the workplace.
- Develop the critical, analytical, problem based learning skills required by the students in the workplace.
- Develop student's competences in a broad range of areas relevant to their current and future employment. Enhance and develop the student's interpersonal skills.

4. Programme Specific outcomes/ Programme Outcomes:

The purpose of the three year B.Sc. Chemistry programme is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of chemistry.

B.Sc. Chemistry outcome:

The three year graduate programme provides students with specialized knowledge and professional skills to prepare them for a career.

Upon successful completion, of three year master programme in Chemistry:

1. Students should have firm foundations in the fundamentals and application of current chemical and scientific theories.

2. Students should be able to integrate their knowledge from each of these areas with critical thinking skills in order to become problem solvers.

3. Students should be proficient in the Chemistry laboratory, especially with respect to the abilities to

- Follow and understand general laboratory practice guidelines, including safety.
- Perform qualitative chemical analyses.
- Perform chemical synthesis.
- Understand and use modern chemical instrumentation.

4. They are able to interpret and analyze quantitative data.
5. Young aspirants pursuing graduation will know the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals.
6. Students will gain employment in industry or government, be accepted at graduate or professional schools or find employment in school systems as instructors or administrators.

5. Advantages of Course:

The B.Sc. course in Chemistry is useful for the students in various aspects and offers them with bright career. The course helps the students in improving their diverse skills in various areas such as laboratory skills, numerical and computing skills, ability to solve the problems both analytically and logically, time management skills, etc.

The B.Sc. Chemistry graduates have many options for their higher studies. Majority of these graduates opt for master's degree in the same. But they can also choose various specialized areas in this field for the post graduation courses.

Some of the higher study options after B.Sc. Chemistry are:

- M.Sc. Organic Chemistry

- M.Sc. Physical Chemistry
- M.Sc. Inorganic Chemistry
- M.Sc. Analytical Chemistry
- M.Sc. Biochemistry
- M.Sc. Biotechnology
- M.Sc. Forensic Science

6.	**Duration of the Course**	**:**	Three year
7.	**Eligibility of the Course**	:	10+2
8.	**Strength of the Students**	:	As per the University/College rules
9.	**Fees for Course**	:	As per University/College rules
10.	**Admission / Selection procedure**	:	Admission by merit through Registration
11.	**Teacher's qualifications**	:	As per UGC/University/College rules
12.	**Standard of Passing**	:	As per UGC/University/College rules
13.	**Nature of question paper with scheme of marking**	:	As per UGC/University/College rules
14.	**List of book recommended**	:	Included in syllabus
15.	**Infrastructure details**	:	Website

Particulars	Quantity	Particulars	Quantity
Digital balance	05	Flame Photometer	01
Centrifuge machine	03	Refrigerator	01
Conductometer	12	Freezing point Apparatus	02
Colorimeter	15	Heating Mental	04
Distillation plant	01	pH-Meter	12
Electric Burner	08	Polarimeter	05
Digital Photofluorometer	02	Melting point Apparatus	02
Potentiometer	14	Rotary Shaker	01
Terbidometer	02	Abbes Refractometer	02
Ultrasonicator	01	FT-IR	01
Suction Machine	01	Magnetic Stirrer	12
Potentio-Galvanostat Electrostation	01	Universal Autotitrator	01
UV-Visible Spectrophotometer	01	Rotamantle	04

16.	**Rules and regulations and ordinance if any**	**:**	As per UGC/University/College rules
17.	**Course duration**	**:**	Each theory course is of 40 Contact hours
18.	**Medium of the language**	**:**	English

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur
Faculty of Science
B.Sc. (First Year) Chemistry
Semester – I& II
CORE COURSE CHEMISTRY

Sr. No	Sem.	Core Courses	Course Title	Total Periods	Periods/ Week	Credits	CIA	End Sem. Exam	Total Marks
1.	I	U-CHE-147	Physical and Inorganic Chemistry-I	45	03	2	20	30	50
		U-CHE-148	Organic and Inorganic Chemistry-II	45	03	2	20	30	50
		U-CHE-149	Laboratory Course-I	45	03	1	20	30	50
2.	II	U-CHE-248	Physical and Inorganic Chemistry-III	45	03	2	20	30	50
		U-CHE-249	Organic and Inorganic Chemistry-IV	45	03	2	20	30	50
		U-CHE-250	Laboratory Course-II	45	03	1	20	30	50
			Total			**10**			**300**

Core Course Chemistry 2 Semester I
Core Course Chemistry 2 Semester II
Core Course Chemistry Lab. Course Semester I
Core Course Chemistry Lab. Course Semester II

Theory Papers 50 Marks: (Internal 20*+External 30*)
*External S.E.E. 30 Marks Theory
* Internal 20 Marks (Two unit test -30 marks + Attendance -05Marks)
Unit Test I: Activity Based 30 Marks
Unit Test II: MCQ patterns 30 MCQ questions
Unit test (I+ II) = 60 converted to15 Marks

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DEPARTMENT OF CHEMISTRY

Skeleton of Marks

Time: 1.30 hours (for Theory) Max. Marks = 30

A] Internal (Continuous Assessment) 20 (15+5*) Marks Each

- Unit Test -I (MCQ) 30 Marks
- Unit Test –II (Activity Based Test/Assignments) 30 Marks
- (Unit Test –I+II=60, Converted to 15)

B] Attendance 05* Marks

- Below 75 % 1.0
- 75.1 - 80.00 % 2.0
- 80.1 - 85.0 % 3.0
- 85.1 - 90.0 % 4.0
- 90.1 and above 5.0

C] Semester End Examination 30 Marks

Theory Course- 30 Marks

Practical Course- 30 Marks

(For Practicals 10 Marks are allotted to Practical Record Book and 10 Marks for Attendance)

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B. Sc. First Year (Semester – I)
Paper – I
Course Title: Physical & Inorganic Chemistry
U-CHE-147

Periods: 45 **Marks: 50**
03/week **Credit: 02**

Course Learning Objective:
Objectives of the course are,
1. To impart the knowledge of Logarithms and Antilogarithms, Integration, Mole concept, atomic weight, molecular weight and equivalent weight.
2. To give perceptions about Bohr's atomic model, concept of shells, sub shells and orbitals,dual nature of electron
3. To clarify the concepts of Elements and the periodic Table like: Periodicity, Fundamental properties of atoms, Ionization energy, Electron affinity, Electronegativity and its trends in periodic table.
4. To confront students with allotropes of carbon.

Course Learning Outcome:
After successful completion of the course the students will:
1. Gain the knowledge of Logarithms and Antilogarithms, integration, mole concept, atomic weight, molecular weight and equivalent weight.
2. Understand Bohr's atomic model, concept of shells, sub shells and orbitals,dual nature of electron.
3. Achieve the knowledge of Periodicity, Fundamental properties of atoms, Ionisation energy, Electron affinity and Electronegativity.
4. Familiarize with allotropes of carbon.

Section A: Physical chemistry

Unit - I Mathematics for chemist and basic concepts in chemistry: 07 Periods

1.1 Logarithms and Antilogarithms – Methods of finding log and Antilog of any number, Rules of logarithms.
1.2 Straight line – Equation, method of finding slope and intercept of straight line, numericals.
1.3 Differentiation – Rules of finding complete and partial derivatives for algebraic, logarithmic and exponential functions, numericals.
1.4 Integration – Rules of finding integration for algebraic and exponential functions numericals
1.5 Permutation and combination, numerical

Unit - II Solution: **08 Periods**

2.1 Mole concept, atomic weight, molecular weight and equivalent weight (Definition)

2.2 Concentration of solution – methods of expressing concentration of solution such as percent by mass, percent by volume, molarity, molality, normality, formality, mole fraction, parts per thousand (ppt), parts per million (ppm) and parts per billion (ppb), numerical.

2.3 Concentration of bulk solutions used in the laboratory and preparation of standard Solutions from them. (e.g. HCl, H_2SO_4, HNO_3, CH_3COOH and NH_3). Numerical problems on $N_1V_1 = N_2 V_2$ and $M_1V_1 = M_2V_2$

2.4 Definition of pH and pOH. Relation between pH and pOH, numerical.

Unit - III Atomic Structure I: **07 Periods**

3.1 Introduction , concept of Atom, Theories of Atomic structure , Discoveries & Properties of Subatomic Particles

3.2 Bohr's atomic model – Postulates, derivation for radius and energy of Bohr's orbit. Atomic spectra, applications of Bohr's theory to spectra of hydrogen, limitations of Bohr's theory. Numericals on radius and energy of Bohr's orbit

3.3 Somerfield atomic theory - Concept of shells & sub shells

Unit- IV Atomic Structure II (Wave Mechanical Approach) **08 Periods**

4.1 Introduction: Origin of quantum mechanics, limitations of classical mechanics

4.2 Black body radiation.

4.3 Planck's quantum theory of radiation

4.4 Compton Effect, Photoelectric effect, explanation on the basis of quantum theory

4.5 De-Broglie hypothesis – Derivation of de-Broglie equation

4.6 Davisson – Germer experiment

4.7 Heisenberg's uncertainty principle, (Statement, explanation)

4.8 Concept of orbitals, Quantum Numbers – Types, explanation and uses

Section B: Inorganic Chemistry

Unit- V Elements and the periodic Table: **08Periods**

5.1 Electronic configuration: Pauli's exclusion principle, Hund's rule, Aufbau principle and their role in writing the electronic configuration

5.2 Periodicity: Periodic law, arrangement of elements in the periodic table period, group, diagonal relationship in the periodic table

5.3 General properties of atoms: Size of atoms and ions, atomic radii, ionic radii, covalent radii, trends in atomic radii

5.5 Ionisation energy: Definition, factors effecting, Inert–pair effect, trends in ionization energy, application to explain the chemical behavior of an atom.

5.5 Electron affinity: Definition, factors affecting, trends in electron affinity, application to explain the chemical behavior of an atom

5.6 Electronegativity: Definition, factors affecting, trends in electronegativity, application to explain chemical bonding

Unit- VI S and P block elements: 07 Periods

6.1 Trends in properties:
- i) Atomic and Ionic Size
- ii) Ionization energy
- iii) Electronegativity
- iv) Oxidation state

6.2 Anomalous behavior of First member of P block elements

6.3 Bonding and shapes of P_4O_{10}, Diamond, Fullerene, Graphite

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Reference Books:

Physical Chemistry

1. Mathematical Preparation for Physical Chemistry – By F. Daniel, MC. Graw Hill publication
2. University General Chemistry – By C.N.R. Raw MC Millan publication
3. Principles of Physical Chemistry – By marron and proton 4th edition. Oxford and IBH publication
4. Physical Chemistry – By G.M. Barrow
5. Essentials of Physical Chemistry – By B.S. Bahl & G.D. Tul
6. A Textbook of Physical Chemistry – By K.L. Kapoor (Vol. 1)
7. Principles of Physical Chemistry – By Puri, Sharma, Pathania
8. Advanced Physical Chemistry – By Gurdeep Raj
9. Elements of Physical Chemistry – By S. Glasstone & D. Lewis
10. Elements of Physical Chemistry – By P.W. Atkins
11. Elements of Physical Chemistry – By Matthew Philips

Inorganic Chemistry

1. Text Book Of Inorganic Chemistry – Puri, Sharma, Kalia
2. Modern Inorganic Chemistry – W.L. Jolly (Mc Graw Hill Book company)
3. Inorganic Chemistry - J.E. Huheey, E.A. Keiter, R.L. Keiter
4. Advanced Inorganic Chemistry – Gurudeep Raj, Chatwal Anand
5. Advanced Inorganic Chemistry – Satyaprakash, G.D. Tuli, S.K. Basu, R.D.Madan
6. Inorganic Chemistry – Wilkinson and Cotton

B. Sc. First Year (Semester – I)
Paper – II
Course Title: Organic & Inorganic Chemistry
U-CHE-148

Periods: 45 **Marks: 50**
03/week **Credit: 02**

Course Learning Objective:

1. To clarify the concept of IUPAC system of nomenclature and structure of organic compound from it
2. To gain the knowledge of different types of reactions and their mechanism
3. To understand the saturated and unsaturated hydrocarbons
4. To Study of different chemical bonds, Vander Waals forces and knowing the properties, preparation and structure of different inert gases.

Course Learning Outcome:

After successful completion of the course the students will:

1. Write the IUPAC name of any organic compounds from their structure and draw its structure from its IUPAC name
2. Identify the types of reactions and write its mechanism.
3. Write general molecular formula, preparation and properties of saturated and unsaturated hydrocarbons.
4. Gain the knowledge of different chemical bonds and Vander Waals forces, properties, preparation and structure of different inert gases

Section A: Organic Chemistry

Unit I Introduction to organic chemistry and nomenclature of organic compounds: 08 Periods

1.1 Development of organic chemistry, unique properties of organic compound

1.2 Functional groups and types of organic compounds, Basic rules of IUPAC nomenclature, Nomenclature of mono- and bi-functional compounds on the basis of priority order of the following classes of compounds: alkanes, alkenes, alkynes, haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles and amines

1.3 Nomenclature of aromatic compounds: mono-, di- and polysubstituted benzene (with not more than two functional groups), Monosubstituted fused polycyclic arenes – naphthalene, anthracene and phenanthrene. Nomenclature of bicyclic compounds

Unit - II Basic concepts in organic chemistry: 08 Periods

2.1 Substrate and Reagents, Electrophiles & Nucleophiles

2.2 Bond breaking process and representation of electronic movement by curved arrows. Homolytic and heterolytic process of bond fission. Assigning of formal charge on the constituent atoms

2.3
a) Electron mobility:
b) Inductive effect (its effect on strength of acids & bases)
c) Mesomerism (aniline, nitrobenzene)
d) Hyperconjugation(toluene)
e) Steric effect (mesitoicacid)

2.4 Formation and Study of reactive intermediates with stability order: Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes & Arynes

2.5 Types of organic reactions: Substitution, Addition, Elimination and Rearrangement. (With one example).

Unit - III Alkanes, Cycloalkanes, Alkenes, Alkynes **08 Periods**

3.1Alkanes:

3.1.1 Introduction

3.1.2 Methods of formation of alkanes by A) Kolbe's electrolytic method
B) Frankland reaction

3.1.3 Chemical Properties: halogenation (mechanism), nitration (mechanism).

3.2 Cycloalkanes

3.2.1 Introduction

3.2.2 Formation of cycloalkanes by Freund's method

3.2.3 Concept of angle strain, stability and reactivity of cycloalkanes: Bayer's strain theory

3.2.4 Ring opening reaction with H_2 & HI

3.3 Alkenes:

3.3.1 Introduction

3.3.2 Methods of formation by:
a) dehydration of alcohols (with mechanism)
b) dehydrohalogenation of alkyl halides (with mechanism).

3.3.3 Chemical Reactions: (with mechanism)
a) Electrophilic addition of Br_2 to ethene
b) Free radical addition of HBr to propene (Peroxide effect)
Reaction of propene with Cl_2/ H_2O (Chlorohydrin formation)

3.4 Dienes:

3.4.1 Introduction & classification of dienes

3.4.2 Resonance & M.O. structure of 1, 3 – butadiene

3.4.3 Formation of 1, 3 – butadiene from 1, 4 – butanediol

3.4.4 Chemical properties:
a) Addition of H_2 & H_2O on 1,3-butadiene
b) Diels – Alder reaction
c) Polymerization reaction

3.5 **Alkynes**

3.5.1 Introduction
3.5.2 Methods of formation of acetylene (ethyne) from:
a) Iodoform
b) Hydrolysis of calcium carbide
3.5.3 Chemical properties:
a) Electrophilic addition reactions of ethyne with Br_2& HBr (with mechanism)
b) Nucleophilic addition reactions of ethyne with by HCN (with mechanism)

Unit – IV **06 Periods**

4.1 **Ethers:**
4.1.1 Introduction
4.1.2 Physical properties
4.1.3 General methods of formation:
a) Williamson's synthesis
b) From diazomethane.
4.1.4 Chemical reactions:
a) Action of hot & cold HI
b) With acetyl chloride

4.2 Epoxides

4.2.1 Introduction
4.2.2 Methods of formation:
a) Oxidation of ethene in the presence of silver catalyst
b) Oxidation of ethene with peracetic acid
4.2.3 Chemical reactions:
a) Ring opening reaction of epoxides (propylene oxide): by acidic reagent and basic Reagent

Section B: Inorganic Chemistry

Unit - V Chemical bonding: **10 Periods**

4.1 Cause of chemical bonding, types of bonding, octet rule
4.2 Ionic bond – Nature of ionic bond, conditions for the formation of ionic compounds, properties of ionic compounds, ion polarization and Fajan's rules. Born Haber cycle
4.3 Covalent bond –Conditions for the formation of covalent bond, Polar and non – polar covalent bond. Percentage ionic character in a polar covalent bond. properties of covalent, compounds
4.4 Coordinate bond – Conditions for the formation of coordinate bond, properties of coordinate bond, and properties of coordinate compounds
4.5 Metallic bond – Nature of metallic bond (electron pool theory), properties of metals
4.6 Hydrogen bond – Nature of hydrogen bond, properties of hydrogen bonding

4.7 Vander Waals forces

4.8 VSEPR theory with special reference to i)BF_3 ii) SF_6 iii)PCl_5 iv) CH_4 V) $SiCl_4$

Unit - V Inert gases **05 Periods**

5.1 Introduction

5.2 Position in periodic table

5.3 Electronic configuration

5.4 Properties of inert gases

5.5 Compounds of inert gases a) Under special conditions
True compounds. i) XeF_2, ii) XeF_4, iii) XeF_6 and iv) $XeOF_4$ Structure

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Reference Books:

Organic chemistry

1. Organic chemistry by – S.M. Mukherji, S.P. Singh, R.P. Kepoor (Vol. I & II)
2. Organic chemistry by – Jagdamba Singh, L.D.S. Yadav (Vol. I & II)
3. A text book of organic chemistry by P.L. Soni.
4. A text book or organic chemistry by – K.S. Tewari, S.N. Mehrotra, N.K. Vishnoi.
5. A text book of organic chemistry by – Arun Bahl & B.S. Bahl.
6. Principal of organic chemistry by – M.K. Jain.
7. Organic chemistry by – Clayden, Greeves, Warren and Wothers.
8. Organic chemistry by – Morrison and Boyd.
9. Organic chemistry by – Carey.
10. Advanced Organic chemistry by – Jerry March.
11. Organic reactions and their mechanism by – P.S. Kalsi.
12. Organic reactions and their mechanism by – P.S. Kalsi.
13. A guide book to mechanism in organic chemistry by – Peter Sykes.
14. Practical organic chemistry by – A.I. Vogel.
15. Advanced practical organic chemistry by – O.P. Agarwal.
16. Advanced practical organic chemistry by – N.K.Vishnoi.

Inorganic chemistry

1. Text book of inorganic chemistry – Puri Sharma Kalia.
2. Modern Inorganic chemistry – W.L. Jolly (Mc Graw Hill Book company.)
3. Inorganic chemistry - J.E. Huheey, E.A. Keiter, R.L. Keiter,
4. Advanced Inorganic chemistry – Gurudeep Raj, Chatwal Anand.
5.Advanced Inorganic chemistry – Satyaprakash, G.D. Tuli, S.K. Basu, R.D.Madan.

B. Sc. I Year (Semester I)
Practical Paper – I
Core Course Title: Laboratory Core Course Chemistry-I
U-CHE-149

Periods: 45 **Marks: 50**
03/week **Credit: 01**

Course Learning Objective:

1. To determine equivalent weight, heat of solution, heat of displacement
2. To estimate the amount of radicals in given mixture.
3. To find out Melting point, boiling point.

Course Learning Outcome:

Upon successful completion of the course, it is expected that students will be able to:

1. Determine equivalent weight of magnesium.
2. Determine the heat of solution, heat of reaction of displacement of copper by zinc.
3. Estimate the amount of radicals in given mixture.
4. Determine the physical constant.

A) Physical Chemistry

1) Preparation of As_2S_3 from As_2O_3 and compare the precipitation power of NaCl and $MgCl_2$.
2) To study the distribution of benzoic acid between benzene and water.
3) Determination of Heat of solution of KNO_3/ NH_4Cl.
4) Determination of heat of reaction of displacement of copper by zinc.
5) Determine the equivalent weight of magnesium by using Eudiometer.
6) Preparation of buffer solutions of different pH values
   i) Sodium acetate-acetic acid
   ii) Ammonium chloride-ammonium hydroxide.

B) Inorganic Chemistry (any five)

1) Prepare standard Na_2CO_3 solution. Standardize the given HCl solution and estimate the amount of NaOH in the given solution.
2) Estimate the amount of NaOH and Na_2CO_3 in the given mixture using standard HCl solution.
3) Estimate the amount of Fe^{++} and Fe^{+++} separately in the given mixture using standard $K_2Cr_2O_7$ solution.
4) Estimate the amount of Cu^{++} in the given solution using standard $Na_2S_2O_3$ solution.
5) Find out the strength of supplied $AgNO_3$ solution using standard $AgNO_3$ solution. NH_4SCN as link solution (Volhard's method).
6) Find out the strength of supplied NaCl solution using standard NaCl and $AgNO_3$ as link solution (Mohr's method).

7) Standardize the given EDTA solution by using standard Zn^{++} solution and estimate the amount of Ca^{++} from given solution.
8) Estimate the amount of Al^{+++} in the given solution by back titration method using EDTA solution.

C) Organic Chemistry

Determination of Nature, functional group and physical constant of organic compounds:
(Any 6)
B-naphthol, benzaldehyde, benzoic acid, p-nitroaniline, acetanilide, nitrobenzene, ethylalcohol and aniline

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Reference Books Practical Chemistry

1. Vogel's Qualitative Analysis.
2. A Text book of Practical Chemistry for B.Sc. By V.V. Nadkarny A.N. Kothari and Y.V. Lawande.
3. Advanced Practical Inorganic Chemistry by O.P. Agarwal.
4. Vogel's Quantitative Analysis.
5. Practical Organic Chemistry by A.I. Vogel.
6. Advanced Practical Organic Chemistry by O.P. Agarwal.
7. Advanced Practical Organic Chemistry by N.K. Vishnoi.
8. Experimental Physical Chemistry by A. Findlay.
9. Advanced Practical Physical Chemistry by J.B. Yadav
10. Experiments in Physical Chemistry by R.C. Das and B. Behra
11. Advanced experimental chemistry Vol-I, II and III by J.N. Gurutu and R. Kapoor
12. Systematic experimental Physical Chemistry by S.W. Rajbhoj and Chondekar
13. Experimental in Physical Chemistry by J.C. Ghosh
14. Practical Physical Chemistry by B.D. Khosala and V.C. Garg
15. Experiments in Chemistry by D.V. Jahagirdar
16. Practical Chemistry, Physical – Inorganic – Organic and Viva-Voce by BalwantraiSatuja

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B. Sc. First Year (Semester–II)
Paper – III
Course Title: Physical & Inorganic Chemistry
U-CHE-248

Periods: 45 **Marks: 50**
03/week **Credit: 02**

Course Learning Objective:

1. To learn Kinetic molecular theory of gases, Molecular velocities, Physical properties of liquids
2. To know the Structure of metal crystals, Symmetry elements in the crystals, Properties of sols
3. To understand the concept of Hard and soft acids and bases.
4. To understand the various properties of d-block elements.

Course Learning Outcome:

Upon successful completion of the course, it is expected that student will:

1. able to derive the kinetic gas equation,solve the numerical on critical constants and Vander Waals constants.
2. know the Vapour pressure,Surface Tension of liquid
3. can determine the crystal structure of NaCl, electro kinetic or Zeta potential, electrophoresis and electro osmosis of sol.
4. know Lewis acid and base concept.
5. know various properties of d-block elements.

Section A: Physical Chemistry

Unit - I Gaseous State : **08 Periods**

1.1 Introduction : Gas laws (Derivation)

1.2 Kinetic molecular theory of gases – postulates, derivation of kinetic gas equation.

1.3 Real and ideal gases - behavior, deviation of gases from ideal behavior, compressibility factor (Z), explanation of deviation – Vander Waal's equation.

1.4 Critical phenomenon – Andrew's isotherms of CO_2,application of Vander Waals equation to Andrews isotherm, relation between critical constants and Vander Waals constants. Numericals based on this relation.

1.5 Principle of corresponding states.

1.6 Molecular velocities – RMS, average and most probable velocities. Maxwell's distribution of molecular velocities. Numerical problems.

Unit - II Liquid State : **06 Periods**

2.1 Introduction – Intermolecular forces and molecular interactions in liquids.

2.2 Physical properties of liquids.

2.3 Vapour pressure – definition, units, effect of temperature. determination by static and dynamic method, effect of vapour pressure on boiling points.

2.4 Surface Tension – definition, units, effect of temperature, determination by stalagmometer (drop no. method). Numerical problems.

2.5 Viscosity – definition, units, effect of temperature, determination by Ostwald's viscometer.

2.6 Refractive index: specific refraction, molar refractions and chemical constitution. Method of determination by Abbe's Refractometer.

Unit - III Solid State : **08 Periods**

3.1 Introduction, space lattice, unit cell. The seven type of crystals (Bravais) lattices.

3.2 Types of cubic systems: simple cubic, BCC, FCC with examples.

3.3 Structure of metal crystals – HCP and CCP arrangements.

3.4 Crystallography – Laws of crystallography.

i) Law of constancy of interfacial angles.

ii) Law of rational indices

iii) Law of symmetry.

3.5 Symmetry elements in the crystals.

3.6 Weiss indices and Miller indices. Numericals.

3.7 Diffraction of X – rays, Derivation of Bragg's equation.

3.8 Determination of crystal structure of NaCl on the basis of Bragg's equation.

Unit - IV Colloidal State **08 Periods**

4.1 Definition of colloids. Type of colloidal systems.

4.2 Solids in liquids (sols)

4.3 Preparation of sols – Aggregation and dispersion methods

4.4 Purification of sols – Dialysis, electro dialysis, ultra filtration and reverse osmosis.

4.5 Properties of sols (in brief) – Color, optical, kinetic properties, electrical properties, charge on sols, electrical double layer, electro kinetic or Zeta potential, electrophoresis and electro osmosis.

4.6 Coagulation (precipitation) of sols.

4.7 Stability of sols – protective action, Hardy – Schulze rule, gold number.

4.8 Liquid in liquid (Emulsions) – Types, preparation, emulsifier.

4.9 Liquid in solid (Gels) – Classification, preparation and properties.

4.10 General applications of colloids.

Section B: Inorganic Chemistry

Unit – V d-block elements **10 Periods**

1.1 Definition, Elements of first, second and third transition series, Electronic configuration of first transition series

1.2 General characteristics of d-block elements, properties of d-block elements (First transition series) such as: Metallic character. Atomic and ionic radii, Melting and Boiling Points, Ionisation enthalpies, Reactivity, Oxidation states, Standard electrode potential, Reducing properties, Colour of ions, Magnetic properties.

Unit - VI Theories of acids and base: **05 Periods**

2.1 Introduction

2.2 Lewis acid and base concept and its limitations.

2.3 Hard and soft acids and bases. (Pearson's classification)

2.4 Lux-Flood and Solvent Concept

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Reference Books:

Physical chemistry

1. Mathematical Preparation for physical chemistry – By F. Daniel, MC. Graw Hill publication.
2. University General Chemistry – By C.N.R. Raw MC Millan publication.
3. Principles of physical chemistry – By marron and proton 4^{th} edition. Oxford and IBH publication.
4. Physical chemistry – By G.M. Barrow.
5. Essentials of physical chemistry – By B.S. Bahl & G.D. Tul.
6. A Textbook of physical chemistry – By K.L. Kapoor (Vol. 1)
7. Principles of physical chemistry – By Puri, Sharma, Pathania
8. Advanced physical chemistry – By Gurdeep Raj
9. Elements of physical chemistry – By S. Glasstone & D. Lewis
10. Elements of physical chemistry – By P.W. Atkins.
11. Elements of physical chemistry – By Matthew Philips.

Inorganic chemistry

1. Text book of inorganic chemistry – Puri Sharma Kalia.
2. Modern Inorganic chemistry – W.L. Jolly (Mc Graw Hill Book company.)
3. Inorganic chemistry - J.E. Huheey, E.A. Keiter, R.L. Keiter,
4. Advanced Inorganic chemistry – Gurudeep Raj, Chatwal Anand.
5. Advanced Inorganic chemistry – Satyaprakash, G.D. Tuli, S.K. Basu, R.D.Madan.

B.Sc. First Year (Semester–II)
Paper – IV
Course Title: Organic and Inorganic chemistry
U-CHE-249

Periods: 45 **Marks: 50**

03/Week **Credits: 02**

Course Learning Objective:

1. Understanding the Huckels rule of aromaticity,mechanism of electrophilic substitution reaction.
2. To know the properties and preparation of organic hydroxyl compounds.
3. To introduce the fats, oils, soaps, and detergents
4. To know the oxidation, reduction, oxidizing agent and reducing agents according to electronic Concept.
5. Gaining the knowledge of occurrence and different methods of isolation of elements.

Course Learning Outcome:

Upon successful completion of the course, it is expected that students:

1 able to identify the aromatic and non aromatic compounds.
2. can write mechanism of electrophilic substitution reactions.
3. can gain the information about fats, oils, soaps, and detergents.
4. can find out the oxidation number of various elements.
5. understand the knowledge of occurrence and different methods of isolation of elements.

Section A: Organic chemistry

Unit - I

1.1 Aromaticity & Aromatic hydrocarbons: **08 Periods**

1.1.1 Introduction
1.1.2 Characteristics of aromatic compounds.
1.1.3 Kekule, resonance and molecular orbital structure of benzene.
1.1.4 Stability of benzene.
1.1.5 Modern theory of aromaticity:
Huckel's rule & its applications to benzene, naphthalene, anthracene, furan, pyrrole, pyridine, thiophene, cyclohexene, cyclooctatetrene, cyclopropene, cylclopropenyl cation and cyclopentadienyl anion and antiaromaticity.
1.1.6 Reactions of benzene - Electrophilic substitution reactions (with mechanism), nitration, halogenation, sulphonation, Friedal-craft alkylation and acylation. Birch reduction.
1.1.7 Orientation - Effect of substituent groups on the reactivity of benzene, activating and deactivating groups, directing influence of the following groups $–CH_3$,-OH, NO_2& Cl.

Unit - II Halo Alkenes & Halo Arenes: **08 periods**

2.1 Vinyl Chloride:

2.1.1 Introduction

2.1.2 Structure- Molecular orbital & Resonance.

2.1.3 Methods of formation of vinyl chloride from:

a) Ethene b) Ethylene dichloride c) Ethyne.

2.1.4 Physical properties of vinyl chloride

2.1.5 Chemical Reactions of vinyl Chloride:

Addition reactions with Br_2, HBr & polymerization reactions.

2.2 Allyl iodide:

2.1.6 Methods of formation of allyl iodide from glycerol.

2.1.7 Physical properties of allyl iodide.

2.1.8 Chemical reactions of allyl iodide: Nucleophilic substitution reactions with NH_3, KCN, $AgNO_2$, Br_2, NaOH and Mg in ether.

2.3 Halo Arenes:

2.2.1 Introduction, structure and stability of chlorobenzene

2.2.2 Synthesis of chlorobenzene from:

a) Hunsdiecker reaction b) Gattermann reaction c) Balz-Schiemann reaction

2.2.3 Chemical reactions of chlorobenzene:

a) Ullmann biaryl synthesis

b) Electrophilic and nucleophilic substitution reactions.

2.2.4 Comparison of reactivity allyl halide, vinyl halide and aryl halides.

Unit - III Organic Hydroxy Compounds: **08 Periods**

3.1 Alcohols:

3.1.1 Introduction & classification.

A) Monohydric Alcohols:

3.1.2 General methods for formation:

a) From alkyl halides

b) Reduction of aldehydes & ketones.

3.1.3 Chemical reactions:

Interconversion of alcohols

i) Primary alcohols to Secondary alcohols

ii) Secondary alcohols to Tertiary alcohols.

B) Dihydric Alcohols:

3.1.4 Methods of formation of ethylene glycol from:

a) Ethylene b) Ethylene dibromide c) Ethylene oxi5de.

3.1.5 Chemical reactions:

a) Reaction with HCN b) oxidation with lead tetraacetate

c) HIO_4 and HNO_3 d) Dehydration reaction.

3.1.6 Uses of ethylene glycol.

C) Trihydric Alcohols:

3.1.7 Methods of formation glycerol:

a) From fat and oil b) From propene.

3.1.8 Chemical reactions with:

a) HNO_3 b) HI

c) $KHSO_4$ d) acetyl chloride

e) reaction with electropositive metal.

3.1.9 Uses of glycerol.

3.2 Phenols :

3.2.1 Introduction and classification

3.2.2 Acidic character - Comparison of acidic properties of phenol and ethanol

3.2.3 Physical properties of phenol

3.2.4 Chemical Properties:

a) Fries rearrangement with mechanism.

b) Lederer Manase reaction.

c) Houben Hoesch reaction.

d) Claisen rearrangement with mechanism.

Unit:- IV Oils, Fats, Soaps and Detergents **06 periods**

4.1 Oils & Fats:

4.1.1 Introduction.

4.1.2 Chemical nature.

4.1.3 General physical properties.

4.1.4 General chemical properties:

a) Hydrolysis

b) Hydrogenation

c) Analysis of Fats and Oils:

i) Saponification number (Saponification value)

ii) Iodine number (Iodine value)

iii) Acid value

4.2 SOAPS

4.2.1 Introduction.

4.2.2 Manufacture of soaps by:

i) Kettles process

ii) Cleansing action of soap.

4.3 Synthetic Detergents

4.3.1 Introduction.

4.3.2 Synthetic detergent classification,

i) Anionic detergent

ii) Cationic detergents

iii) Non ionic detergents.

b. Inorganic Chemistry

Unit IV: Oxidation and reduction **07 Periods**

1.1 Definition of oxidation, reduction, oxidizing agent and reducing agents according to electronic concept.

1.2 Definition of oxidation, reduction, oxidizing agent and reducing agents according to oxidation number concept.

1.3 Rules for assigning oxidation number.

1.4 Balancing of redox reaction by 1) Ion – electron method and 2) Oxidation number method.

Unit V: Occurrence and Isolation of Elements: **08 Periods**

2.1Terms involved in metallurgy, types of ores

2.2 Occurrence of elements.

2.3 Preliminary operations in metallurgy.

2.4 Ore dressing.

2.5 Pyrometallurgical operations with special reference to Fe & Al

2.6 Different methods of reduction.

2.7 Different methods of refining.

2.8 Furnaces – Blast furnace, Reverberatory furnace.

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Reference Books:

Organic Chemistry:

1. Organic chemistry by – S.M. Mukherji, S.P. Singh, R.P. Kepoor (Vol. I & II)
2. Organic chemistry by – Jagdamba Singh, L.D.S. Yadav (Vol. I & II)
3. A text book of organic chemistry by P.L. Soni.
4. A text book or organic chemistry by – K.S. Tewari, S.N. Mehrotra, N.K. Vishnoi.
5. A text book of organic chemistry by – Arun Bahl & B.S. Bahl.
6. Principal of organic chemistry by – M.K. Jain.
7. Organic chemistry by – Clayden, Greeves, Warren and Wothers.
8. Organic chemistry by – Morrison and Boyd.
9. Organic chemistry by – Carey.
10. Advanced Organic chemistry by – Jerry March.
11. Organic reactions and their mechanism by – P.S. Kalsi.
12. Organic reactions and their mechanism by – P.S. Kalsi.
13. A guide book to mechanism in organic chemistry by – Peter Sykes.
14. Practical organic chemistry by – A.I. Vogel.
15. Advanced practical organic chemistry by – O.P. Agarwal.
16. Advanced practical organic chemistry by – N.K.Vishnoi.

Inorganic chemistry

1. Text book of inorganic chemistry – Puri Sharma Kalia.
2. Modern Inorganic chemistry – W.L. Jolly (Mc Graw Hill Book company.)
3. Inorganic chemistry - J.E. Huheey, E.A. Keiter, R.L. Keiter,
4. Advanced Inorganic chemistry – Gurudeep Raj, Chatwal Anand.
5. Advanced Inorganic chemistry – Satyaprakash, G.D. Tuli, S.K. Basu, R.D.Madan.

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B. Sc. I Year (Semester – II)
Paper – IV (Practical)
Core Course Title: Laboratory Core Course Chemistry-II

U-LAC-250

Periods: 45 **Marks: 50**
06/Week **Credits: 04**

Course Learning Objective:

1. To determine the viscosity, surface tension.

2 To analyze Qualitatively two acidic radicals and two basic radicals.

3.To study the purification of organic compound.

Course Learning Outcome:

Upon successful completion of the course, it is expected that students will be able to:

1. Determine the viscosity, surface tension.

2. Analyze the two acidic and two basic radicals Qualitatively.

3. Purify the given organic compound by recrystallization,sublimation,distillation.

A) Physical Chemistry:

1) Determination of the viscosity of given liquid by using Oswald's viscometer.
2) Determination the viscosity of mixture of two liquids A & B and find the composition of the mixture of two liquids. (Density of liquids, viscosity of water to be give) [Any two liquids from: Acetone, CCl_4, Chloroform, Ethyl alcohol. Benzyl alcohol, Ethylene glycol and n-propyl alcohol].
3) To determine the surface tension of a given liquid by using stalagmometer/Tensiometer.
4) To study kinetics of hydrolysis of methyl acetate in presence of HCl.
5) Study the variation of viscosity with different concentration of sugar solutions.
6) Construction of various crystal modelsof NaCl unit cell.
7) Deetermine the refractive index o given liqiuids & calculate Moar refractions using Abbes refractometer.

B) Inorganic Chemistry: Qualitative analysis

Qualitative analysis with two acidic radicals and two basic radicals in the form of mixture (Minimum five mixtures) containing one interfering radical:

Acidic radicals: Carbonate, Chloride, Bromide, Iodide, Nitrate, Sulphate.

Basic radicals: Copper, Bismuth, Ferric, Aluminum, Manganese, Nickel, Zinc, Barium, Calcium, Magnesium, Ammonium, Potassium.

C) Organic Chemistry: Methods of Purification of organic compounds:

a) Recrystallization: Benzoic acid, β–naphthol, cinnamic acid, m–nitroaniline and acetanilide. (any 3)

b) Sublimation: Naphthalene, camphor.

c) Simple distillation: (any one)

i) Separation of ethanol & water from mixture

ii) Separation of acetone & water from mixture

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Reference Books Practical Chemistry

1. Vogel's Qualitative Analysis.
2. A Text book of Practical Chemistry for B.Sc. By V.V. Nadkarny A.N. Kothari and Y.V. Lawande.
3. Advanced Practical Inorganic Chemistry by O.P. Agarwal.
4. Vogel's Quantitative Analysis.
5. Practical Organic Chemistry by A.I. Vogel.
6. Advanced Practical Organic Chemistry by O.P. Agarwal.
7. Advanced Practical Organic Chemistry by N.K. Vishnoi.
8. Experimental Physical Chemistry by A. Findlay.
9. Advanced Practical Physical Chemistry by J.B. Yadav
10. Experiments in Physical Chemistry by R.C. Das and B. Behra
11. Advanced experimental chemistry Vol-I, II and III by J.N. Gurutu and R. Kapoor
12. Systematic experimental Physical Chemistry by S.W. Rajbhoj and Chondekar
13. Experimental in Physical Chemistry by J.C. Ghosh
14. Practical Physical Chemistry by B.D. Khosala and V.C. Garg
15. Experiments in Chemistry by D.V. Jahagirdar
16. Practical Chemistry, Physical – Inorganic – Organic and Viva-Voce by Balwantrai Satuja

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Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

Seat No. ☐

SEE-20____

Faculty of Science

B.Sc. First Year (Semester-I/II)
SEE WINTER/SUMMER 20_____

Subject : Analytical Chemistry
Course Title:
Course Code:

Date: **Time:**

Time: 1:30 hrs **Maximum Marks: 30**

Q1. Answer any Four of the following: **[3×4=12]**

a)
b)
c)
d)
e)

Q2. Answer any Two of the following: **[4×2=08]**

a)
b)
c)

Q3. Answer any One of the following: **[10×1=10]**

a)
b)

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