Kuvempu University

Bachelor of Science (B.Sc.) Semester Scheme

Curriculum Structure for Undergraduate Programme for 2024-25
Case-1: 3 Majors with a General Degree in all 6 Semesters

Curriculum Framework for UG Programmes as suggested by KSHEC, Govt. of Karnataka
(As per G.O. No.: ED 166 UNE 2023, Bengaluru, dated: 08-05-2024)

Total Credits required for the award of Degree as per KSHEC: 128 (Min) and 150 (Max) for UG Degree.

Allocation of credits in Kuvempu University for UG-Science programmes
Case-1: 3 Subjects Combination in all 6 Semesters

Sl. No.	Subject Category	No. of Credits
1.	Major Courses	90
2.	Languages	24
3.	Compulsory	12
4.	Electives/Optional	04
Total		**130**

Semester-wise allocation of credits in Kuvempu University for UG Science programmes (Three Subjects Combination)

Year	Semester	Credits	Total Credits
1.	I	23	**46**
	II	23	
2.	III	25	**50**
	IV	25	
3.	V	17	**34**
	VI	17	
Total		**130**	**130**

Semester-wise allocation of credits in Kuvempu University for UG Science programmes for framing syllabus of One Major Subject in Three Major Subjects

Combination (Case - 1 Stream)

Year	Semester	Credits	Total Credits
1	I	05	**10**
	II	05	
2	III	07*	**14***
	IV	07*	
3	V	05	**10**
	VI	05	
Total		**34***	**34***

Total number of credits including Major papers (T+P) and interdisciplinary Elective/Optional papers.

Kuvempu University

Bachelor of Science (B.Sc.) Semester Scheme

Curriculum Structure of Undergraduate Programme for the year 2024-25

Course / Examination Pattern for One Major Subject (CHEMISTRY)

Sl. No.	Course Code	Title of the Course (Paper)	Subject Category	Teaching Hours/ week	Semester End Examination	Internal Assessment	Total Marks	Credits	Examination Duration
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I - Semester									
I	**CHET1**	Chemistry - I	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP1	Chemistry Practical - I	Major Course	04	40	10	**50**	02	3 Hrs.
	Total			**07**	**120**	**30**	**150**	**05**	---
II - Semester									
II	**CHET2**	Chemistry - II	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP2	Chemistry Practical - II	Major Course	04	40	10	**50**	02	3 Hrs.
	Total			**07**	**120**	**30**	**150**	**05**	---
III - Semester									
III	**CHET3**	Chemistry - III	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP3	Chemistry Practical - III	Major Course	04	40	10	**50**	02	3 Hrs.
	CHEL3.1 **CHEL3.2**	Chemistry Elective - III.1 Chemistry Elective - III.2	Open Elective Open Elective	02	40	10	**50**	02	2 Hrs.
	Total			**09**	**160**	**40**	**200**	**07**	---
IV - Semester									
IV	**CHET4**	Chemistry - IV	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP4	Chemistry Practical - IV	Major Course	04	40	10	**50**	02	3 Hrs.
	CHEL4.1 **CHEL4.2**	Chemistry Elective - IV.1 Chemistry Elective - IV.2	Open Elective Open Elective	02	40	10	**50**	02	2 Hrs.
	Total			**09**	**160**	**40**	**200**	**07**	---
V - Semester									
V	**CHET5**	Chemistry - V	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP5	Chemistry Practical - V	Major Course	04	40	10	**50**	02	3 Hrs.
	Total			**07**	**120**	**30**	**150**	**05**	---
VI - Semester									
VI	**CHET6**	Chemistry - VI	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP6	Chemistry Practical - VI	Major Course	04	40	10	**50**	02	3 Hrs.
	Total			**07**	**120**	**30**	**150**	**05**	---
	Grand Total			**---**	**800**	**200**	**1000**	**34**	---

Course Pattern for CHEMISTRY (Major Subject) at Under Graduate Level:

I – Semester	: CHET1 – Chemistry - I
	: CHEP1 – Chemistry Practical - I
II – Semester	: CHET2 – Chemistry - II
	: CHEP2 – Chemistry Practical - 2
III – Semester	: CHET3 – Chemistry - III
	: CHEP3 – Chemistry Practical - III
	: * CHEL3.1 – Chemistry Elective - III.1
	: * CHEL3.2 – Chemistry Elective - III.2
IV – Semester	: CHET4 – Chemistry - IV
	: CHEP4 – Chemistry Practical - IV
	: * CHEL4.1 – Chemistry Elective - IV.1
	: * CHEL4.2 – Chemistry Elective - IV.2
V – Semester	: CHET5 – Chemistry - V
	: CHEP5 – Chemistry Practical - V
VI – Semester	: CHET6 – Chemistry - VI
	: CHEP6 – Chemistry Practical - VI

Note: There shall be two elective papers offered in Semester-III and Semester-IV by every major subject offering departments. Out of this, a student shall choose/select/opt One Elective Paper in each semester (i.e., Semester-III and Semester-IV, respectively).

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Continuous Assessment Programme / Internal Assessment / Formative Assessment
Major Subject (Chemistry)

Sl. No.	Continuous Assessment Programme / Internal Assessment	Maximum Marks
(1)	(2)	(3)
1.	Two Session Tests with a proper record for assessment (5+5 = 10)	**10**
2.	Assessment of Skill Development activities / Seminars / Group Discussion / Assignment etc., with proper record	**05**
3.	Attendance with proper record*	**05**
TOTAL MARKS		**20**

*** Attendance Marks-breakup**

<75% - 00 Marks
75-80% - 01 Mark
80-85% - 02 Marks
85-90% - 03 Marks
90-95% - 04 Marks
>95% - 05 Marks

Continuous Assessment Programme / Internal Assessment / Formative Assessment
Elective / Optional Papers (Chemistry Elective)

Sl. No.	Continuous Assessment Programme / Internal Assessment	Maximum Marks
(1)	(2)	(3)
1.	Two Session Tests with a proper record for assessment (2+2 = 4)	**04**
2.	Assessment of Skill Development activities / Seminars / Group Discussion / Assignment etc., with proper record	**03**
3.	Attendance with a proper record*	**03**
TOTAL MARKS		**10**

***Attendance Marks-breakup**

<75% - 00 Marks
75-80% - 01 Mark
85-90% - 02 Marks
90-100% - 03 Marks

Practical Examination: I - VI Semesters (Major Subject: Chemistry)

Description	Marks
Experimentation	35
Viva Voice	05
Total	**40**

Internal Assessment for Practical Paper I - VI semesters (Major Subject: Chemistry)

Description	Marks
Attendance	05
Record/Journal	05
Total	**10**

Theory Examination and Question Paper Pattern for One Major Subject (Chemistry)
(I - VI Semesters)

B.Sc. Semester-I/II/III/IV/V/VI Degree Examination: 2024-25
(Semester Scheme; New Syllabus: 2024-25)

Subject: Chemistry

Paper Code – _____ : Title - _____

Time: 3 Hours. **Max. Marks: 80**

Instructions to candidates:

1) All sections are compulsory.
2) Draw neat and labelled diagrams wherever necessary.
3) Figures to the right indicate marks.

Section - A

1. Answer **all** the following questions: **(2×10=20)**

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

Section – B

Answer **any Six** of the following: (TWO Questions from each Unit) **(5×6=30)**

2.
3.
4.
5.
6.
7.
8.
9.

(**Note:** 6 Marks question may be divided into 3 + 3 or 2 + 4, if required)

Section - C

Answer **any Three** of the following: **(10×3=30)**

10. From Unit-I
11. From Unit-II
12. From Unit-III
13. From Unit-IV

(**Note:** 10 Marks question may be divided into 3 + 7 or 4 + 6 or 5 + 5, if required)

Theory Examination and Question Paper Pattern for Elective / Optional Papers

B.Sc. Semester - III / IV Degree Examination: 2024-25

(Semester Scheme; New Syllabus: 2024-25)

(Paper – Elective / Optional for III & IV Semesters)

Subject: Chemistry Elective

Paper Code _____: Title_____

Time: 2 Hours **Max. Marks: 40**

Instructions to candidates:

1) All sections are compulsory
2) Draw neat and labelled diagrams wherever necessary.
3) Figures to the right indicate marks.

Section - A

Answer **all** the following questions: **(2×5=10)**

1.
2.
3.
4.
5.

Section - B

Answer **any Six** of the following: **(5×6=30)**

6.
7.
8.
9.
10.
11.
12.
13.

(**Note:** 6 Marks question may be divided into 3 + 3 or 2 + 4, if required)

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THEORY PAPER MODEL

SEMESTER – I/II/III/IV/V/VI

Major Course: Chemistry

Major Course; Paper-I: CHET1 (Paper Title) Chemistry - I

Total Hours of Teaching - 48

Course Objectives:

a)
b)
c)
d)
e)

Course Outcome: On successful completion of the course, the student will able to:

a)
b)
c)
d)
e)
f)

UNIT 1:	**(12Hrs)**
UNIT 2:	**(12Hrs)**
UNIT 3:	**(12Hrs)**
UNIT 4:	**(12Hrs)**

Suggested References/Textbooks (Provide a minimum of Six Reference Books, out of which at least should be latest books):

1.
2.
3.
4.
5.
6.
7.
8.

THEORY PAPER MODEL

EL/OP Theory Papers (Semesters III & IV):

Major Course: Chemistry

CHEL3.1 (paper title) Chemistry Elective – 3.1

Total Hours of Teaching - 32

Course Objectives:

a.
b.
c.
d.
e.
f.

Course Outcome: On successful completion of the course, the student will able to

a.
b.
c.
d.
e.
f.

UNIT 1:	**(8Hrs)**
UNIT 2:	**(8Hrs)**
UNIT 3:	**(8Hrs)**
UNIT 4:	**(8Hrs)**

Suggested References/Textbooks (Provide a minimum of Six Reference Books, out of which at least should be latest books):

1.
2.
3.
4.
5.
6.
7.
8.

Kuvempu University

Jnanasahyadri, Shankaraghatta - 577451

Syllabus for B.Sc. Programme (Semester Scheme) 2024-2025

(As per G.O. No.: ED 166 UNE 2023, Bengaluru, dated: 08-05-2024)

Case-1: 3 Majors with a General Degree in all 6 Semesters

Major Subject: Chemistry

I - Semester

Theory Paper: CHET1 - Chemistry-I **Total Teaching Hours: 48**

Unit - I: Analytical Chemistry **12 Hours**

Chapter-1: Fundamentals of Analysis (2 Hours)

Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ).

Chapter-2: Laboratory Reagents and Solvents (3 Hours)

Reagents, Classification of reagents according to their action; (i) acids (ii) bases (iii) salts (iv) complexing agents (v) oxidizing and reducing agents (vi) precipitating agents (vii) chelating agents. Each type to be explained with at least one suitable example. Primary and secondary standards: Definition, characteristics, uses examples for different types of reactions. Solvents: Solute, Solvent & Solution, classification of solvents (i) Protic and aprotic (ii) Acidic, basic, amphiprotic and neutral (iii) Aqueous and non-aqueous (iv) Polar and non polar. Each type is to be explained with at least one example.

Chapter-3: Titrimetric analysis (7 Hours)

Basic principle of titrimetric analysis. Classification, Preparation and dilution of reagents/solutions. Preparation of solutions from source materials: Normality, molarity, conversion factors (using equivalent weights/molecular weights).

Acid-base titrimetry: Ostwalds theory acid-base titrations, Titration curve for strong acid-strong base.

Redox titrimetry: Theory of redox indicators (Example: diphenylamine), role of H_3PO_4 in redox titration, Applications of redox titrations.

Complexometric titrimetry: Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA – direct and indirect determinations, Application for the determination of hardness of water. (Numerical Problems to be solved, wherever necessary).

References:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman.
2. Willard, Hobert H. et.al., Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. New York- John Willy, 2004.
4. Harris, Daniel C, Quantitative Chemical Analysis, 3 rd Edition, W.H. Freeman and Company, New York, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry New Age, International Publisher, 2009.

6. Skoog, West and Holler, Fundamentals of Analytical Chemistry, 6th Edition, Sauders College Publishing, New York. 1991.
7. Quantitative Analysis, R.A. Day and A.L. Underwood, VI Edition, 1993, Prentice Hall, Inc. New Delhi.
8. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, VI Edition, Third Indian Reprint. 2003. Pearson Education Pvt. Ltd., New Delhi.
9. Analytical Chemistry Principles, John H. Kennedy, II Edition, Saunders College Publishing, California, 1990.

UNIT - II: Inorganic Chemistry **12 Hours**

Chapter-1: Atomic structure (7 Hours)

Wave nature of electron, de-Broglie equation. Heisenberg uncertainty principle. Schrodinger wave equation (no derivation). Significance of ψ and ψ^2 –atomic orbitals, Eigen values and eigen function, radial angular wave function and probability distribution curve for 1s, 2s, 2p, 3s and 3p orbitals.

Quantum numbers and their significance. Shapes of s, p and d-orbitals and their nodal planes. Assigning of quantum number to a given electron in an atom (I and II period elements) in the periodic table. Energy level diagrams of poly electron system, shielding or screening effect of inner shell electron on valence electron, factors affecting the magnitude of screening effect, effective nuclear charge, applications of effective nuclear charge, screening effect based on Slater's rule - Numerical problems to be solved.

Chapter-2: Periodic properties (5 Hours)

Ionization energy: Explanation, factors affecting the magnitude of ionization energy, variation of ionization energy in a group and period. Successive ionization energies, effect of ionic size and electronic configuration (III period), applications.

Electron affinity: Definition, factors affecting the magnitude of electron affinity, variation of electron affinity in a group and period, explanation for the observed trend, applications.

Electronegativity: Definition, explanation, factors influencing electronegativity variation in a group and period, explanation for the observed trend, Anomalies to be accounted, Pauling scale and Mulliken's scale of electronegativity (Problems to be solved), applications.

References:

1. Principles of Inorganic Chemistry (UGC Syllabus), B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publishers, New Delhi, India, 2008.
2. Advanced Inorganic Chemistry by Gurudeep Raj, Chatwal and Anand, Goel Publications, 1974.
3. Modern Inorganic Chemistry by R.D. Madan, S. Chand and Co., 1987.
4. Advanced Inorganic Chemistry by Sathyaprakash, S. Chand Publishers, 2000.
5. J.E. Huheey, E.A. Keiter and R.L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, IV Edition, Pearson Education, India,2006.
6. F.A. Cotton, G. Wilkinson, C.M. Murillo and M. Bochmann, Advanced Inorganic Chemistry, VI Edn, John Wiley and Sons, Inc., New York,1999.

UNIT - III: Organic Chemistry **12 Hours**

Chapter-1: Structure and bonding in organic molecules (3 Hours)

Nature of chemical bonding: covalent and hydrogen bonding with examples. Orbit and orbital, shapes of s and p orbitals. Concept of hybridization in carbon atom. Shape, structure, bond length, bond angle, bond energies of methane and ethane, ethene and ethyne.

Chapter-2: Basic concepts in mechanism of organic reactions (6 Hours)

Arrow notations: curved arrow, single headed, double headed, and half headed arrow. Cleavage of covalent bond- homolytic and heterolytic with example.

Types of reactions: addition, elimination, substitution, rearrangement reactions with suitable examples. Types of reagents: electrophilic reagents, nucleophilic reagents. Electronic effects: inductive, electromeric, mesomeric, hyper conjugation. Resonance- rules for writing resonance.

Reactive intermediates- formation, structure and stability of free radicals, carbocation, carbanion, carbene, nitrene with examples.

Chapter-3: Chemistry of Aliphatic hydrocarbons (3 Hours)

Carbon-Carbon Sigma bonds Chemistry of alkanes: Formation of alkanes, Wurtz reaction, Wurtz-Fittig reaction, Ullmann reaction. Free radical substitutions: Mechanism of Halogenation- relative reactivity and selectivity.

References:

1. Organic Chemistry, Bahl and Arun Bahl, S. Chand and Sons, New Delhi, 2005.
2. Organic Chemistry, R.T. Morrison and R.N. Boyd, VI Edition, Printice-Hall of India Limited, New Delhi, 1992.
3. Organic Chemistry, B.Y. Paula, III Edition, Pearson Education, Inc. (Singapore), New Delhi, Reprint, 2002.
4. Textbook of Organic Chemistry, P.S. Kalsi, Mac Millan, 2000.

UNIT - IV: Physical Chemistry **12 Hours**

Chapter-1: Gaseous State (9 Hours)

Elementary aspects of kinetic theory of gases, Ideal and real gases. Molecular velocity, collision frequency, collision diameter, Collision cross section, collision number and mean free path and coefficient of viscosity, calculation of σ and η, variation of viscosity with temperature and pressure.

Maxwell's Boltzmann distribution law of molecular velocities (Most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies (derivation), law of equipartition of energy.

Behaviour of real gases: Deviation from ideal gas behaviour. Compressibility factor (Z) and its variation with pressure for different gases. Causes of deviation from ideal behaviour, vander Waals equation of state (No derivation) and application in explaining real gas behaviour. Critical phenomena - Andrews isotherms of CO_2, critical constants. Law of corresponding states. (Numerical problems to be solved, wherever necessary).

Chapter-2: Distribution Law (3 Hours)

Nernst Distribution Law - Statement and its derivation. Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo a) Association b) Dissociation, Applications.

References:

1. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing House, 2021.
2. Essential of Physical Chemistry; Arun Bahl, B.S. Bahi and G.D. Tuli, S. Chand and Co., 2020.
3. Physical Chemistry through Problems, S.K. Dogra, New Age International Publishers, 2015.
4. Physical chemistry; R. L. Madan, G.D. Tuli, S. Chand &Co., 2022.
5. Elements of Physical Chemistry - Glasstone and Lewis - Macmillan, 1962.
6. Text book of Physical Chemistry - S. Glasstone- Macmillan (India) Ltd., 2009.
7. Numerical Problems on Physical Chemistry- Gashal, Books and Allied (P) Ltd., 2013.
8. Physical Chemistry, P.C. Rakshit, V Edition (1988), Fourth Reprint (1997), Sarat Book House, Calcutta, Fourth Reprint, 1997.
9. W. Kauzmann, Kinetic Theory of Gases (Thermal Properties of Matter, Vol (I), Benjamin, Reading, MA, 1966.

I - Semester

Practical Paper: CHEP1 – Chemistry Practical-I **Total Teaching Hours: 64**

1. Acid-Base Titrations

a) Calibration of pipettes, burettes and standard flasks.
b) Preparation of standard solution of Sodium carbonate, standardization of HCl and estimation of NaOH.
c) Preparation of standard solution of potassium biphthalate, standardization of sodium hydroxide solution and estimation of HCl.
(d) Determination of alkali content of antacid tablets using HCl.
(e) Estimation of calcium content in chalk as calcium oxalate.
(f) Estimation of carbonate and hydroxide present together in mixture.
(g) Estimation of carbonate and bicarbonate present together in a mixture.
(h) Estimation of free alkali present in different soaps/detergents

2. Oxidation-Reduction Titrations

(a) Preparation of Standard solution of oxalic acid, standardization of $KMnO_4$ solution and estimation of Mohr's salt.
(b) Estimation of oxalic acid and sodium oxalate in a given mixture.
(c) Preparation of standard $K_2Cr_2O_7$ solution and estimation of Mohr's salt using internal (diphenylamine) indicator.

References:

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6 th edition, Third Indian Reprint, Pearson Education Pvt. Ltd.(2007).
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
3. Analytical Chemistry, G.D. Christian, 6 th edition, Wiley-India (2007).
4. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).

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I – Semester

Course Objectives:

1. To congregate the basic concepts of analysis and analytical techniques, choice of analytical methods, to learn about the different laboratory reagents and solvents, their types, preparation of their solutions, to study the different types of titrimetric analysis.
2. To create a firm basis for successful integration of the knowledge of wave nature of an electron, along with the shapes of orbitals, to understand the quantum numbers, their significance also to explore the various periodic properties and their trend in the periodic table.
3. To study basics of structure and bonding in organic molecules, hybridization, to learn about the basic concepts in mechanism of organic reactions, also to know about the chemistry of aliphatic hydrocarbons.
4. To understand the elementary aspects of kinetic theory of gases, molecular velocities, behavior of real gases and also about the distribution law and its modifications.
5. To develop expertise in experimental skills of acid-base and redox titrimetric analysis.

Course Outcome:

After successful completion of I-Semester in Chemistry, a student should be able to;

1. Understand the definitions of analysis, determination, measurement, techniques and methods, Choice of an analytical method, learn the types of reagents and preparation of their solutions of required concentrations.
2. Understand principles of titrimetric analysis and applications.
3. Describe the atomic structure, electronic configurations of atom and various periodic properties.
4. Explain bond properties, basic concept of organic reaction mechanism, the Chemistry of hydrocarbons.
5. Gain knowledge of Gaseous State Elementary aspects of kinetic theory of gases, Ideal and real gases. Boyle temperature (derivation not required), Molecular velocity, and allied concepts.
6. Understand the fundamentals of gaseous state, the Nernst distribution law, distribution constant and factors affecting it.
7. Perform and practice the calibration of glass wares, understand the basic concepts involved in different titrimetric analyses.

II – Semester

Theory Paper: CHET2 – Chemistry-II **Total teaching Hours: 48**

UNIT-I: Analytical Chemistry **12 Hours**

Chapter-1: **Evaluation of analytical data (4 Hours)**

Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples –mean, median, range, standard deviation and variance, confidence limit, test of significance, rejection of a result, Q- Test.
(Numerical problems to be solved)

Chapter-2: Chromatography – I (8 Hours)

General description of chromatography- classification, chromatograms, retention time, retention factor, capacity factor, selectivity factor, band broadening and column efficiency, methods for describing column efficiency – plate theory. Theory of band broadening, van Deemter equation, column resolution, variables affecting column resolution.
Paper Chromatography (PC): Principle, R_f, R_x and R_G values, techniques of paper chromatography; two-dimensional paper chromatography, visualization and evaluation of chromatograms, quantitative estimations, applications, experimental paper chromatography.
Thin-layer Chromatography (TLC): Superiority of TLC, theory of TLC, techniques of TLC, applications.

References:

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas, B. Sivasankar, 6th Edition, Pearson Education, New Delhi, India, 2012.
2. Instrumental methods of Chemical Analysis (covering UGC Syllabus), H. Kaur, Pragathi Prakashan, New Delhi, India, 2021.
3. Introduction to Chromatography- Theory and Practice, V.K. Srivatsan and K.K. Srivatsan, S. Chand Company Ltd. 4th Edition (1991).
4. Quantitative Chemical Analysis, Daniel C. Harris, 6th Edition, W.H. Freeman and Company, New York, USA, 2003.
5. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, E.J. Holler, S.R. Crouch, 8th Edition, Thomson Asia Pvt. Ltd., Singapore, 2004.
6. Instrumental Analysis, D.A. Skoog, E.J. Holler, S.R. Crouch, 11th Indian Reprint, Cengage Learning India Pvt. Ltd., New Delhi, 2012.
7. Analytical Chemistry – Theory and Practice,, R.M. Verma, 3rd Edition, CBS Publishers and Distributors, New Delhi, India, 2007.
8. Quantitative Analysis, Day and Underwood, Prentice/Hall Pvt. Ltd. 6th Edition (1993).
9. Vogel's text Book of Quantitative Chemical Analysis, Revised by G.H. Jaffery, J. Bassett, J. Menden and R.C. Denny, ELBS 5th Edition (1998).
10. Analytical Chemistry, Gray D. Christian, 5th Edition, John Wiley and Sons, Inc., 1994.

UNIT-II: Inorganic Chemistry **12 Hours**

Chapter – 1 Chemical bonding, molecular structure, ionic bonding (4 Hours)

General characteristics of ionic compounds. Energy considerations in ionic bonding, lattice energy and 6alvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Landé equation and calculation of lattice energy. Born Haber cycle and its applications.

Polarizing power and polarizability: Fajan's rules, ionic character in covalent compounds and percentage of ionic character.

Chapter-2: Covalent bonding (8 Hours)

General characteristics of covalent compounds. VB approach, shapes of inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Molecular Orbital Theory: LCAO method, bonding and antibonding Mos and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules: O_2, N_2 and ions of 1st and 2nd periods: He_2^+, O_2^+ and heteronuclear diatomic molecules such as CO, CN^- and NO^+. Comparison of VB and MO approaches. Writing the electronic configuration, calculation of bond order based on MOT.

References:

1. Inorganic Chemistry – Principles of Structure and Reactivity, James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, 4th Edition, Pearson Education, Indian Edition, New Delhi, India, 2013.
2. Inorganic Chemistry, Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong, 5th Edition, Oxford University Press, UK, 2013. 10
3. Inorganic Chemistry – Principles of Structure and Reactivity, James E. Huheey, Ellen A. Keiter, Richard L. Keiter, 4th Edition, Pearson, Indian Edition, New Delhi, India, 2004.
4. Inorganic Chemistry, Gary L. Miessler, Donald A. Tarr, 3rd Edition, Pearson Education, New Delhi, India, 2004.
5. Inorganic Chemistry, Keith F. Purcell, John C. Kotz, First Indian Reprint, Cengage Learning India Pvt. Ltd., New Delhi, India, 2010.
6. Concise Inorganic Chemistry, 5th Edition, J.D. Lee, Blackwell Science Ltd., London, 2003.
7. Advanced Inorganic Chemistry, Volume-I, Satya Prakash, G.D. Tuli, S,K, Basu, R.D. Madan, S. Chand and Company, New Delhi, India, 2008.
8. Principles of Inorganic Chemistry (UGC Syllabus), B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publishers, New Delhi, India, 2008.
9. Inorganic Chemistry, James E. House, First Indian Reprint, Academic Press, USA, 2010.
10. Basic Concepts of Inorganic Chemistry, D.N. Singh, Pearson Education, New Delhi, 2010.

UNIT – III: Organic Chemistry 12 Hours

Chapter-1: Alkenes (4 Hours)

Nomenclature. Methods of preparation- dehydration of alcohols, dehydrohalogenation of alkyl halides, partial hydrogenation of alkynes. Addition of HBr to propene – Markownikoff's rulemechanism. Peroxide effect, mechanism. Reactions- oxidation with acidic $KMnO_4$, lead tetra acetate, Bayer's reagent. Dienes: Nomenclature and classification of dienes. Preparation of butadiene from 1,4-diols, n-butane. Addition of HBr to butadiene with mechanism. Diel's-Alder reaction with mechanism.

Chapter-2: Alkynes (2 Hours)

Nomenclature. Preparation from vicinal and gem dihalides. Alkylation of acetylene. Acidity of alkynes. Reactions with ammonical $AgNO_3$, Cu_2Cl. Addition reaction: Addition of H_2O, mechanism of addition of HCl to ethyne.

Chapter-3: Alcohols (6 Hours)

Monohydric alcohols- Classification, nomenclature, preparation from alky halides, aldehydes, ketones. Distinguish test between 1^0, 2^0, 3^0 by Victor-Meyer method, Lucas method. Test for hydroxyl alcohol- formation of alkoxide, esterification with mechanism, oxidation.

Dihydric alcohols- Nomenclature, preparation of glycol from alkene. oxidative cleavage using lead tetra acetate, periodic acid. Uses of ethylene glycol. Pinacol - Pinacolone rearrangement with mechanism.

Trihydric alcohol- Nomenclature. manufacture of glycerol from Spent lye. Synthesis from propene. Reactions of glycerol with oxalic acid at different temperatures, reaction with PCl_5, with fatty acids.

References:

1. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. B.S. Bahl and Arun Bahl, Organic Chemistry, S. Chand and Sons, New Delhi, 2005.
3. R. K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993.
4. J. March, Advanced Organic Chemistry, Wiley Interscience, 1994.
5. E.S. Gould, Mechanism and Structure in Organic Chemistry, Halt, Rinhart& Winston, New York, 1963.
6. Peter Sykes, A Guide book to mechanism in Organic Chemistry., Pearson Education India, 2003.
7. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, III Edition, Plenum Press, New York, 1990.
8. S. K. Ghosh, Advanced General Organic Chemistry, Book and Allied (P) Ltd, 1998.

UNIT-IV: Physical Chemistry 12 Hours

Chapter-1: Liquid State (5 Hours)

Definition and determination of surface tension using stalagmometer, effect of temperature and solute on surface tension.

Viscosity: Definition, Coefficient of viscosity. Determination of viscosity of a liquid using Oswald's viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces.

Refraction: Specific and molar refractions- definition and advantages. Determination of refractive index by Abbe's Refractometer. Additive and constitutive properties. Parachor: Definition, Atomic and structure parachor, Elucidation of structure of benzene and benzoquinone. (Numerical Problems to be solved).

Chapter-2: Solid State and Crystallography (5 Hours)

Classification of solids – Isotropic and anisotropic crystals. Elements of symmetry – plane, axes and center of symmetry. Definition of unit cell & space lattice.

Laws of crystallography: – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Representation of planes – Miller Indices, Weiss indices and its calculations using simple examples. X-ray diffraction by crystals, derivation of Bragg's equation. Determination of crystal structure of NaCl. (Numerical Problems to be solved).

Liquid Crystals: Definition, types of liquid crystals, Classification of liquid crystals into Smectic and Nematic. Applications of Liquid Crystals.

Chapter-3: Ionic equilibria (2 Hours)

Hydrolysis of salts of weak acids and weak bases. Ionic product of water. Degree of

hydrolysis. Effect of temperature and dilution on degree of hydrolysis. pH of solutions. Common-ion effect, buffers, buffer action, Henderson's equation (No derivation). Solubility product and ionic product in precipitation and in qualitative analysis.

References:

1. Physical Chemistry; R. L. Madan, G. D. Tuli, S. Chand & Co., 2010.
2. Solid State Chemistry, D.K. Chakrabarty, New Age International, 2010.
3. Crystal Engineering: A Textbook, Gautam R. Desiraju, Jagadese J. Vittal, IISc Press and World Scientific Publishing, Singapore, 2011.
4. Solid State Chemistry and Its Applications, Anthony R. West, John Wiley & Sons, 2022.
5. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing Co., 2020.
6. A Textbook of Physical Chemistry, Volume 2, K L Kapoor, Mc. Millanpublishersndia Limited, 2000.
7. Physical Chemistry, K. J. Laidler and J. M. Meiser, III Edition, Houghton Mifflin Comp., New, York, International Edition (1999).
8. Physical Chemistry, V Edition, G. M. Barrow, Tata McGraw Hill, 1996.

II – Semester

Practical Paper: CHEP2 – Chemistry Practical-II **Total Teaching Hours: 64**

Systematic Qualitative Organic Analysis

Systematic qualitative analysis of the organic compound, naming of the compound and preparation of a suitable solid derivatives.

The following compounds may be given for the analysis.

Urea, Oxalic Acid, Glucose, Aniline, Toluidene, Benzoic Acid, Salicylic Acid, Cresol, Resorcinol, Benzaldehyde, Acetophenone, Benzyl Alcohol, Toluene, Chlorobenzene, Nitrobenzene, Benzamide and Acetanilide.

References:

1. Vogel's Text book of Practical Organic Chemistry, 5th edition, B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Longmann Publishers, 1989.
2. A Laboratory Manual Of Qualitative Organic Analysis, H.T. Openshaw, Cambridge University Press, 1945.
3. Qualitative Organic Analysis, Oliver Kamm, John Wiley and Sons., 1922.
4. Comprehensive Practical Organic Chemistry: Qualitative Analysis, V.K. Ahluwalia, S. Dhingra, Universities Press, 2004.
5. Organic Qualitative Analysis: A Systematic and Conceptual Approach, Dr. Sushil Ramakant Mathapati, Prabhakar Publication Latur, Edition, 2023.

II - Semester

Course Objectives:

1. To teach students the concept of evaluation of analytical data, statistical treatment of finite samples and to develop a solid understanding of concepts in chromatographic techniques, classification and their theories and to explore the principles and applications of planar chromatography.
2. To impart the concepts of general characteristics of ionic, covalent compounds, to learn the shapes of inorganic molecules based on VBT and to understand MOT using several examples.
3. To explore the nomenclature, preparation methods and reactions of alkenes and alkynes, to have a knowledge of classification, nomenclature, preparation, reactions of alcohols.
4. To make students to have knowledge on the theoretical aspects related to liquids, solids and liquid crystals.
5. To perform the systematic qualitative analysis of the organic compound, naming of the compound and preparation of a suitable solid derivatives, to have an expertise, skills in these experiments.

Course Outcome:

After successful completion of II semester in Chemistry, a student should be able to;

1. Learn the evaluation of analytical data and a description of chromatographic techniques.
2. Know the general characteristics of ionic and covalent compounds, suitable examples, using VB, VSEPR and MOT.
3. Understand the structural features and reactivity of alkenes, alkynes and alcohols.
4. Explain the theoretical aspects related to liquids, solids and liquid crystals.
5. Perform the systematic qualitative analysis of the organic compound, naming of the compound and preparation of a suitable solid derivatives.