



RAICHUR UNIVERSITY, RAICHUR

**Under Graduate Curriculum for Degree of
Bachelor of Science (B.Sc) in**

**Chemistry
(I & II Semester)**

**As per Revised NEP 2024
With Effect from the Academic year from
2024-25 and onwards**

Programme Outcomes (PO):

On completion of the 03 years Degree in Chemistry students will be able to:

- PO 1** Demonstrate, solve and an understanding of major concepts in all the disciplines of chemistry.
- PO 2** Provide students with broad and balanced knowledge and understanding of key chemical concepts.
- PO 3** Understand practical skills so that they can understand and assess risks and work safely and competently in the laboratory.
- PO 4** Apply standard methodology to the solutions of problems in chemistry.
- PO 5** Provide students with knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas involving chemistry.
- PO 6** Provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes.
- PO 7** Develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.
- PO 8** Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.
- PO 9** Prepare students effectively for professional employment or research degrees in chemical sciences.
- PO 10** Cater to the demands of chemical industries of well-trained graduates.
- PO 11** Build confidence in the candidate to be able to work on his own in industry and institution of higher education.
- PO 12** Develop an independent and responsible work ethics.

B.Sc. Semester – I

DSC-1: Chemistry (Theory) 1

Course title - Chemistry-1

Course Code: C 1 CHE 1 T 1

Course Outcome (CO):

After completion of course (Theory), students will be able to:

CO1: Describe the dual nature of radiation and matter; dual behavior of matter and radiation, de Broglie's equations, Heisenberg uncertainty principle and their related problems. Quantum mechanics. Derivation of Schrodinger's wave equation. Orbital shapes of *s*, *p*, *d* and *f* atomic orbitals, nodal planes. Electronic configurations of the atoms.

CO2: Define periodicity, explain the cause of periodicity in properties, classify the elements into four categories according to their electronic configuration. Define atomic radii, ionization energy, electron affinity and electronegativity, discuss the factors affecting atomic radii, describe the relationship of atomic radii with ionization energy and electron affinity, describe the periodicity in atomic radii, ionization energy, electron affinity and electronegativity.

CO3: Explain bond properties, electron displacement effects (inductive effect, electrometric effect, resonance effect and Hyper conjugation effect). steric effect and their applications in explaining acidic strength of carboxylic acids, basicity of amines. Understand basic concept of organic reaction mechanism, types of organic reactions, structure, stability and reactivity of reactive intermediates.

CO4: Describe important characteristics of configurational and conformational isomers. Practice and write conformational isomers of ethane, butane and cyclohexane. Understand the various concepts of geometrical isomerism and optical isomerism. Describe CIP rules to assign E,Z notations and R& S notations. Explain D and L configuration and *threo* and *erythro* nomenclature. Explain racemic mixture and racemization, resolution of racemic mixture through mechanical separation, formation of diastereomers, and biochemical methods, biological significance of chirality.

CO5: Explain the existence of different states of matter in terms of balance between intermolecular forces and thermal energy of the particles. Explain the laws governing behavior of ideal gases and real gases. Understand cooling effect of gas on adiabatic expansion. Describe the conditions required for liquefaction of gases. Realize that there is continuity in gaseous and liquid state. Explain properties of liquids in terms of intermolecular attractions.

CO6: Understand principles of Analytical chemistry and statical analysis.

CO7:: Understand principles of titrimetric analysis. Understand principles of different type's titrations.

CO8: Understand stages in gravimetric analysis, conditions of precipitation. theories of precipitation, factors influencing precipitation, co-precipitation and post-precipitation. To know about Structure, specificity, conditions

Syllabus

DSC-1 : Chemistry 1 (C 1 CHE 1 T 1)

Unit-I : ATOMIC STRUCTURE & PERIODICITY OF ELEMENTS

Atomic Structure: Review of Rutherford's atomic model, Bohr's theory, Hydrogen atomic spectra. Derivation of radius and energy of an electron in hydrogen atom, limitations of Bohr's theory, dual behavior of matter and radiation, de Broglie's equations, Heisenberg uncertainty principle and their related problems. Schrodinger's wave equation for hydrogen atom and meanings of various terms in it (derivation not required). Physical Significance of ψ and ψ^2 . Radial and angular wave functions (atomic orbitals) and their distribution curves for $1s$, $2s$, $2p$, $3s$, $3p$ and $3d$ orbitals (Only graphical representation). Radial and angular nodes, nodal planes and their significance. Quantum numbers and their significances. Shapes of s , p and d atomic orbitals. Rules for filling electrons in various orbitals, electronic configurations of the atoms (atomic number up to 54). Concept of exchange energy. Anomalous electronic configurations.

Periodicity of elements: Brief account on the following properties with reference to s , p , d , and f block elements and trends in groups and periods: Atomic and ionic radii, Effective nuclear charge, screening effect, Slater's rules, ionization enthalpy, electron gain enthalpy, electro negativity, Pauling / Allred-Rochow scale.

Unit-II FUNDAMENTALS OF ORGANIC CHEMISTRY & STEREOCHEMISTRY-I

Fundamentals of Organic Chemistry: Review of hybridization (sp^3 , sp^2 and sp). Bond parameters - bond lengths, bond angles, bond energies and dihedral angles, bond polarity, dipole moment and illustrate with examples of organic compounds, factors affecting bond parameters. Localized and delocalized bonds. Linear and crossed conjugation system. Electron displacement effects and their applications: inductive effect, electrometric effect, resonance effect, hyper conjugation, and steric effect.

Organic reaction Mechanism: Meaning of reaction mechanism. Curly arrow rules. Classification of organic reactions: substitution, addition, elimination, rearrangement, oxidation and reduction reactions with suitable examples, Types of bond fission. Types of reagents: Electrophiles and nucleophiles (all types of examples to be given). Reactive intermediates: Structure, formation, stability and reactions of Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes and Arynes.

Stereoisomerism-I:

Meaning of stereoisomerism, Molecular representation: Fischer's projection formulae, Newman's formulae, Saw horse formulae. conformational isomers and configurational isomers (distinction between conformation and configuration), Geometrical isomerism: definition, reason for geometrical isomerism, E and Z notation, determination of configuration of geometric isomers by dipole moment method and anhydride formation method, Syn and Anti isomers in compounds containing $C=N$ and their significance.

Unit-III GASEOUS & LIQUID STATES

Gaseous state: Review of Ideal gas behaviour and kinetic theory of gases.

Molecular velocity: Distribution of molecular velocities, most probable, average and root mean square velocities. Relation between RMS, average and most probable velocities. Distribution of energy amongst molecules. Law of equipartition of energy.

Collision properties: Collision frequency, collision diameter (σ), 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.

Critical phenomena: Andrews's isotherms of CO_2 , critical constants and their determination. Relation between critical constants and van der Waals equation (Derivation), principle of continuity of states, law of corresponding states. Numerical problems are to be solved wherever applicable.

Liquid state: Molecular forces and general properties of liquids.

Surface tension: surface tension, surface energy, shapes of liquid drops and soap bubbles, capillary action, determination of surface tension by capillary rise method, drop weight and drop number methods. Effect of temperature on surface tension. Parachor, Additive and constitutive properties: atomic and structural

parachor. Elucidation of structure of benzene and benzoquinone.

Viscosity: Viscosity coefficient, fluidity, molecular viscosity, relative viscosity and absolute viscosity, determination of viscosity using Ostwald viscometer. Effect of temperature, weight, size and shape of molecules and intermolecular forces.

Refractive index: Definition, specific and molar refraction. Determination of refractive index using Abbe's refractometer. Additive and constitutive properties: Elucidation of structure of molecules. Numerical problems are to be solved wherever applicable.

Unit-IV Analytical chemistry.

Introduction to Analytical Chemistry Definition and scope of Analytical Chemistry, Importance of Analytical Chemistry in various fields Types of analytical techniques: Error, Accuracy and precision. Classification of errors determinate and indeterminate errors, minimization of errors. Statistical treatment of finite samples: measures of central tendency and variability (mean, median, range, standard deviation, and variance). Problems to be solved

Introduction to Volumetric analysis.: Principles Volumetric analysis Derivation of $N_1V_1=N_2V_2$. Equivalent weight, (acid, base, salt, oxidising and reducing agents) Concentrations of solutions Normality, Molarity, Molality, Mole, Mole fraction and ppm. Standard solution. Titrations, Types of titrations Equivalence point and End point. Indicators and types of indicators. Problems to be solved.

Introduction to Gravimetric analysis.: Principles, theories of precipitation, conditions of precipitation factors influencing precipitation, Types of precipitation. steps involved in the gravimetric analysis. Whatman filter and its types. Crucibles and its types .

Recommended Books/References

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: Principles of Structure and Reactivity, Pearson Education India, 2006.
5. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
6. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
7. Rodgers, G. E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.
8. Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012) Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry. John Wiley & Sons, 1974.
9. G.L. Miessler & Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
10. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
11. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., New York (1985).
12. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
13. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi, 2004.
14. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
15. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
16. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
17. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
18. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
19. Graham Solomons, T. W., Fryhle, C. B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons

(2014).

20. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
21. Organic Chemistry-F. A. Carey, 4th Edition, McGraw Hill (2000).
22. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983.
23. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998.
24. Organic Chemistry - L. Ferguson, Von Nostrand, 1985.
25. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
26. Organic Chemistry- Mehta and Mehta, 2005.
27. Castellan, G.W. Physical Chemistry, 4th Ed. Narosa, 2004.
28. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi, 2009.
29. P.W. Atkins: Physical Chemistry, 2002.
30. W.J. Moore: Physical Chemistry, 1972.
31. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
32. Text Book of Physical Chemistry - S. Glasstone, Mackmillan India Ltd., 1982.
33. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
34. Physical Chemistry - Alberty R. A. and Silbey, R. J. John Wiley and sons, 1992.
35. Physical Chemistry - G. M. Barrow, McGraw Hill, 1986.
36. Physical Chemistry (3rd Edition) - Gilbert W. Castilian, Narosa Publishing House, 1985.
37. Chemical Kinetics by K. J. Laidler, Tata McGraw Hill Publishing Co., New Delhi.
38. Kinetics and Reaction Mechanisms by Frost and Pearson, Wiley, New York, 1981.
39. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
40. Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
41. Vogel's Qualitative and quantitative Inorganic Analysis, G.Svehla, 7th Ed, Longman (2001).

B.Sc. Semester – I

DSC 2: Chemistry Practical I

Course title - Chemistry-2

Course Code: C 1 CHE 1 P 1

Course Outcome (CO):

After completion of course (Practical), students will be able to:

CO1: Understand and practice the calibration of glassware's (burette, pipette, volumetric flask).

CO2: Gain basic concepts involved in titrimetric analysis, primary standard substances, and preparation of standard solutions.

CO3: Explain the principles of acid-base, titrations.

CO4: Work out the stoichiometric relations based on the reactions involved in the titrimetric analysis.

CO5: Based on principles of titrimetric analysis student can perform different analysis.

Syllabus-

Chemistry (Practical) I (C 1 CHE 1 P 1)

Inorganic chemistry experiments

Calibration of glass wares (burette, pipette, and volumetric flask), primary and secondary standard solutions, normality, molarity, molality and calculation of equivalent mass of acids, bases, oxidants and reductants.

1. Standardization of HCl solution using standard sodium carbonate solution and determination of sodium carbonate and sodium hydroxide present in a mixture.
2. Standardization of HCl solution using standard sodium carbonate solution and determination of sodium carbonate and sodium bicarbonate in a mixture.
3. **Determinations of total alkalinity in antacids in terms of calcium carbonate (two different samples).**
4. **Determination of Vitamin C in fruit juice / formulations by iodate method (two different samples).**

Distribution of marks

Accuracy- 20 (10+10)Marks, Technique and presentation - 04 Marks, Reactions and Calculations- 06 Marks,

Viva- 05 Marks, Journal- 05 Marks, Total - 40 Marks

Deduction of marks for accuracy : : ± 0.2 CC – 10 marks, ± 0.4 CC- 08 marks, ± 0.6 CC- 06 marks, ± 0.8 CC - 04 marks. Above ± 1.0 CC - 00 marks

Explanation regarding crystallization, fractional crystallization, sublimation, reflux, distillation, fractional distillation, distillation under reduced pressure, steam distillation and determination of melting point of the crystallized solid & boiling point of the liquid. (Students should write in the journal regarding the above).

Preparation of organic compounds

1. Acetylation - Synthesis of acetanilide from aniline using Zn Dust/AcOH. (Green method)
2. Nitration – Acetanilide to p-nitro acetanilide.
3. Hydrolysis - Benzamide to benzoic acid.
4. Oxidation – Benzaldehyde to benzoic acid.
5. Reduction – m-dinitrobenzene to m- nitro aniline.

Note: In the preparation experiment, student has to write mechanism of reactions, calculation of quantitative yield, determination of melting point and to perform recrystallization.

Distribution of marks for preparation experiments: (15 marks.)

Calculation of theoretical yield – 03 marks, observed yield -10 marks, M.P- 02 marks,

Deduction of marks for observed yield: Less than 10% - 10 marks, 11-15% - 8 marks, 16-20% - 6 marks, 21-25 % - 4 marks & above 25% - 2 marks.

Physical Chemistry

1. **Determination of surface tension and parachor of toluene and xylene**
2. Determination of density and viscosity of ethyl acetate & toluene.
3. **Determination of viscosity of sucrose solutions for various concentrations by Ostwald's Viscometer and percentage of unknown composition.**
4. **Study the distribution of acetic acid/ benzoic acid between water and toluene.**
5. **Determination of specific refraction of liquids A & B and calculation of percentage composition of unknown liquid mixture of A and B using Abbe's refractometer (formula method).**

Distribution of Marks:

Accuracy-18 marks, Technique and Presentation-3marks Calculation and graph-(5+4) 9 marks, Journal-5 marks, Viva-Voce-5 marks, Total=40 marks.

Deduction of Marks for accuracy:

Error up to 5% - 18 marks, 6 - 10%-15 marks, 11-15%- 12 marks, 16-20% 09 marks, above 20% zero (0) marks

General instructions:

In the practical examination, in a batch of ten students, minimum two different experiments may be given Selection of experiments may be done by the students based on lots. Viva questions may be asked on any of the experiments prescribed in the practical syllabus. *Manual is not allowed in the examination.*

Books recommended:

Vogel's Qualitative and quantitative Inorganic Analysis, G. Svehla, 7th Ed, Longman (2001).

1. **Advanced Practical Chemistry, Pragathi, Publications, Jagadamba Singh,**
2. **Advanced Practical Inorganic Chemistry, Gurdeep Raj, Goel Publishing House, Meerut**