



Deccan Education Society's
Fergusson College (Autonomous)
Pune

Learning Outcomes-Based Curriculum
for 3/4 years B.Sc /B.Sc (Honours) Programme
as per guidelines of
NEP-2020

for

F. Y. B. Sc. (Chemistry)

With effect from Academic Year

2024-2025

Program Outcomes (POs) for B. Sc. Programme

PO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of an graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	Social competence: Display the understanding, behavioural skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	Personal and professional competence: Performing dependently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	Self-directed and Life-long learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PSO No.	Program Specific Outcomes (PSOs) Upon completion of this programme the student will be able to
PSO1	<p>Academic Competence:</p> <p>i. Understand the fundamental concepts of theoretical and experimental aspects of physical, organic, inorganic, analytical and allied chemistry subjects.</p> <p>ii. Explain and clarify the understanding of thermodynamic, spectroscopic, kinetic and quantum models, stereochemistry and mechanism of organic reactions, chemical bonding and structure elucidation, analytical techniques and solving numerical problems.</p> <p>iii. Correlate and apply the theoretical chemistry knowledge in explaining practical schemes</p>
PSO2	<p>Personal and Professional Competence: i. Solve numerical problems, mechanisms, analytical interpretation using chemistry concepts and knowledge. ii. Execute the knowledge of spectroscopic techniques learnt to characterize and identify structures of molecules used in drugs and pharmaceutical products. iii. Analyse chemical species qualitatively and quantitatively using appropriate analytical techniques. iv. Build confidence, patience, time management, leadership and intangible skills to achieve the goals in competitive examinations for higher learning courses in chemistry to meet global competencies.</p>
PSO3	<p>Research Competence: i. Identify and understand research literature and appropriate techniques used in chemistry related problems. ii. Create awareness and promote research attitudes among students. iii. Interpret spectroscopic data to identify basic organic compounds.</p>
PSO4	<p>Entrepreneurial and Social Competence: i. Understand and explain the processes needed in domain related industries and write their general aspects. ii. Apply information related to material safety data sheets (MSDS) needed in various industries. iii. Embrace reduce, recycle and restore chemicals (3R's) approach and gain the sense of ethical, social and environmental awareness and responsibility.</p>

Fergusson College (Autonomous), Pune

NEP 2.0 Paper Weightage Distribution 2024-25

Department of CHEMISTRY

Class: F. Y. B. Sc. Sem. I

FYBSc Sem -I	Theory/ Practical	Paper Code	Paper Title	Credits	Exam type
Discipline Specific Core, DSC	Theory	CHE- 1001	Fundamentals of Chemistry I	2	CE +ESE
Discipline Specific Core, DSC	Practical	CHE- 1011	Chemistry Practical I	2	CE +ESE
Open Elective-1 (For other faculty)	Theory	CHE- 1021	Food Chemistry	2	Only CE

FYBSc Sem -II	Theory/ Practical	Paper Code	Paper Title	Credits	Exam type
Discipline Specific Core, DSC-3	Theory	CHE- 1002	Fundamentals of Chemistry II	2	CE +ESE
Discipline Specific Core, DSC-4	Practical	CHE1012	Chemistry Practical II	2	CE +ESE
Open Elective- 2 (For other faculty)	Theory	CHE- 1022	Chemistry in daily life	2	Only CE
Skill Enhancement Course, SEC-1	Theory/ Practical	CHE- 1032	Good Laboratory Practices	2	Only CE

Sr. No.	Course Outcome	Blooms Taxonomy level	Weightage in % (For Example)	Evaluation method CE/ ESE
1	CO1. Recall the gas laws, their properties and effect of parameters on them. Recall the basics of Mole concept.	Remember	25	CE+ ESE
2	CO-2:Understand terminologies of various states of matter and mole concept.	Understand	40	CE+ ESE
3	CO-3:Derive various equations for state of matters and their properties. Solve numericalsbased on states of matter and mole concept.	Apply	20	CE +ESE
4	CO-4 Ensure the value of molar gas constant by eudiometer. Investigate the relative viscosity of liquids and packing fraction of solid.	Analyze	15	CE +ESE

Note: Number of COs can vary from subject to subject depending on expected learning Outcome

	Title and contents	CO	Weightage
Unit- 1	Gaseous State: Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behavior, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants, and their calculation from van der Waals equation. Andrew's isotherms of CO ₂ . Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules.	CO-1,2,3,4	(10 L)
Unit-	Liquid State: Intermolecular forces, physical properties of liquids- vapour pressure, surface tension and coefficient of viscosity and their determination,	CO-1,2,3,4	(05L)

2	cleansing action of detergents, effect of temperature on physical properties, liquid crystals.		
Unit- 3	Solid State: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, point and space groups, seven crystal systems and Bravais lattices, X-ray diffraction, Bragg's law, Relation between radius and edge, packing fraction and density of crystal.	CO-1,2,3,4	(05L)
Unit- 4	Mole Concept:(10L) GMV relationship, problems based on mole concept, methods of expressing concentrations, strength, normality, molarity, molality, %w/v, %v/v, ppm, standardization of solutions, primary and secondary standard substances, preparation of standard solution of acids and bases, problems related to acid base titration. Principles involved in volumetric analysis (from practical experiments) to be carried out.	CO-1,2,3	10

Note: Number of Units can vary from subject to subject depending on expected learning Outcome and number of credits

Resources:

1. Principles of physical chemistry by S. H. Maron and C. F. Prutton
2. Chemistry by John McMurry.
3. Chemistry The central Science by Brown 14th Edition Pearson Publication
4. Physical Chemistry by Robert G. Mortimer

Fergusson College (Autonomous), Pune
NEP 2.0 Paper Weightage Distribution 2024-25
Department of CHEMISTRY

Class: F. Y. B. Sc. Sem. II

Paper Code: CHE- 1002 **Paper Title:** Fundamentals of Chemistry II.

Number of Credits:02

Sr. No.	Course Outcome	Blooms Taxonomy level	Weightage in % (For Example)	Evaluation method CE/ESE
1	CO-1: Remember Classification hydrocarbons up to aromatic compounds, and apply IUPAC nomenclature rules to name alkanes and alkenes. Isomerism Classification and Representation. Analyse different types of isomerism, including conformational, geometrical, and optical isomerism, and represent molecules using Fischer, Newman, and Sawhorse projections. Recall the concept of oxidation and reduction.	Remember	20	CE +ESE
2	CO-2: Understanding Molecular Structure and Bonding, describe the covalent bond, hybridization, and molecular shapes, and analyze the influence of hybridization on bond properties and molecular geometry. Understanding Alkane and Alkene Formation, formation of alkanes and alkenes through reactions such as Wurtz reaction, Wurtz-Fittig reactions, and elimination reactions, including the mechanisms involved. Understanding and comprehending Aromaticity Hückel's rule and assessing the aromatic character of arenes, including benzene, and analyzing the stability of cyclic carbocations, carbanions, and heterocyclic compounds. Understand the terms and their relations. Understand oxidation states and oxidation number.	Understand	20	CE +ESE
3	CO-3: Apply Cahn-Ingold-Prelog (CIP) rules to assign R/S configurations, distinguish between enantiomers and diastereomers, and the properties of racemic mixtures and meso structures. Solve the numerical problems related to oxidation number.	Apply	20	CE +ESE
4	CO-4: Analyse Electronic Effects and demonstrate proficiency in explaining electronic displacements such as inductive, resonance, and mesomeric effects, and their impact on the stability and reactivity of organic compounds. Analyse Alkene	Analyze	20	CE +ESE

	Reactions, predict and explain the outcome of electrophilic addition reactions of alkenes, including Markovnikov and anti-Markovnikov additions, and their mechanisms. Analyze and balance redox reaction using oxidation number and ion-electron methods.			
5	CO-5: Evaluate Acids and Bases and compare and contrast organic acids and bases, assess their relative strengths based on pKa and pKb values, and predict their behavior in chemical reactions. Interpreting Isomer Energy Profiles. Analyze energy profile diagrams to understand the conformational isomerism in alkanes and predict the stability of different conformers.	Evaluate	10	CE +ESE
6	CO-6: Explore Aromatic Substitution reactions of benzene and its derivatives, predicting regioselectivity and product formation based on electronic and steric factors. Explore redox reactions in different pH mediums.	Create	10	CE +ESE

Note: Number of COs can vary from subject to subject depending on expected learning Outcome

Unit	Title and contents	CO	Weightage
Unit-1	Basics of Organic Chemistry (5L) Organic Compounds: Covalent bond, hybridization, shapes of molecules, influence of hybridization on bond properties, inter and intramolecular hydrogen bonding, Electronic Displacements: Inductive, resonance and mesomeric effects, hyper conjugation, tautomerism and their applications, dipole moment, organic acids and bases, their relative strength, strength of acids and bases, pKa and pKb values of common organic acids and bases.	CO-2,4,5	20
Unit-2	Chemistry of Hydrocarbons (5L) Introduction to Hydrocarbons, Classification of hydrocarbons (up to aromatic hydrocarbons), Alkanes: IUPAC nomenclature, formation of alkanes, Wurtz reaction, Wurtz-Fittig reactions, free radical substitutions: Halogenation-relative reactivity and selectivity, Alkenes: IUPAC nomenclature, formation of alkenes by elimination reactions, mechanism of E1, E2, E1cb reactions, Saytzeff and Hofmann eliminations, Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/AntiMarkownikoff addition).	CO-1,2,4,	20

Unit-3	Stereochemistry (7L) Introduction to isomerism and its classification. Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions. Conformational isomerism in alkanes (Ethane, propane and n-butane) with energy profile diagrams, Geometrical isomerism Geometrical isomerism: cis-trans and, syn-anti isomerism E/Z notations with C.I.P rules, Optical isomerism: Optical activity, specific rotation, chirality/asymmetry, enantiomers, molecules with two or more chiral-centres, distereoisomers, meso structures, racemic mixture and resolution, relative and absolute configuration, D/L, R/S and E/Z designations.	CO-1,3,5	20
Unit-4	Aromatic Hydrocarbons (3L) Aromaticity: Hückel's rule, aromatic character of arenes, homocyclic and polycyclic aromatic hydrocarbons (benzene, naphthalene, anthracene), cyclic carbocations/carbanions and heterocyclic compounds with suitable examples (Pyrrole, furan, thiophene, pyridine and its basicity) with their relevance to industry, Electrophilic aromatic substitution: Reactions of benzene.	CO-2,6	16
Unit-5	Oxidation and Reduction:(10L) Definitions of related terms, oxidizing and Reducing agents, Oxidation number, Rules to assign oxidation number. Balancing redox reactions by ion-electron method (both acidic and alkaline medium), Problem based on equivalent weight of oxidants and reductants. Standard Electrode Potential and its application to redox reactions.	CO - 1,2,3,4,6	10

Note: Number of Units can vary from subject to subject depending on expected learning Outcome and number of credits

References:

1. Clayden, J., Greeves, N., & Warren, S. G. (2012). Organic chemistry. Oxford: Oxford University Press, 2012.
2. Morrison, R. N. & Boyd, R. N. Organic Chemistry, 6th Edition, (Pearson Education), 1992.
3. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
4. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
5. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
6. Sarin and Sarin Numerical Problems in Chemistry, 1980.
7. Principles of Physical chemistry by Maron and Prutton, 1992.

Professor (Dr.) V. B. Tadke
Head
Department of Chemistry