First Year (I Semester)

Year	Semester	Course Code	Course Name	Theory/ Practical	Credit	Total Credit	Min. Counce lling hrs
CERTIFICATE IN CHEMISTRY							
I	**I**	CHE(N)-101	Fundamental Chemistry- I	Theory	3	4	9
		CHE(N)-101L	Laboratory Course/work	Practical	1		3

SEMESTER-I
(THEORY)

Programme: Certificate In Chemistry	**Year: I**	**Semester-I**
Course Code: CHE(N)-101		
Course Name: Fundamental Chemistry- I		
Credit: 3		
Max. Marks: 70+30 =100		

Course Objective and Outcomes:

Learnes will gain an understanding of

- Molecular geometries, physical and chemical properties of the molecules.
- Current bonding models for simple inorganic and organic molecules in order to predict structures and important bonding parameters.
- This course gives a broader theoretical picture in multiple stages in an overall chemical reaction.
- It describes reactive intermediates, transition states and states of all the bonds broken and formed.
- It enables to understand the reactants, catalyst, stereochemistry and major and minor products of any organic reaction. It describes the types of reactions and the kinetic and thermodynamic aspects one should know for carrying out any reaction and the ways how the reaction mechanism can be determined.
- The chapter stereochemistry gives the clear picture of two-dimensional and three-dimensional structure of the molecules, and their role in reaction mechanism. The course will also strengthen the knowledge of students regarding complete picture of states of matter that includes gaseous, liquid and solid states.

Syllabus Details

Block-1: Atomic structure and chemical bonding

Unit 1: Atomic structure

Idea of de Broglie matter wave, Heisenberg uncertainty principle, Schrodinger wave equation, significance of ψ and ψ^2 , quantum numbers, radial and angular wave functions and probability distribution curve, shape of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configuration of the elements, effecting nuclear charge.

Unit 2: Periodic Properties

The general idea of Modern periodic table, Atomic and ionic radii, ionization energy, electron affinity and electronegative- definition, methods of determination or

evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior.

Unit 3: Chemical bonding –I

Covalent bond- Valence bond theory and its limitation, directional characteristics of covalent bond, types of hybridization and shape of simple inorganic molecule and ion. Valence shell electron pair repulsion theory (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3.ICl_2^- and H_2O. MO theory, homonuclear and heteronuclear (CO and MO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Unit 4: Chemical bonding –II

Hybridization, Bond length and bond angles, bond energy, localized and delocalized chemical bond, van der Waal interactions, Inclusion compounds, clatherates, charge transfer complexes, resonance, hyperconjution, aromaticity, Steric effect (Inductive. resonance/mesomeric, electromeric and field effect) hydrogen bonding.

Block-2: Organic reaction and stereochemistry

Unit 5: Mechanism of organic reactions

Curve arrow notation, drawing electron movements with arrows, half-headed and double headed arrows, homolytic and heterolytic bond cleavage. Types of reagents, recapulation of types of reagents.

Reaction intermediates- carbocations, carbanions, free radicals, carbenes, nitrenes and benzynes (with examples). Assigning formal charge on intermediates and other ionic species.

Unit 6: Stereochemistry- I

Concept of isomerism. Types of isomerism. Optical isomerism- elements of symmetry, molecular chirality, enantiomers, stereogenic centres, optical activity, properties of enantiomers , chiral and achiral molecules with two stereogenic centres, diastereomers threo and erythro diastereomers , meso compound, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rule, D& L and R& S system of nomencleature.

Unit 7: Stereochemistry- II

Geometrical isomerism- determination of configuration of geometrical isomers. E & Z system of nomenclature, geometrical isomerism in oximes and acyclic compounds. Conformational analysis of ethane and n- butane, conformation of cyclohexane, axial and equatorial bond, conformation of mono substituted cyclohexane. Newman projection and Sawhorse formula, Fischer and flying wedge formula. Difference between configuration and conformation.

Block-3: Aliphatic Hydrocarbon

Unit 8: Alkane

IUPAC nomencleature of branch and unbranched alkanes, classification of carbon atoms in alkanes. Isomerism of alkanes, sources, methods of formation (with special reactions, Kolbe's reaction, Corey-House reaction of alkanes.; Cycloalkanes-nomencleature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations.

Unit 9: Alkene

Nomencleature of alkenes, isomerism of alkenes, methods of preparation, Physical properties of alkenes. Chemical reaction of alkenes, mechanism involved in hydrogenation, electrophilic and free radical addition, Markownikoff's rule,

hydroboration oxidation, oxymercuration reduction, ozonolysis and oxidation with $KMno_4$ and OSO_4. Polymerization of alkenes. Industrial application of ethylene and propene.

Nomencleature and classification of dienes; isolated, conjugated and cumulated dienes. Structure of allenes and butadienes. Methods of formation, polymerization. Chemical reactions -1,2 and 1,4 addition, Diels – Alder reaction.

Unit 10: Alkyne

Nomenclature, and classification, structure and bonding in alkynes. Methods of formation. Physical properties. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, oxidation and polymerization.

Block-4: State of matter

Unit 11: State of matter –I

Gases State II

Molecular velocities; Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collosion number, mean free path and collision diameter. Liquification of gases (based on Joule Thomson effect).

Liquid state

Intermolecular forces, structure of liquid (a qualitative description). Structural differences between solid, liquid and gases. Liquid crystal: difference liquid crystal, solid and liquid. Classification, structure of nematic and cholesterol phases.

Unit12: State of matter –II

Definitation of space lattice, unit cell, Law of crystallography- (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry element in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method)

SEMESTER-I

(LABORATORY WORK/PRACTICAL)

Programme: Certificate In Chemistry	**Year: I**	**Semester-I**
Course Code: CHE(N)-101L		
Course Name: Laboratory Course/Work		
Credit: 1		
Max. Marks: 50		

Course Objective and Outcomes:

Upon completion of this course, the learners will have the knowledge and skills to: understand the laboratory methods and tests related to inorganic mixture analysis and estimation of surface tension of commercial products. Also, they can understand the absolute configuration of organic molecules with the help of models. The learners will able to

- Qualitatively estimate anions and cations in samples.
- Determine the relative surface tension of a given liquid.
- Find out the absolute configuration of organic molecules.

Syllabus Details

Block-1: Laboratory hazards and safety

Unit 1: Laboratory hazards and safety precautions

Laboratory hazards and safety precautions

Block-2: Experiment

Unit 2: Inorganic exercise: Salt mixture analysis (I & II group)

Identification of acid radicals (three to four) including anions in combination and basic radicals upto II Group in the given salt mixture.

Unit 3: Organic exercise: Sterochemistry and functional group analysis of organic molecules

Learners are supposed sketch the structure of simple organic compounds showing their stereochemistry using Fischer Projection. Differentiation between alkanes, alkenes and alkynes. Identify the functional group present in the organic compounds.

Unit 4: Physical exercise: Determination of relative surface tension

Determination of relative surface tension of the given liquid using Stalagmometer.

Distribution of marks shall be as given below:

1.	Inorganic exercise	:	12
2.	Organic exercise	:	12
3.	Physical excercise	:	11
4.	Viva	:	05
5.	Home assignment/internal assessment, lab record and attendance	:	10