Course Structure for Under-Graduate Programme in Chemistry, 2025

Semester	Course Type	Courses	Course Code	Credits (T+P)	Marks	Internal Assessment	End Semester	
							Theory	Practical
First Semester	DSC-A1	Inorganic Chemistry-I	CHEM-111	3+1	100	30	50	20
	DSC-B1	To be chosen from **(Phys/Maths /Botany/Zoology)**		3+1	100	30	50	20
	MC-1	To be chosen from **(Phys/Maths/Botany/Zoology)**		3+1	100	30	50	20
	MDC 1	Introductory Chemistry-I	CHEM-112	3+0	75	25	50	00
	SEC 1	Basic Analytical Chemistry-I	CHEM-113	3+0	75	25	50	00
	AEC1	To be chosen from language course		2+0	50	15	35	00
Second Semester	DSC-A2	Organic Chemistry-I	CHEM-121	3+1	100	30	50	20
	DSC-B2	To be chosen from **(Phys/Maths/Botany/Zoology)**		3+1	100	30	50	20
	MC-2	To be chosen from **(Phys/Maths/Botany/Zoology)**		3+1	100	30	50	20
	MDC 2	Introductory Chemistry-II	CHEM-122	3+0	75	25	50	00
	SEC 2	Basic Analytical Chemistry-II	CHEM-123	3+0	75	25	50	00
	I/A/P/C	Internship/Apprenticeship/Project /Community Outreach	-	4+0	100	-	-	-
	Value Added Course (VAC)	As proposed by Department of Environmental Science	-	2+0	50	15	35	00

DSC offered by the Chemistry discipline will be treated Minor course for other disciplines

COURSE CONTENTS
DSC FOR CHEMISTRY
(Common with Minor course)
(SEMESTER I)
CHEM-DSC-111TH
INORGANIC CHEMISTRY-I

Max. Marks: 50 **Time Allowed: 3 Hours**

Credits: 3

Note for Examiners and Students:
For DSC Courses, the evaluation pattern will be as follows:

End Semester Exam	-50 Marks
End Term Practical Exam	-20 Marks
Internal Assessment	-30 Marks

Internal Assessment:

Attendance	-05 Marks
Class Test	-10 Marks
Assignments & Presentations	-10 Marks
Internal Assessment of Practical	-05 Marks

- End Semester theory examination shall be of 50 Marks and the duration of the examinations will be 3 hours. There will be four parts (Sections i.e. A, B,C,D) and the examiner will set 7 questions in total from all the three Sections/Blocks (I, II, III) of the syllabus.
- Part A will have 2 questions of 12 Marks each from Section/Block I of the syllabus and students will have to attempt any one question.
- Part B will have 2 questions of 12 Marks each from Section/Block II of the syllabus and students will have to attempt any one question.
- Part C will have 2 questions of 12 Marks each from Section/Block III of the syllabus and students will have to attempt any one question.
- Part D will have 10 short answer questions of 2 Marks each from all the three Sections/Blocks (I, II, III) of the syllabus and students will have to attempt 7 questions.

End Term Practical Examination will be of 20 Marks:
(Performance=10 Marks, Viva-Voce =5 Marks, File= 5 Marks)

NOTE: Pass marks of each subject: 40% Aggregate and minimum 35% in each individual component (term end exams, practical, IA, etc.) of a subject.

Course Objectives

- To understand various atomic theories, quantum mechanical model, and other aspects of atomic structure.
- To have a comprehensive review of ionic bonding and energy considerations in ionic bonding.
- To get acquainted with chemical bonding in covalent compounds with emphasis on various theories of covalent bonding.
- To have practical knowledge of preparations of solutions and estimation of some of the chemical species from solutions and mixtures of solutions.

Learning Outcomes: Upon completing the course, students will be able to:

- Apply the knowledge of the quantum mechanical model of the atom, quantum numbers, radial and angular distribution curves, shapes of orbitals, electronic configuration and calculate effective nuclear charge.
- Determine molecular geometries using radius ratio Rules, VSEPR theory, and MO diagrams. Understand the concept of lattice energy and the role of ionic character in covalent bonds.
- Understand the shapes of some inorganic molecules and ions by applying various theories. Recognize the significance and application of chemical bonds, and their impact on properties.
- Prepare solutions of different concentrations, standardization of solutions, and estimation of some of the chemical species from their solutions.

SECTION -A

Atomic Structure

Review of Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. Schrodinger wave equation and meaning of various terms in it. Significance of ψ and ψ2 .Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, Shapes of s, p and d atomic orbitals, nodal planes. Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations, Slater rules and applications.

SECTION - B

Ionic Bonding

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds.Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability.Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

SECTION –C

Covalent Bonding

Covalent bonding- VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonalbipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the 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 up to Ne (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches

Reference Books:

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.

LAB COURSE
(SEMESTER I)
CHEM –DSC-111PR (Common with Minor course)

TIME ALLOWED: 03 HOURS **Max Marks: 20**

Credits – 1

Inorganic Chemistry

1. Preparation of solutions of different concentration and standardization of acid solutions.
2. Estimation of sodium carbonate using standardized HCl solution.
3. Estimation of sodium carbonate and sodium bicarbonate present in a mixture.
4. Estimation of oxalic acid by titrating it with $KMnO_4$.
5. Estimation of oxalic acid and sodium oxalate in a given mixture.

Reference Books:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

SEMESTER-II
CHEM-DSC-121 TH
(Common with Minor course)
ORGANIC CHEMISTRY-I

Max. Marks: 50 **Time Allowed: 3 Hours**
Credits: 3

Note for Examiners and Students:
For DSC Courses, the evaluation pattern will be as follows:

End Semester Exam	-50 Marks
End Term Practical Exam	-20 Marks
Internal Assessment	-30 Marks
Internal Assessment:	
Attendance	-05 Marks
Class Test	-10 Marks
Assignments & Presentations	-10 Marks
Internal Assessment of Practical	-05 Marks

- End Semester theory examination shall be of 50 Marks and the duration of the examinations will be 3 hours. There will be four parts (Sections i.e. A,B,C,D) and the examiner will set 7 questions in total from all the three Sections/Blocks (I, II, III) of the syllabus.
- Part A will have 2 questions of 12 Marks each from Section/Block I of the syllabus and students will have to attempt any one question.
- Part B will have 2 questions of 12 Marks each from Section/Block II of the syllabus and students will have to attempt any one question.
- Part C will have 2 questions of 12 Marks each from Section/Block III of the syllabus and students will have to attempt any one question.
- Part D will have 10 short answer questions of 2 Marks each from all the three Sections/Blocks (I, II, III) of the syllabus and students will have to attempt 7 questions.

End Term Practical will be of 20 Marks:
(Performance=10 Marks, Viva-Voce =5 Marks, File= 5 Marks)

NOTE: Pass marks of each subject: 40% Aggregate and minimum 35% in each individual component (term end exams, practical, IA, etc.) of a subject.

Course Objectives

- Understand basic concepts of organic chemistry, such as structure, shape and reactivity of organic molecules, reactive intermediates and aromaticity.
- Understand the fundamental concepts of stereochemistry including conformational, optical, and geometrical isomerism.
- Get acquainted with the methods of preparation and properties of aliphatic hydrocarbons (alkanes, alkenes and alkynes).
- To have practical knowledge of determination of melting and boiling point of organic compounds, separation of organic compounds from their mixtures by chromatographic techniques, and synthesis of some organic compounds

Learning Outcomes: Upon completing the course, students will be able to:

- Understand the properties and behaviors of organic compounds based on the fundamental concepts and identify various reactive Intermediates during chemical reactions
- Apply fundamental concepts of stereochemistry for visualizing organic molecules in three dimensions.
- Understand the preparation, properties and uses of various organic compounds with emphasis on aliphatic hydrocarbons (alkanes, alkenes and alkynes).
- To determine melting and boiling point of organic compounds, separate organic compounds from their mixtures by using paper and thin layer chromatograpy, and synthesize some organic compounds.

SECTION -A

Fundamentals of Organic Chemistry& Stereochemistry-I

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. Conformations with respect to ethane, butane and cyclohexane.

SECTION -B

Stereochemistry-II

Interconversion of Wedge Formula, Newman, Sawhorse and Fischer projections. Concept of chirality (upto two carbon atoms) Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis-trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). Conformations with respect to ethane, butane and cyclohexane.

SECTION -C

Aliphatic Hydrocarbons (Alkanes, Alkenes & Alkynes)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and *anti*-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: Formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alkaline KMnO4.

Reference Books:

1. Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. A. Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
4. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
5. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
6. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
7. Bahl, A. &Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

SEMESTER-II
LAB COURSE
(Common with Minor course)
CHEM –DSC-121PR

TIME ALLOWED: 03 HOURS **Max Marks: 20 Credits – 1**

1. To determine the melting and boiling point of given organic compounds (Solid and liquid).
2. Separation of a mixture of two amino acids/sugars by radial/ascending paper chromatography.
3. Separation of a mixture of *o*-and *p*-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC).
4. Organic Synthesis:

(i) Preparation of Iodoform.
(ii) Preparation of Glucosazone

Reference Books

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.