COURSE STRUCTURE AT A GLANCE
UG CHEMISTRY, NEP 2020

CORE COURSES

Course Code	Name of the course	Type of course	L	T	P	Credits	
MJC45CHM101(T)25	Chemistry Major 1 (Theory)	A: Inorganic Chemistry -1 B: Organic Chemistry-1 C: Physical Chemistry-1	2	1	0	**3**	**4**
MJC45CHM101(P)25	Chemistry Major 1 (Practical)	A: Inorganic Chemistry Laboratory- I (Major) B: Organic Chemistry Laboratory- I (Major)	0	0	1	**1**	
MNC45CHM101(T)25	Chemistry Minor 1 (Theory)	A: Inorganic Chemistry - 1 B: Organic Chemistry-1 C: Physical Chemistry-1	**2**	**1**	**0**	**3**	**4**
MNC45CHM101(P)25	Chemistry Minor 1 (Practical)	A: Inorganic Chemistry Laboratory -I (Minor) B: Organic Chemistry Laboratory- I (Minor)	**0**	**0**	**1**	**1**	
MDC45CHM101(T)25	Introductory Chemistry	Introductory Chemistry	**2**	**1**	**0**	**3**	

MANIPURUNIVERSITY
Bachelor of Science in Chemistry
(Effective from Academic Year 2025-26)

SEMESTER-I

CHEMISTRY MAJOR-1 **Corse Code: MJC45CHM101(T)25**

L	T	P	Credit
2	1	0	3

1 Major Courses **(45 Hrs.)**

1.1 Section A: INORGANIC CHEMISTRY - I
1.2 Section B: ORGANIC CHEMISTRY – I
1.3 Section C: PHYSICAL CHEMISTRY-I

Paper I
Learning objective:
By studying this course, the students will be able to understand:

- Atomic theory and the concept of wave function.
- Elements in the periodic table: physical and chemical characteristics, and their periodicity.
- Atomic structure, chemical bonding, and molecular geometry based on accepted models.
- Basics of organic molecules, structure, bonding, reactivity, and reaction mechanisms. molecules and nomenclature.
- Electrophiles, nucleophiles, free radicals, electronegativity, resonance, and intermediatesalong the reaction pathways.
- Mechanism of organic reactions (effect of nucleophile/leaving group, solvent),substitution *vs*. elimination
- Physical properties of each state of matter and laws related to describe the states.

SECTION A: INORGANIC CHEMISTRY-I

UNIT-1 Atomic Structure: **(5 Hrs.)**

Brief revision of Bohr model and its limitations, atomic spectra of Hydrogen and Hydrogen-like atoms, Quantization of angular momentum, dual nature of electrons, de Broglie equation, wave functions, Quantum numbers and their significance, concept of orbit and orbitals. Radial probability diagrams and shapes of s, p, and d-orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Electronic configuration of atoms, Variation of orbital energy with atomic number.

UNIT-2: Periodicity of Elements: **(5 Hrs.)**

Details on the modern Periodic Table with reference to the periodic changes of atomic, ionic, and covalent radii. Ionisation energies, successive ionization energies, factors affecting ionization energy, and application of ionization energy. Electron affinity and electron negativity, Pauling, Mullikan, and Alfred Rachow scales of electronegativity. Bond order, partial charge, hybridization, group electronegativity, Effective nuclear charge, shielding or screening effect, Slater's rule, variation of effective nuclear charge in periodic table.

UNIT-3: Chemical Bonding: (8 Hrs.)

Type of chemical bonding and its characteristics:

Ionic bond: General characteristics, type of ions, size effect, radius ratio rule and its limitation, packing of ions in crystals, Madelung constant, Born-Haber cycle and its application, Solvation energy.

Covalent bond: Lewis structure, Shapes of simple molecules containing lone/bond-pairs of electrons, multiple bonding, sigma and pi-bond approach, Valence Shell Electron Pair Repulsion Theory (VSEPR), Valence Bond theory (Heitler-London approach). Molecular orbital theory. Molecular orbital diagrams of simple homonuclear/heteronuclear diatomic molecules, N_2, O_2, B_2, F_2, CO, NO, and their ions. (Ideas of s-p mixing and orbital interaction to be given). Hybridization of atomic orbitals (s, p, and d only), shapes of s, p, and d hybrid orbitals, BeF_2, BF_3, NH_3, H_3O^+, SF_4, ClF_3, ICl_2^-.

Covalent character in ionic compounds and Ionic character in covalent compounds. Bond moment and Dipole moment. Ionic character from dipole moment and electronegativity difference.

Section B. ORGANIC CHEMISTRY – I

UNIT-4: Basic Concepts of Organic Chemistry: (8 Hrs.)

Organic Compounds: Classifications and nomenclature, hybridization, shapes of molecules, influence of hybridization on bond properties. Electronic displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications.

Organic acids and bases and their relative strengths. Homolytic and heterolytic fission with suitable examples. Curly arrow rules, formal charges, Electrophiles and Nucleophiles, Nucleophilicity and basicity, Types, shape, and relative stabilities of reaction intermediates (Carbocations, Carbanions, Free radicals, Carbenes, and Nitrenes). Organic reactions and their mechanism: Addition, Elimination, and Substitution reactions.

UNIT-5: Chemistry of Aliphatic Hydrocarbons: (12 Hrs.)

Preparation, properties and reactions of alkanes: Wurtz reaction, Wurtz-Fitting reaction, Free radical substitutions: Halogenation -relative reactivity and selectivity.

Preparation, properties and reactions of alkenes and alkynes:Elimination reactions, Mechanism of E1, E2, E1cB reactions. Saytzeff's and Hofmann's eliminations. Electrophilic additions, their mechanisms (Markownikoff /Anti-Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), *syn*- and *anti*-hydroxylation (oxidation). 1, 2- and 1,4-addition reactions in conjugated dienes and Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethylbenzene, acidity of alkynes

Cycloalkanes and Conformational Analysis, Cycloalkanes and stability, Baeyer strain theory, Conformation analysis, Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms.

Section C. PHYSICAL CHEMISTRY-I

UNIT-6: Introduction to Classical Thermodynamics (7 Hrs.)

Intensive and extensive variables; state and path functions; isolated, closed and open systems; Laws of thermodynamics, zeroth law of thermodynamics. First law: Concept of heat (q), work (w), internal energy (U), enthalpy (H), relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heat of reactions, standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations), pressure on enthalpy of reactions.

Learning outcome:

On completion of this course, the students will be able to understand:

- Atomic theory and concept of wave function.
- Elements in periodic table; physical and chemical characteristics, and their periodicity.
- Atomic structure, chemical bonding, and molecular geometry based on accepted models.
- Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms. molecules and nomenclature.
- Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways.
- Mechanism of organic reactions (effect of nucleophile / leaving group, solvent), substitution *vs*. elimination
- Physical properties of each state of matter and laws related to describe the states.

Recommended Books/References:

1. Lee, J. D. *Concise Inorganic Chemistry,* Wiley, 5thEdn.
2. Douglas, B.E., McDaniel, D.H., AlexanderJ.J., *Concepts & Models of Inorganic Chemistry,*

(Third Edition) John Wiley & Sons, 1999.
3. Atkins, P.W. and DePaula, J. *Physical Chemistry*, Tenth Edition, Oxford University Press,2014.
4. Rodger, G. E. *Inorganic and Solid-State Chemistry*, Cengage Learning, 2002
5. Morrison, R.N. and Boyd, R.N. Organic Chemistry, 6thEdn., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Pine S.H. Organic Chemistry, Fifth Edition, McGraw Hill, (2007)
7. F.A.Carey, Organic Chemistry, Seventh Edition, Tata McGraw Hill (2008).
8. J. Clayden, N. Greeves, S.Warren, Organic Chemistry, 2ndEd., (2012), Oxford University Press.
9. F.A. Carey, R.J. Sundberg, Advanced Organic Chemistry, Part A: Structure and Mechanism, Kluwer Academic Publisher, (2000).
10. I. N. Levine; Quantum Chemistry, Tata McGraw Hills
11. D. A. McQuarrie, Quantum Chemistry, Oxford University Press
12. G. M Barrow, Physical Chemistry, McGraw Hill
13. Puri, Sharma and Kalia, Principles of Inorganic Chemistry

Semester I **Course Code: MJC45CHM101(P)25**

L	T	P	Credit
0	0	1	1

30 Hrs.

Inorganic Chemistry Laboratory I (Major)

Titrimetric Analysis

(i) Calibration and use of apparatus.
(ii) Preparation of solutions of different Molarity/Normality of titrants.
(iii) Use of primary and secondary standard solutions.

Acid-Base Titrations (any one of the following)

(i) Estimation of carbonate and hydroxide present together in the mixture.
(ii) Estimation of carbonate and bicarbonate present together in a mixture.
(iii) Estimation of free alkali present in different soaps/detergents

Organic Chemistry Laboratory I (Major)

1. Purification of organic compounds by crystallization using the following solvents:
   a. Water b. Alcohol c. Alcohol-Water
2. Determination of the melting points of given organic compounds and unknown organic compounds (using Kjeldahl method and electrically heated melting point apparatus).
3. Effect of impurities on the melting point−mixed melting point of two unknown organic compounds.
4. Determination of boiling point of liquid compounds. (boiling point lower than and more

than 100°C by distillation and capillary method)

5. Chromatography: Separation of a mixture of two amino acids by ascending and horizontal paper chromatography

Mark distribution in practical:(1 credit)```

Inorganic Chemistry	Organic Chemistry	Lab. Note Book	Viva voce	Total
6 Marks	12 Marks	3 Marks	4Marks	25 Marks

Recommended Books/References:

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2. Svehala G. and Sivasankar I.B, *Vogel's Qualitative Inorganic Analysis*, Pearson,India, 2012.
3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5thEd.,* Pearson (2012)

(List of experiments and references are suggestive. However, more experiments can be added/list of experiments can be revised as per available facilities).

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SEMESTER-I

CHEMISTRY MINOR-1 **Corse Code: MNC45CHM101(T)25**

L	T	P	Credit
2	1	0	3

1 Minor Courses (45 Hrs.)

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1.2 Section B: ORGANIC CHEMISTRY – I
1.3 Section C: PHYSICAL CHEMISTRY-I

Paper I (CHM101T)

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probability diagrams and shapes of s, p, and d-orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Electronic configuration of atoms, Variation of orbital energy with atomic number.

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Total Number of Hours = 45

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Semester I **Course Code: MNC45CHM101(P)25**

L	T	P	Credit
0	0	1	1

Inorganic Chemistry Laboratory I (Minor) **30 Hrs.**

Titrimetric Analysis

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3. Effect of impurities on the melting point–mixed melting point of two unknown organic compounds.
4. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100°C by distillation and capillary method)
5. Chromatography: Separation of a mixture of two amino acids by ascending and horizontal paper chromatography

Mark distribution in practical:(1 credit)

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Learning outcome:
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