DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
Four Year Undergraduate Course Structure:
Subject: Chemistry Semester V NEP (Revised)
For students admitted in session 2024-25 onwards

Semester V						
Paper	**Paper Title**	**Type**	**Credits**	**Internal Assessment**	**Univ Exam**	**Total Marks**
Paper 9	Organic Chemistry 2	Theory	4	25	75	100
Paper10	Physical Chemistry 2	Theory	4	25	75	100
IS	Chemistry Internship (Chemistry Practical 5)	Practical	4	-	100	100
P9'	Second major subject	Theory	4	25	75	100
P10'	Second major subject	Theory	4	25	75	100
	Total Credits		**20**			

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
Four Year Undergraduate Course Structure:
Subject: Chemistry Semester V NEP (Revised)
For students admitted in session 2024-25 onwards

Organic Chemistry 2

Semester V **Paper 9** **Credits 4**

MM 100 (75 + 25)

Course outcome

The completion of this course enables the student to understand the subject initially

- CO-1 The preparation and chemical reactions of Alcohols and Epoxides - Alcohols Dihydric alcohols: (Ethylene Glycol)
- CO-2 Understanding the order of reactivity of different carboxylic acid derivatives and the reactivity of different carboxylic acid derivatives.
- CO-3 Able to recognize structures of acid halides, esters, amides, acid anhydrides.
- CO-4 Able to write down structure of phenol and phenoxide ion and chemical reactions of phenols.
- CO-5 Know the mechanism of named reactions of carbonyl compounds and condensation reactions as well as their use in food and pharmaceuticals.

Unit 1

- **Alcohols and Phenols:**
  - Synthesis, physical and chemical properties of monohydric alcohols, dihydric alcohols (Ethylene glycol) and Trihydric alcohols (glycerol).
  - Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Chemical reactions of phenols.

Unit 2

- **Aldehydes and Ketones:**
  - Synthesis, Physical and chemical properties of aldehydes and ketones. Mechanism of nucleophillic addition to carbonyl group, reactions involving α hydrogens, reduction, oxidation, condensation and Wittig reaction.

Unit 3

- **Carboxylic Acids:**
  - Synthesis, physical and chemical properties of carboxylic acids, acidity of carboxylic acids, effects of substituents on acid strength. Carboxylic acid derivatives (acid chlorides, esters, amides and acid anhydrides): Synthesis, physical and chemical properties.
- **Fats, Oils and Detergents:**
  - Introduction rancidity and analysis of fats and oils (saponification value, iodine value, acid value and Reichert Meissel value). Cleansing action of soaps and detergents.

Unit 4

- **Organic Compounds of Nitrogen:**
  - Mechanisms of nucleophilic substitution in Nitroarenes and their reductions in acidic, neutral and alkaline media.
  - Preparation, physical properties and chemical reactions of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines.
- **Amino Acids, Proteins and Peptides:**
  - Introduction and classification of amino acids. Acid-base behaviour, isoelectric point and electrophoresis, Preparation, physical properties and chemical reaction of α amino acids. Classification of peptides, geometry and Merrifield solid phase peptide synthesis.
  - General characteristics and colour test of proteins, biological function, denaturation/renaturation of proteins.

.

Books Suggested (Theory Courses)

1. Organic Chemistry, Morrison and Boyd, Prentice Hall.
2. Organic Chemistry, L.G. Wade Jr. Prentice Hall
3. Fundamentals of Organic Chemistry Solomons, John Wiley.
4. Organic Chemistry, Vol. I, II, III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
5. Organic Chemistry, F.A. Carey, Tata McGraw-Hill Publishing Company, Insia
6. Introduction to Organic Chemistry, Streitwiesser, Hathcock and Kosover, Macmillan.
7. Organic Chemistry, Vol. I, II, I.L. Finar

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
Four Year Undergraduate Course Structure:
Subject: Chemistry Semester V NEP (Revised)
For students admitted in session 2024-25 onwards

Physical Chemistry 2

Semester V **Paper 10** **Credits 4**

MM 100 (75 + 25)

Course outcome

- CO-1- After the completion of the semester, student will acquire knowledge of first law and second law of thermodynamics, thermochemistry, entropy enthalpy etc.
- CO-2- It will also make them familiar with conductance, equivalent conductance, Kohlrausch's law, Ostwald dilution law, Deby-Huckel Onsagar equation, e.m.f. of cell, types of cell, liquid junction potential, pH and pka, Henderson- Hazel equation etc.

Unit 1

- **Thermodynamics - II**
  - Second law of thermodynamics: statements of second law of thermodynamics, Carnot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature, Le Chatelier's principle, reaction isotherm and reaction isochore, Clapeyron- Clausius equation and its applications
- **Concept of entropy:**
  - Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, criteria of spontaneity and equilibrium change in ideal gases and mixing of gases.
  - Gibbs and Helmholtz free energy functions and their definitions

Unit 2

- **Electrochemistry-1:**
  - Electrical transport - Kohlrausch's law, weak and strong electrolyte, Arrhenius theory of electrolyte dissociation and its limitations.
  - Ostwald's dilution law its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and its determination by Hittorfs method and moving boundary method.
  - Applications of conductivity measurements: Determination of degree of dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salt.

Unit 3

- **Electrochemistry - II:**
  - Types of reversible electrodes- Gas-metal ion, metal-ion, metal- insoluble salt-anion and redox electrodes. Electrode reactions, single electrode potential, standard electrode potential. Reference electrode: standard hydrogen electrode and calomel electrode, Nernst equation, derivation of cell E.M.F., electrochemical series and its significance.

- Electrolytic and Galvanic cells- Reversible and irreversible cells, conventional representation of electrochemical cells.
- EMF of a cell and its measurements- Calculation of cell EMF. Calculation of thermodynamic quantities of cell reactions (G, H and K)

Unit 4

- **Concentration Cell**
  - Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient. Determination of pH using quinhydrone, calomel and glass electrodes by potentiometric method.
- **Surface Chemistry:**
  - Physical and chemical adsorption, Freundlich and Langmuir adsorption isotherm, multilayer adsorption and BET isotherm (no derivation).

Books Suggested (Theory Courses)

1. Physical Chemistry. G.M. Barrow. International Student Edition, McGraw Hill.
2. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
3. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
4. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.
5. Graduate physical Chemistry, Volume I-III By L.R. Sharma and M.S. Pathania
6. Principles of Physical Chemistry by B.R. Puri, L.P Sharma and M.S. Pathania, Vishal publication, Jallandhar.

Chemistry Internship (Chemistry Practical 5)

Semester V **IS** **Credits 4**

MM 100

Course Objectives

- The objectives of this course are to acquisition of skills in Inorganic, Organic and Physical Chemistry. To develop the ability to correlate the chemical and physical properties of elements. To establish the link between theory and laboratory practice by conducting laboratory experiments. To acquire expertise in chemistry laboratory in handling of reagents and solvents as well as in analytical techniques.

Course Outcome

After completing the course, the student will be able to: -

- **CO-1** Having acquired knowledge to handle instruments and its calibration.
- **CO-2** Explain the structure and bonding in molecules / ions and predict the structure of molecules / ions.
- **CO-3** Explain selected crystal structures, explain and perform calculations of the lattice enthalpy of ionic compounds.
- **CO-4** Having knowledge of Beer Lamberts law
- **CO-5** To separate compounds chromatographically.
- **CO-6** Able to make solutions accurately to perform conductance experiments.
- **CO-7** To understand making circuit connections and taking observations.

Inorganic Chemistry

- **Synthesis and Analysis**
  - Preparation of potassium trioxalatoferrate (III), $K_3[Fe(C_2O_4)_3]$ and determination of its composition by permagnometry.
  - Preparation of $[CoHg(SCN)_4]$ and estimation of its sulphur content by gravimetric analysis.
  - Preparation of triacetylactonatoaluminium(III) $[Al(acac)_3]$.
  - Preparation of tetraamminecopper(II) sulphate, $[Cu(NH_3)_4]SO_4$
  - Preparation of cis-and trans-dioxalatodiaquachromate(III) ion.
- **Colorimetry**
  - To verify Beer-Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given solution.
  - Determination of Fe^{3+} content by thiocyanate method.

Organic Chemistry

- **Mixture Analysis**
  - Organic mixture separation and identification (two components)

- **Electrochemistry**
  - To determine the strength of the given acid conductometrically using standard alkali solution.
  - To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
  - To determine the ionization constant of a weak acid conductometrically.
- **Molecular Weight Determination**
  - Determination of molecular weight of a non-volatile solute by Rast method/Beckmann freezing point method.
  - Determination of the apparent molecular weight of non-volatile solute at different concentration and determine Van't Hoff factor by ebullioscopy.
- **Colorimetry/Spectrophotometer**
  - Determination pKa values of indicators
  - Determination of Chemical oxygen demand (COD)
  - Determination of Biological oxygen demand (BOD)

- **Record & Viva**

Books Recommended

1. Chemistry Practical by S. Giri, D.N. Bajpai and O.P. Pandey, S. ChandPublication.
2. Practical Chemistry Volume 1-3 by Fateh Bahadur, Vishal Publication
3. Advanced Physical Chemistry by J.B. Yadav, Goel Publication
4. Systematic Chemistry Practical, P.C. Kamboj, Vishal Publication

Distribution of Maximum Marks:

The maximum marks in the evaluation of the practical exercises, viva-voce and records of their class-work are given below.

Internship (Chemistry Practical 5)				
Class	Inorganic/Organic/Physical	Viva	Class Record	Total
B.Sc. Semester V	60	30	10	100

Note:

- ***Experiments from all three branches have to be done in class. In practical examination one experiment has to be allotted to the student through a lottery system.***
- ***For exempted students, marks of class record will be added to the marks of viva-voce for practical examinations since they do not have the class record.***