



DEPARTMENT OF CHEMISTRY  
UNIVERSITY OF LUCKNOW  
LUCKNOW

Four Year Undergraduate Course Structure  
Subject: Chemistry Semester IV

Paper	Major Branch	Type	Credits	Total Credits
Paper 7 (P7)	Inorganic Chemistry 2	Theory	4	4
Paper 8 (P8)	Organic Chemistry 2	Theory	4	4
VC 2	Chemistry Vocational 2	Introduction of Household Chemicals, Soaps and Detergents	4	4
Paper 7 (P4'')	Inorganic Chemistry 2	Minor Theory	4	4
P7'	Second major subject	Theory	4	4
P8'	second major subject	Theory	4	4
	<b>Total Credits</b>			<b>24</b>

Choice will be given to student to opt in which major subject he wishes to do internship and minor project



DEPARTMENT OF CHEMISTRY  
UNIVERSITY OF LUCKNOW  
LUCKNOW

Four Year Undergraduate Course Structure  
Subject: Chemistry Semester IV

Inorganic Chemistry 2 (Major P7 and Minor P4")

Semester IV

Paper 7

Credits 4

Course outcome

**CO-1** Chemistry of transition and inner-transition elements. These insights are important as they help in the rational selection of the cations of these elements for tailor-made syntheses of newer complexes

**CO-2** Concepts of coordination chemistry and their applications

**CO-3** Importance of different acid-base concepts which forms the basis of rational ligand designing and coordination complex formation for specific bio-inorganic, materials and optoelectronic applications.

**CO-4** Importance and different chemical aspects of non-aqueous solvents which now-a-days are gaining importance in varied targeted syntheses of drugs and materials for technological applications

**UNIT I**

- I. Chemistry of Elements of First Transition Series: Characteristic properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry.
- II. Chemistry of Elements of Second and Third Transition series: General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

**Unit - II**

- III. Coordination Compounds double salts: Werner's coordination theory and its experimental verification, Sidwick's concept of effective atomic number, EAN concept, Polydentate ligands or chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes, Inner and outer orbital complexes, Limitations of VBT.

**UNIT III**

- IV. Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, ceric ammonium sulphate and its analytical uses.
- V. Chemistry of Actinides: Electronic conformation, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.

**Unit IV**

- VI. Oxidation and Reduction: Electrode potential, electrochemical series and its applications. Principles involved in the extraction of the elements.



**DEPARTMENT OF CHEMISTRY  
UNIVERSITY OF LUCKNOW  
LUCKNOW**

**Four Year Undergraduate Course Structure  
Subject: Chemistry Semester IV**

- VII. Acids and Bases : Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concept of acids and bases.
- VIII. Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, Reactions in non-aqueous solvents with reference to liquid  $\text{NH}_3$  and liquid  $\text{SO}_2$ .

**Text Books (Theory Courses):**

- Concise Inorganic Chemistry, J.D. Lee, Blackwell Science Ltd.
- Inorganic Chemistry, Puri, Sharma, Kalia and Kaushal.
- Pradeep's Inorganic Chemistry, K.K. Bhasin, Pradeep Publication.
- Chemistry for degree students, R. L. Madan

**Reference Books:**

- Inorganic Chemistry, J.E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.
- Inorganic Chemistry, D.E. Shriver, P W. Atkins and C.H.L. Langford, Oxford.
- Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.
- Concepts of Models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and J Alexander, John Wiley.
- Inorganic Chemistry, W.W. Porterfield, Addison - Wesley.
- Inorganic Chemistry, A.G. Sharpe, ELBS
- Inorganic Chemistry, G.L. Meissler and D.A. Tarr, Prentice-Hall.



DEPARTMENT OF CHEMISTRY  
UNIVERSITY OF LUCKNOW  
LUCKNOW

Four Year Undergraduate Course Structure  
Subject: Chemistry Semester IV  
Organic Chemistry 2

Semester IV

Paper 8 (P8)

Credits 4

**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 I**

I. Alcohols:

Monohydric alcohols - Methods of formation by reduction of aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols.

Dihydric alcohols - Nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [ $\text{Pb}(\text{OAc})_4$  and  $\text{HIO}_4$ ] and pinacole-pinacolone rearrangement.

II. Ethers and Epoxides: Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions - cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening by Grignard and organolithium reagents.

**UNIT II**

III. Phenols:- Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols - electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

IV. Aldehydes and Ketones: synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as



**DEPARTMENT OF CHEMISTRY  
UNIVERSITY OF LUCKNOW  
LUCKNOW**

**Four Year Undergraduate Course Structure  
Subject: Chemistry Semester IV**

protecting group, Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner,  $\text{LiAlH}_4$  and  $\text{NaBH}_4$  reductions. Halogenation of enolizable ketones. An introduction to  $\alpha, \beta$ -unsaturated aldehydes and ketones.

**UNIT III**

V. Carboxylic Acids: physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction, Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids, Mechanism of decarboxylation. Methods of formation and chemical reactions of halo acids,

VI. Hydroxy acids: Preparation and reactions. Methods of formation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acids: Methods of formation and effect of heat and dehydrating agents.

VII. Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms of esterification and hydrolysis (acidic and basic).

**UNIT IV**

VIII. Organic Compounds of Nitrogen: Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media.

IX. Amines: Preparation, physical properties, stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel -phthalimide reaction, Hoffmann bromamide reaction. Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

**Books Suggested (Theory Courses)**

- a) Organic Chemistry, Morrison and Boyd, Prentice Hall.
- b) Organic Chemistry, L.G. Wade Jr. Prentice Hall
- c) Fundamentals of Organic Chemistry Solomons, John Wiley.
- d) Organic Chemistry, Vol. I, II, III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
- e) Organic Chemistry, F.A. Carey, McGraw-Hill Inc.
- f) Introduction to Organic Chemistry, Streitwieser, Hathcock and Kosover, Macmillan.
- g) Organic Chemistry, Vol. I, II, I.L. Finar
- h) Spectrometric Identification of organic compounds. Robert M. Silverstein, Clayton G. Bassler, Terence C. Morrill, John Wiley.



DEPARTMENT OF CHEMISTRY  
UNIVERSITY OF LUCKNOW  
LUCKNOW

Four Year Undergraduate Course Structure  
Subject: Chemistry Semester IV

Introduction of Household Chemicals, Soaps and Detergents

Semester IV

Chemistry Vocational 2 VC 2

Credits 4

**Course Outcome**

**CO 1** To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.

**CO 2** To enhance student sense of enthusiasm for chemistry and to involve them in an intellectually stimulating experience of learning in a supportive environment.

**CO 3** To enhance practical knowledge

**CO 4** To motivate self-employment ability

**CO 5** To create self-efficiency

**UNIT I**

**Household chemicals:** History of household Industry, Basic Theory of Household Chemicals, and Raw material required for household product, Product manufacture in household industry. Role of household product in day-to-day life.

**UNIT II**

**Cleaning agents:** Introduction, **synthesis** and applications of Natural cleaning agents, cleaning action, Floor cleaner, Toilet Cleaner, Bathroom Cleaner, Kitchen Cleaner

**UNIT III**

**Technology of Soap:** Chemistry of soap; Raw material for soap industry and their selection; hard fats yielding and oil yielding soaps; Chemical reactions of soaps; Hard and Soft soaps; Plant and process employed in soap manufacture; Liquid hand wash and liquid dish wash.

**UNIT IV**

**Detergents and surfactants:** Introduction; Different terms used in detergents; Raw materials for detergents; Washing action of detergents; Types of detergents; Introduction of surfactants; Types of surfactants.

**Recommended Books:**

- Small scale industries and house hold industries in developing economy by Shetty M.C.
- Manufacture of perfume cosmetics and detergents by Prasad Giri Raj
- Industrial chemistry by B.K. Sharma
- flavours & Essential oils, Industries SBP Board
- Perfumes soaps & cosmetics by Poucher.
- Manufacture of perfumes, cosmetics and detergents by Giriraj Prasad
- Manufacture of perfumes, cosmetics and detergents by Prasad.