DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
LUCKNOW
Four Year Undergraduate Course Structure
Subject: Chemistry Semester V

Paper	Major Branch	Type	Credits	Total Credits
Paper 9	Organic Chemistry 3	Theory	4	4
Paper 10	Chemistry Practical 3	Practical	4	4
Paper 11 x	Analytical Chemistry	Chemistry Elective 1	4	4
Paper 11 y	Chemical Energetics and Radiochemistry	Chemistry Elective 2		
IS	Chemistry Internship	Theory/Practical	4	4
P9'	Second major subject	Theory	4	4
P10'	second major subject	Theory	4	4
	Total Credits			**24**

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Four Year Undergraduate Course Structure
Subject: Chemistry Semester V
Organic Chemistry 3

Semester V **Paper 9 (P9)** **Credits 4**

Course outcome

Students on completion of the course will develop a comprehensive knowledge of

CO-1 The organometallic compounds such as Grignard reagent which have been widely used on both laboratory and commercial scale and is one of the most common organometallic reagents used for the formation of carbon–carbon bonds. Organosulphur compounds which have therapeutic use and pharmacology

CO-2 Carbohydrate, its classification and use in the food industry etc.

CO-3 Protein, aminoacid and peptides. Chemical structure of RNA and DNA.
CO-4 Various polymers, their method of polymerization and their use in industry

Unit I

Organometallic Compounds: Organomagnesium compounds: the Grignard reagents, formation, structure and chemical reactions. Organolithium compounds formation and reactions. Nomenclature, structural, features, methods of formation and chemical reactions of organosulphur compounds
Introduction and Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti- inflammatory agents (Aspirin, paracetamol); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital).
Heterocyclic compounds

Introduction: Molecular orbital picture and aromatic characteristic of pyrrole, furan, thiophene and pyridine, methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reaction in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six membered heterocycles. Preparation and reactions of indols, quinoline and isoquinoline with special reference to Fisher Indols synthesis, Skraup synthesis and Bischler – Nepieralski synthesis. Mechanism of electrophilic substitution reaction of indole, quinoline and isoquinoline.

Unit II

Carbohydrates: Classification and nomenclature, configuration and conformation of monosaccharides, Erythro and threo diastereomers, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Formation of glycoside, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+) glucose. Mechanism of mutarotation, structure of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose, lactose) and polysaccharide/starch and cellulose) without involving structure determination. Concept of glycosidation.

Unit III

Amino Acids, peptides, proteins and Nucleic Acids: Classification, structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis, Preparation and reaction of a amino acids, structure and nomenclature of peptides and proteins. Classification of proteins, peptides structure determination, and group analysis. Selective hydrolysis of peptides. Classical peptide synthesis, solid phase peptide synthesis. Structure of peptides and proteins level of protein structures. Protein denaturation/renaturation.

Nucleic Acids: Introduction - Classification of nucleic acids Ribonucleosides and Ribonucleotides. The double helical structure of DNA.

Unit IV

Synthetic Polymers: Addition or chain-growth polymerization, Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resin, epoxy resins and poly urithanes. Natural and synthetic rubbers.

Synthetic Dyes: Colour and constitution / electronic concept classification of dyes. Chemistry and synthesis of Methyl orange, conge red, Malachite green, crystal violet, phenophthalein, Fluorescin, Alizarin and Indigo.

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, Streitwiesser, Hathcock and Kosover, Macmillan.
g) Organic Chemistry, Vol. I, II, I.L. Finar

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Four Year Undergraduate Course Structure
Subject: Chemistry Semester V
Chemistry Practical 3

Semester V **Paper 10 (P10)** **Credits 4**

Course Objective

The objectives of this course are to acquisition of skills in General Chemistry 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.

A: Inorganic Chemistry

I. Synthesis and Analysis

a. Preparation of potassium trioxalatoferrate (III), $K_3[Fe(C_2O_4)_3]$ and determination of itscomposition by permagnometry.

b. Preparation of Ni-DMG complex, $[Ni(DMG)_2]$

c. Preparation of copper tetraammine complex, $[Cu(NH_3)_4]SO_4$

d. Preparation of cis-and trans-bisoxalatodiaqua chromate (III) ion.

II. Colorimetry

a. To verify Beer-Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of thegiven solution.

b. Determination of Fe^{3+} content by thiocyanate method.

III. Solvent Extraction

a. Separation and estimation of Mg(II) and Fe(II) Ion Exchange Method

b. Separation and estimation of Mg(II) and Zn(II).

IV. Chromatography

a. Chromatographic separation of metal ions.

B: Organic Chemistry

I. Mixture Analysis

a. Organic mixture separation and identification (two components)

II. Preparation

b. One step preparation.

C: Physical Chemistry

I. Electrochemistry

a. To determine the strength of the given acid conductometrically using standard alkali solution.

b. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.

c. To determine the ionisation constant of a weak acid conductometrically.

II. Refractometry and Polarimetry

a. To verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer.

b. To determine the specific rotation of cane sugar solution by polarimeter.

III. Molecular Weight Determination

a. Determination of molecular weight of a non-volatile solute by Rast method/Beckmann freezing point method.

b. Determination of the apparent molecular weight of non volatile solute at different concentration and determine Van't Hoff factor by ebullioscopy.

IV. Colorimetry

a. To verify Beer-Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given solution of the substance.

Books Recommended

a) Chemistry Practical by S. Giri, D.N. Bajpai and O.P. Shukla, S. Chand Publication.
b) Practical Chemistry Volume 1-3 by Fateh Bahadur, Vishal Publication
c) Advanced Physical Chemistry by J.B. Yadav, Goel Publication

DEPARTMENT OF CHEMISTRY
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Four Year Undergraduate Course Structure
Subject: Chemistry Semester V
Analytical Chemistry (Chemistry Elective 1)

Semester V **Paper 11 X (P11)** **Credits 4**

Course Outcome:

CO 1. Understand the basic of this course and think & develop new ideas and concepts in analytical chemistry.

CO 2. Know about electroanayltical, thermoanalytical, radiochemical, chromatographicand spectral techniques.

CO 3. To study concepts and theories behind basic methods and techniques used in analytical chemistry. This theory can be used to solve many rigorous problems of universe.

CO 4. To prepare the students for further research in analytical methods of chemistry.

Unit-I

Electroanalytical Techniques:

a. **Conductometric:** Discussion of the nature of the curves of acid-base (including mixtures of acids), precipitation and complexometric titrations

b. **Potentiometric:** Different types of electrodes, discussion of the nature of the curves for oxidation-reduction and acid-base titrations, comparision with the conductometric method

c. **Voltametry:** Cyclic voltametry

d. **Polarography:** Dropping mercury electrode and its advantages, polarographically active species, concept of residual, diffusion and limiting current of half wave potential, Ilkovic equation and factors affecting diffusion current

Unit-II

Thermoanalytical Methods:

a. **Thermogravimetry:** Apparatus, factors affecting TG, Interpretation of TG curves of $CaC_2O_4.H_2O$ and $MgC_2O_4.2H_2O$

b. **Differential Thermal Analysis and Differential Scanning Calorimetry:** Apparatus, factors affecting DTA and DSC curves with special reference to heating rate, particle size and packing, measurement of heat of transition, heat of reaction and heat of dehydration of salts and metal hydrates.

Unit-III

Radiochemical Methods

a. Isotope method

b. Inverse isotopic dilution

c. Neutron activation technique

a. Chromatographic Method:

(i) Gas Chromatography: GLC and GSC

(ii) HPLC

b. Spectral Methods:

(i) Nephelometry

(ii) Turbidimetry

(iii) Flame Photometry

Reference Books:

a) Fundamentals of Analytical Chemistry: D.A. Skoog, D.M. West and F.J. Holler, 1992, 6e
b) Quantitative Inorganic Analysis, A.I. Vogel, 2012, 7e
c) Instrumental Methods of Chemical Analysis: B.K. Sharma, 2011
d) Instrumental Methods of Chemical Analysis: H. Kaur, 2016, 12 e
e) Analytical Chemistry, Gary D. Christian, 2007, 6e
f) Instrumental Methods of Analysis: H.H. Willard, L.L. Merrit, Jr. J.A. Dean, 1974

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Four Year Undergraduate Course Structure
Subject: Chemistry Semester V
Chemical Energetics and Radiochemistry (Chemistry Elective 2)

Semester V **Paper 11Y (P11)** **Credits 4**

Course Outcome:

Student will

CO 1. Understand the introductory quantum mechanics and concept of third law of thermodynamics, distribution law and phase rule.

CO 2. Get introduced to the law of photochemistry and photosensitized reactions energy transfer processes.

CO 3. Study about the dilute solutions and colligative properties.

CO 4. Get familiar with radiopharmaceuticals and radiochemistry.

Unit 1

I. Introductory Quantum Mechanics: Plank's radiation law, photoelectric effect, Optical activity, polarization (clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment, temperature method and refractivity method, magnetic properties – paramagnetism, diamagnetism and ferromagnetism

II. Third law of thermodynamics, Nernst heat theorem .Thermodynamic derivation of Nernst distribution law and its application. Phase rule, Derivation of Gibbs phase rule and its application.

Unit II

III. Photochemistry

1. Interaction of radiation with matter, difference between thermal and photochemical processes.
2. Laws of photochemistry: Grothus-Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions- energy transfer processes (simple examples).

Unit III

IV. Solutions, Dilute Solutions and Colligative Properties:

Ideal and non-ideal solutions, methods of expressing concentration of solutions, activity and activity coefficient, Dilute solution, Raoult's law, relative lowering of vapour pressure, molecular weight determination, Osmosis, theory of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, Elevation of boiling point and depression of freezing point and its thermodynamic relation. Experimental methods of determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

Radiochemistry

Natural and induced radioactivity; radioactive decay----α-decay, β-decay, γ-decay; neutron emission, positron emission, electron capture; unit of radioactivity (Curie); half life period; Geiger-Nuttal rule, radioactive displacement law, radioactive series. Measurement of radioactivity: ionization chamber, Geiger counters, scintillation counters. Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labelling studies, nuclear medicine-99mTc radiopharmaceuticals

Reference Books:

a) Physical Chemistry G.M. Barrow. International Student Edition IMC McGraw Hill.
b) Graduate Physical Chemistry, Volume III L.R. Sharma and M.S. Pathania, 2017.
c) Principles of Physical Chemistry, Volume III, B.R. Puri, L.P. Sharma and M.S. Pathania, Vishal Publications, Jalanadhar.
d) Quantum Chemistry by R.K. Prasad.
e) Elements of Physical Chemistry, P.W. Atkins, Oxford
f) Physical Chemistry, R.A. Alberty: Wiley Eastern Ltd.
g) Physical Chemistry through Problems, S.K. Dogra and S. Dogra Wiley Eastern Ltd.