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

Paper	Major Branch	Type	Credits	Total Credits
Paper 12	Inorganic Chemistry 3	Theory	4	4
Paper 13	Quantum Mechanics and Spectroscopy	Theory	4	4
Paper 14 x	Polymer Chemistry	Chemistry Elective 3	4	4
Paper 14 y	Chemistry of natural products	Chemistry Elective 4		
MP	Chemistry Minor Project	Theory/Practical	4	4
P11'	Second major subject	Theory	4	4
P12'	second major subject	Theory	4	4
	Total Credits			**24**

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Subject: Chemistry Semester VI

Inorganic Chemistry 3

Semester VI **Paper 12 (P 12)** **Credits 4**

Course outcome

After the completion of the semester student will acquire knowledge

CO-1 Semi-modern concepts of metal ligand bonding in coordination complexes

CO-2 Inorganic polymers viz. silicones which find applications in materials pharmaceutical industries and surgery too. Phosphazenes which in last couple of years had witnessed significant development as emerging smart materials.

CO-3 Class-a and class-b donor-acceptors, symbiotic relationship

Unit - I

I. Metal-ligand bonding in Transition Metal Complexes: Limitation of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors effecting the crystal field parameters. Effect of CFSE on lattice energy, Ionic radii.

Unit - II

II. Magnetic Properties of Transition Metal Complexes: Types of magnetic behaviour, methods of determining magnetic susceptibility, spin only formula, L-S coupling, spectroscopic ground state. Correlation of μ_S and μ_{eff}values. Orbital contribution to magnetic moments. Application of magnetic moment data for 3d metal complexes.

Unit - III

III. Silicones and phosphazenes as examples of inorganic polymers. Nature of bonding in triphosphazenes. Pseudohalogens and pseudohalides: Preparation, properties and reactions. Structure and bonding of NO, ligand behaviour of NO. Preparation of nitrosyl complexes, effective atomic number (EAN) as applied to nitrosyls.

Unit - IV

IV. Hard and Soft Acids and bases (HSAB) : Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness. Applications of HSAB principle, limitations of HSAB principle.

Text Books (Theory Courses):

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

Reference Books:

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

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
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Four Year Undergraduate Course Structure
Subject: Chemistry Semester VI
Quantum Mechanics and Spectroscopy

Semester VI **Paper 13 (P 13)** **Credits 4**

Course outcome

This course provides students with a detailed knowledge of the fundamental aspects of the subject spectroscopy such as

CO-1 Infrared spectroscopy in which characteristic absorptions of various functional groups.

CO-2 Ultraviolet absorption spectroscopy, Beer Lambert Law, types of electronic transitions and the effect of conjugation and concept of chromophore and auxochrome.

CO-3 Nuclear magnetic resonance, interpretation of NMR spectra of simple organic molecule.

CO-4 Quantum mechanics as well as of spectroscopy. They will have comprehensive understanding of valence bond model and molecular orbital model.

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Subject: Chemistry Semester VI
Quantum Mechanics and Spectroscopy

Semester VI **Paper 13 (P 13)** **Credits 4**

Unit I

I. Spectroscopy:

a. Rotational Spectroscopy of Diatomic Molecules: Energy level of a rigid rotor (semi classical principles) selection rules, spectral intensity, distribution using population distribution (Maxwell – Boltzman distribution) determination of bond length, isotope effect.

b. Vibrational Spectrum-Infrared Spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of an harmonic motion and isotope on the spectrum.

c. Raman Spectrum: Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

Unit II

II. Elementary Quantum Mechanics: de Broglie's hypothesis, the Heisenberg's uncertainty principle, Hamiltonian operator. Statement of Born-oppenheimer approximation. Schrodinger wave equation and its importance. Physical interpretation of wave function, postulates of quantum mechanics, particle in one dimensional box. Schrodinger wave equation for H –atom and its separations into three equations (without derivation), quantum numbers, wave function, angular wave functions.

III. Basic idea of molecular orbital theory, criteria for forming M.O's from A.O's, construction of M.O's by LCAO-H^{2+} ion, calculation of energy levels from wave functions, physical picture of bonding and antiboding wave functions, Hybrid Orbitals-sp, sp^2, sp^3, calculation of coefficients of A.O's used in sp and sp^2 hybrid orbital only. Introduction to valence bond model of H_2, comparison of M.O. and V.B. models.

Unit III

I. Electromagnetic Spectrum Absorption Spectra:

a. Ultraviolet (UV) absorption spectroscopy -absorption laws (Beer-Lambert law); molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and Auxochrome, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. U.V.spectra of conjugated enes and enones, woodward fieser rule

b. Infrared (I.R.) absorption spectroscopy- Molecular vibrations, Hook's law, Selection rules, intensity and position of I.R. bands, fingerprint region, characteristic absorptions of various functional

groups and interpretation of I.R. spectra of simple organic compounds-hydrocarbons, aldehydes & ketones in IR spectrum (positions only)

Unit IV

II. Spectroscopy: Nuclear magnetic resonance (NMR): Spectroscopy, proton magnetic resonance (1H NMR) spectroscopy, nuclear shielding and deshielding. Chemical shifts and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of 'H NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 2 tribromoethane, ethyl acetate, toluene and acetophenones. Problems pertaining to the structure elucidation of simple organic compounds using 1H NMR spectroscopy techniques.

III. **Introduction to Mass Spectrometry:** Principle of mass spectrometry, the mass spectrum, mass spectrometry diagram, molecular ion, metastable ion, Nitrogen Rule, fragmentation process, McLafferty rearrangement.

Book Suggested

a) Physical Chemistry G.M. Barrow. International Student Edition IMC Graw Hill.
b) Principles of Physical Chemistry Volume III, B.R. Puri, L.P. Sharma, and M.S. Pathania, Vishal Publication, Jallandhar
c) Graduate Physical Chemistry, Volume III, L.R. Sharma and M.S. Pathania,2017
d) Fundamentals of Molecular spectroscopy, C.N. Banwell IV edition, Mc Graw hill education
e) Quantum Chemistry by R.K. Prasad
f) Fundamental Principles of Spectroscopy, B.K. Sharma, Krishna Publication.

DEPARTMENT OF CHEMISTRY
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Four Year Undergraduate Course Structure
Subject: Chemistry Semester VI
Polymer Chemistry (Chemistry Elective 3)

Semester VI **Paper 14 X (P 14)** **Credits 4**

Course outcome:
Students will learn to:
CO-1. define related concepts of polymers.
CO-2. summarize historical evolution of the polymers.
CO-3. recognize monomers and polymers.
CO-4. evaluate the structure of polymers.
CO-5. recognize bonds between polymer chains.
CO-6. debate thermal character and affecting factors of thermal behaviours.
CO-7. use determining method of molecular weights.
CO-8. categorize polymers.
CO-9. explain polymers production processes.

Unit I

Introduction and Characterization of Polymer:
Theory of reactivity of large monomeric molecules, ring formation vs. chain formation. Chain Reaction, Free radical, Cationic, Anionic and living polymers. Polymerization conditions and reactions, Coordination and co-polymerization, 3D network. IR and NMR of polymers. X-ray diffraction study. Microscopy. Thermal and chemical analysis, physical testing hardness, tensile strength. Fatigue, impact. Tear and abrasion resistance.

Unit II

Structure and Properties
Configuration of polymer chains, crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, Melting point (Tm), effect of chain flexibility and other steric factors. Entropy and heat of fusion. The glass transition temperature (Tg), Relationship between Tm and Tg. Polymer structure and property relationship.

Unit III

Polymer processing
General idea about elastomers, plastics and fibers. Compounding and vulcanization of elastomers. Processing techniques: Calendaring, die casting, rotational casting, film casting, injection molding, blow molding, extrusion molding, thermoforming, foaming and reinforcing and fiber spinning.

Unit IV

Commercial and Specialty Polymers
Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins silicone and PTFE polymers. Specialty polymers: Fire retarding polymers and electrically conducting polymers, liquid crystal polymer. Biomedical polymers – contact lens, dental, artificial heart, kidney, skin and blood cells – polymers.

Recommended Books:

a) Textbooks of Polymer science, F.W. Billmeyer, Jr. Wiley.
b) Polymer Science, V.R. Gowariker, N.V. Vishwanathan and J. Sreedhar, Wiley-Estern.
c) Functional Monomers and Polymers, K. Takemoto, Y.Inaki and R.M. Ottanbrite.
d) Contemporary Polymer Chemistry, H. R. Alcock and F.W. Lambe, Prentice hall.
e) Physics and Chemistry of Polymers, J.M.G. Cowie, Blackie Academic and Professional.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
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Four Year Undergraduate Course Structure
Subject: Chemistry Semester VI
Chemistry of Natural Products (Chemistry Elective 4)

Semester VI **Paper 14 Y (P 14)** **Credits 4**

COURSE OUTCOME

At the end of the course students will be able to...

CO1 Learn the different types of alkaloids, steroids, vitamins & terpenes etc and their chemistry and medicinal importance.

CO2 Explain the importance of natural compounds as lead molecules for new drug discovery.

CO3 Explain vitamins Chemistry and Physiological significance of Vitamin

CO4 Elaborate general methods of structural elucidation of compounds of natural origin.

CO5 Learn advanced methods of structural elucidation of compounds of natural origin.

Unit-I

Alkaloids

Introduction, Occurrence, medicinal importance and general methods of structure elucidation of alkaloids. Structure elucidation of papaverine and quinine.

Unit-II

Terpenoids

Introduction, occurrence and classification of terpenoids and structure determination of menthol and zingiberene

Unit-III

Vitamins

Classification, sources, biological importance of vitamins and structure determination of vitamin A, B1, B2.

Unit-IV

Steroids

Introduction, occurrence, importance of steroids, physiological action, stereochemistry and structure determination of cholesterol. Structure and semi synthesis of estrogen, testosterone and progesterone

Suggested Books

a) Organic Chemistry By I.L.Finar vol I and II
b) Phytochemical Methods, 2nd Edition, J. B. Harborne, 1984, Springer, Dordrecht
c) Classical Methods in Structure Elucidation of Natural Products, R. W. Hoffmann, 2018, Hoffmann, Wiley