Syllabus

CHM-75T-301 - Hard & Soft Acids and Bases, Transition metal Complexes, Spectroscopy, Organosulphur Compounds, Synthetic Polymers, Drugs & Dyes, Electrochemistry

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
V	CHM-75T-301	Hard & Soft Acids and Bases, Transition metal Complexes, Spectroscopy, Organosulphur Compounds, Synthetic Polymers, Drugs & Dyes, Electrochemistry			7	4
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	4	0	4	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	CHM-75T-301 Hard & Soft Acids and Bases, Transition metal Complexes, Spectroscopy, Organosulphur Compounds, Synthetic Polymers, Drugs & Dyes, Electrochemistry	CA- 1Hrs EoSE -3Hrs	CA- 20 Marks EoSE- 80 Marks	CA- 08 Marks EoSE-32 Marks

Objectives of the Course:	The main objective of this course is to provide students with a theoretical and conceptual understanding of the principles and applications of HSAB theory in predicting the stability and reactivity of chemical species. Furthermore, the coordination chemistry for transition metals including crystal field theory and ligand field theory is also explored. Principles and applications of electronic transitions (UV), vibrational modes (IR) including NMR Spectroscopic study are also incorporated in this course to determine the structures and dynamics of organic molecules. Structure, synthesis, and reactivity of sulfur-containing organic molecules along with structure, properties and applications of synthetic polymers are also included to enhance knowledge in this field. Chemistry and applications of synthetic drugs and industrial dyes along with the principles of electrochemistry, redox reactions, and applications such as batteries, fuel cells, and electroplating are also incorporated to provide knowledge. This course aims to furnish theoretical concepts with practical applications and to effectively prepare students for advanced studies, critical thinking skills and research in chemistry

Syllabus

CHM-75T-301 - Hard & Soft Acids and Bases, Transition metal Complexes, Spectroscopy, Organosulphur Compounds, Synthetic Polymers, Drugs & Dyes, Electrochemistry

Unit-I

Hard & 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, electronegativity and hardness and softness.

Metal-ligand bonding in Transition Metal Complexes:

Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal-field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

Magnetic properties of Transition Metal Complexes:
Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

15 Lecture

Unit-II

Electromagnetic Spectrum: An Introduction, Absorption Spectroscopy.
Ultraviolet (UV) Spectroscopy: Absorption laws (Beer-Lambert Law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones. Applications of UV-visible spectroscopy, electronic spectra.

Infrared (IR) spectroscopy - Molecular vibrations, modes of vibrations in diatomic, linear and non-linear polyatomic molecules. Force constant and its significance. Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. Applications of infrared spectroscopy in elucidation of structure of molecules.

Nuclear Magnetic Resonance (NMR) Spectroscopy:
Proton magnetic resonance (^{1}H-NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals. Interpretation of NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using ^{1}H NMR data.

15 Lecture

Unit-III

Organosulphur Compounds: Nomenclature, structural features, methods of formation and chemical reactions of thiols, sulphonic acids, sulphonamides. Sulpha drugs: sulphacetamide, sulphaguanidine, sulphadiazine, sulphapyrimidine, sulphamethoxazole.

Organic Synthesis via Enolates: Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Claisen condensation, Keto-enol tautomerism in ethyl acetoacetate. Synthetic applications of ethyl acetoacetate and malonic ester.

Synthetic Polymers: Addition or chain-growth polymerization. Free radical and ionic polymerization. Ziegler-Natta catalyst condensation or step-growth polymerization. Polyesters, polyamides, phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubber.

Synthetic Drugs: Nomenclature, classification, drug actions metabolism of drugs, Antipyretics, Analgesic, Antiseptics Antimalarial etc.

Synthetic Dyes: Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of methyl orange, congo red, malachite green, crystal violet, phenolphthalein, fluorescein, alizarin and indigo.

15 Lecture

Unit- IV

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

Electrochemistry: Types of reversible electrodes: Gas- metal ion, metal- metal ion, metal - insoluble salt- anion and redox electrodes, electrode reactions. Nernst's equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance.
Electrolytic and galvanic cell: Reversible and irreversible cells, conventional representation of electrochemical cells. E.M.F. of a cell and its measurements. Computation of cell EMF. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Polarization, over potential and hydrogen over-voltage. Structure of double- layer, theories by Helmholtz, Guoy-Chapman and Stern.
Concentration cells with and without transport, liquid-junction potential, application of concentration cells, valency of ions. Solubility product and activity coefficient, potentiometric titrations. Determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods.

15 Lecture

Suggested Books and References:

1. Concise Inorganic Chemistry by J.D. Lee, Wiley.
2. Inorganic Chemistry by Catherine E. Housecroft and Alan G. Sharpe, Pearson.
3. Selected Topics in Inorganic Chemistry by Wahid U. Malik, G. D. Tuli and R. D. Madan, S. Chand, New Delhi.
4. Advanced Inorganic Chemistry: Volume I & II by Satya Prakash, G. D. Tuli, S. K. Basu and R. D. Madan, S. Chand, New Delhi.
5. Principles of Inorganic Chemistry by Puri, Sharma & Kalia, Vishal Publishing Co.
6. Spectroscopy of Organic Compounds P S Kalsi, New Age international Publisher.
7. Organic Spectroscopy by William Kemp Mac Millan.
8. Elementry organic Spectroscopy by Y. R. Sharma S Chand and Compony PVt Ltd.
9. Organic Chemistry by Leroy G.Wade , Jan W. Simek & Maya S.Singh, Pearson.
10. Organic Chemistry by I. L. Finar, Pearson.
11. Organic Chemistry by R.T. Morrison, R.N. Boyd & S.K. Bhattacharjee, Pearson.
12. Dyes and Drugs by Harold H. Trimm, William Hunter Jr., Taylor & francs Ltd.
13. Introduction synthetic drugs and dyes by R.S. Rao, Gomathi Shridhar, Himalya Publishing House.
14. Polymer Chemistry: Synthesis and Charactrisation By Prashant D. Ashtaputrey & Santosh D. Ashtaputrey, Prints Publication PVT. Ltd.
15. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma & M. S. Pathania, Vishal Publishing Co.
16. Advanced Physical Chemistry by Gurdeep Raj, Goel Publishing House.
17. Physical Chemistry by W. Atkins, Oxford University Press.

18. Physical Chemistry by R. J. Silby and R. A. Alberty, John Wiley & Sons.
19. Physical Chemistry by G.M. Barrow, Tata McGraw-Hill.
20. Photochemistry by Gurdeep Raj, Krishana Prakashan.
21. Basic Concepts in Electrochemistry by Bhatu Shivaji Desale, Walnut Publication.
22. Introduction to Polymer Science and Technology by N.B. Singh and S.S. Das, New Age International Publisher.
23. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, Vishal Publishing Co.
24. A Textbook of Physical Chemistry by K. L. Kapoor (Volume 4), Macmillan Ltd

Suggested E-resources:

All the above suggested books are available as e- books.

Online Lecture Notes and Course Materials:

All prescribed courses are available in digital form in the form of e-books, Adobe Acrobat documents (PDF), web page

Syllabus
CHM-75P-302 - Chemistry Lab-V

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
V	CHM-75P-302	Chemistry Lab-V			7	2
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	0	2	2	Practical	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Practical	CHM-75P-302 Chemistry Lab-V	CA- 1Hrs EoSE -4Hrs	CA- 10 Marks EoSE- 40 Marks	CA- 04 Marks EoSE-16 Marks

Objectives of the Course:	The main objective of this course is, to provide students with hands-on experience in Inorganic, Organic, and Physical Chemistry experiments to strengthen their theoretical knowledge and develop laboratory skills. Students will learn to prepare coordination compounds, analyze organic mixtures, and determine molecular properties through experimental techniques. The course emphasizes skill development in qualitative and quantitative analysis, synthesis, separation, purification, and identification of compounds, along with accurate data recording, result interpretation, and safety practices in the laboratory. It also aims to build confidence for viva voce and enhance scientific reasoning.

Syllabus

CHM-75P-302 - Chemistry Lab-V

Inorganic Chemistry **10 marks**

Preparations:

a. Potassium trioxalatochromate(III)trihydrate, $K_3[Cr(C_2O_4)_3].3H_2O$

b. Hexammine nickel (II) chloride, $[Ni\ (NH_3)_6]Cl_2$

c. Tris (Thiourea) copper (I) sulphate, $[Cu.3[CS(NH_2)_2]\ 2SO_4.2H_2O$

d. Prussian blue [Iron (III) hexacyano ferrate (II)], $KFe[Fe(CN)_6]$

Organic Chemistry **10 marks**

Qualitative Analysis:

Analysis of an organic mixture containing two solid components using H_2O, $NaHCO_3$ and $NaOH$ for separation and identification of components through the functional group analysis, determination of melting point and prepare their derivatives and further determine their melting points.

Physical Chemistry **10 marks**

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 degree of dissociation of an electrolyte (e.g. NaCl) in aqueous solution at different concentrations by ebullioscopy.
c. Determination of molecular weight of organic compound by elevation of boiling point

Conductometry

a. To determine the strength of the given acid using standard alkali solution (strong acid vs. strong base, weak acid vs. strong base, and strong acid vs. weak base).

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

c. To study the kinetics of saponification of ethyl acetate using standard sodium hydroxide. To determine the ionization constant of a weak acid.

Viva voce **5 marks**

Practical Record **5 marks**

Suggested Books and References:

1. Vogel's Qualitative Inorganic Analysis, A. I. Vogel Prentice Hall.
2. Vogel's Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, ELBS.
3. Vogel's Textbook of Quantitative Chemical Analysis, A. I. Vogel, Pearson Education Ltd.
4. Advanced Practical Organic Chemistry by N. K. Vishnoi, Vikas Publishing House Pvt Ltd.
5. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K Ahluwalia. Universities Press, Hyderabad.
6. Laboratory Techniques in Organic Chemistry by V. K Ahluwalia, I K International, N
7. Advanced Practical Organic Chemistry J. B Yadav, Goel Publishing House.
8. Practical Physical Chemistry, by B. D Khosla, S. Chand & Company.

Suggested E-resources:

All the above suggested books are available as e- books.

Online Lecture Notes and Course Materials:

All prescribed courses are available in digital form in the form of e-books, Adobe Acrobat documents (PDF), web pages etc.

Course Learning Outcomes:

By the end of this course, students will get a clear understanding of various concepts related to the principles and applications of HSAB theory in predicting the stability and reactivity of chemical species. Further, students will get clear and deep understanding of a coordination chemistry of transition metals, including crystal field theory and ligand field theory. Principles and applications of electronic transitions (UV), vibrational modes (IR) including NMR spectroscopic study will provide knowledge to determine the structures and dynamics of molecules. Structure, syntheses, and reactivity of sulfur-containing organic molecules in addition to structure, properties, and applications of synthetic polymers, pharmaceuticals and industrial dyes will enhance the knowledge of students. They can understand the principles of electrochemistry, including redox reactions and practical applications such as batteries, fuel cells, and electroplating.

This course integrates theoretical knowledge with practical applications, equipping students for advanced studies, research and professional practice in the field of chemistry.

Syllabus

CHM-76T-303 - Bioinorganic chemistry, Organometallic chemistry, Heterocyclic chemistry, Carbohydrates, Spectroscopy, Quantum Mechanics and MOT

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
VI	CHM-76T-303	Bioinorganic chemistry, Organometallic chemistry, Heterocyclic chemistry, Carbohydrates, Spectroscopy, Quantum Mechanics and MOT			7	4
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	4	0	4	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	CHM-76T-303 Bioinorganic chemistry, Organometallic chemistry, Heterocyclic chemistry, Carbohydrates, Spectroscopy, Quantum Mechanics and MOT	CA- 1Hrs EoSE -3Hrs	CA- 20 Marks EoSE- 80 Marks	CA- 08 Marks EoSE-32 Marks

Objectives of the Course:	The main objective of this course is to provide students with a theoretical understanding of advanced concepts in chemistry emphasizing both fundamental principles and practical applications. Bioinorganic chemistry is introduced to study the role of metals in biological systems and their coordination environments. Organometallic chemistry is explored including the structure, bonding and reactivity of metal-carbon bonds along with the chemistry of inorganic polymers with their synthesis, properties and applications. The syntheses and reactivity of heterocyclic compounds and carbohydrates have been incorporated to achieve knowledge and deep understanding in these fields. Spectroscopic techniques are incorporated, viz. rotational and vibrational spectroscopy to understand molecular rotations and vibrations, raman spectroscopy for complementary vibrational analyses, electronic spectroscopy for studying electronic transitions in molecules. Principles of quantum mechanics and its applications in molecular orbital theory (MOT) are also introduced for understanding molecular structure and bonding. This course integrates theoretical concepts of spectroscopy and quantum mechanics to prepare students for advanced research and problem-solving in modern chemistry

Syllabus

CHM-76T-303 - Bioinorganic chemistry, Organometallic chemistry, Heterocyclic chemistry, Carbohydrates, Spectroscopy, Quantum Mechanics and MOT

Unit-I

Bioinorganic chemistry:
Essential and trace elements to biological processes, Metalloporphyrin with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}, Nitrogen fixation.

Organometallic Compounds:
Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti, A brief account of metal ethylenic complexes and homogeneous hydrogenation, Mononuclear carbonyls and the nature of bonding in metal carbonyls.

Inorganic Polymers:
Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

15 Lecture

Unit-II

Heterocyclic Compounds
Introduction: Molecular orbital diagram and aromatic characteristics 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 reactions in pyridine and derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five- and six-membered heterocyles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher-indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis, Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Carbohydrates: Introduction, classification, constitution and reaction of glucose and fructose, Mutarotation and its mechanism, Cyclic structure : pyranose and furanose forms, Haworth projection formulae, Configuration of monosaccharides, Determination of ring size, Conformational analysis of monosaccharides, Epimerization, Chain lengthening and chain shortening in aldoses. Interconversion of aldoses and ketoses.
Disaccharides: Structure determinations of maltose, lactose and sucrose.
Polysaccharides: Structure of starch and cellulose, glycosidic linkages.

15 Lecture

Unit-III

Spectroscopy:

Introduction: Electromagnetic radiation, Spectrum, Basic features of different spectrometers, Statement of the Born-Openheimer approximation, Degrees of freedom.

Rotational Spectrum: Diatomic molecules, Energy levels of a rigid rotator (semi-classical principles), Selection rules, Spectral intensity using population distribution (Maxwell-Boltzmann distribution), Determination of bond length, Qualitative description of non-rigid rotator, Isotope effect.

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 anharmonic motion and isotope on the spectrum, Idea of vibrational frequencies of different functional groups.

Raman Spectrum: Basic principles and applications, Concept of polarizability, Pure rotational and pure vibrational Raman spectra of diatomic molecules, Selection rules

Electronic Spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals, Qualitative description of selection rules and Frank Condon principle. Qualitative description of σ, π and n M.O. and their respective energy levels.

15 Lecture

Unit-IV

Elementary Quantum Mechanics:

Black-body radiation, Planck's radiation law, Photoelectric effect, Heat capacity of solids, Bohr's mode of hydrogen atom (no derivation) and its defects. Compton effect.

De Broglie hypothesis, The Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, Physical interpretation of the wave function, Postulates of quantum mechanics, quantum number and their importance, Particle in a one-dimensional box.

Molecular orbital theory:

Basic ideas, criteria for forming M.O. from A.O. Construction of M.O's by LCAO method- H_2^+ ion, calculation of energy level from wave functions, physical picture of bonding and antibonding wave functions, concept of σ, σ^*, π, π^* orbitals and their characteristics. Hybrid orbitals - sp, sp^2, sp^3, calculation of coefficients of A.O.'s used in these hybrid orbitals. Introduction to valence bond model of H_2, comparison of M.O. and V.B. models.

Suggested Books and References:

1. Bioorganic, bioinorganic and supramolecular chemistry by Kalsi and Ashu , New Age International.
2. Bioinorganic Chemistry by Ankita Das, Asim K Das and Mahua Das. Books & Allied.
3. Principal of bioinorganic Chemistry by Stphen J. Lippard, Jerem M. Berg, Universal Science Books.
4. Basic Organometallic Chemistry by B D Gupta, A. J. Elias, Universities Press
5. Organometallic Chemistry and Catalysis by Didier Astruc, Springer.

6. Organic Chemistry by R. T. Morrison and R. N. Boyed, Prentice Hall.
7. Organic Chemistry by I. L. Finar (Vol. I & II), ELBS.
8. Advanced Organic Chemistry by A. Bahl and B. S. Bahl, S. Chand.
9. Organic Chemistry by S. S. Gupta, Oxford University Press.
10. Modern Organic Chemistry by M.K. Jain and S. C. Sharma, Vishal Publishing Co.
11. Essentials of carbohydrate Chemistry by John F. Robyt, Springer
12. Heterocyclic Chemistry By R.R Gupta, Springer.
13. Heterocyclic Chemistry by R K Bansal New Age International Publishers.
14. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, Vishal Publishing Co.
15. Advanced Physical Chemistry by Gurdeep Raj, Goel Publishing House.
16. Atkins' Physical Chemistry by Atkins, Julio De Paula and James Keeler, Oxford.
17. Quantum Chemistry (2nd edition) by Donald A. McQuarrie, University Science Book Sausalito, California.

Suggested E-resources:

All the above suggested books are **available as e- books**

Online Lecture Notes and Course Materials:

All prescribed courses are available in digital form in the form of e-books, Adobe Acrobat documents (PDF), web pages etc.

Syllabus

CHM-76P-304 - Chemistry Lab-VI

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
VI	CHM-76P-304	Chemistry Lab-VI			7	2
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	0	2	2	Practical	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Practical	CHM-76P-304 Chemistry Lab-VI	CA- 1Hrs EoSE -4Hrs	CA- 10 Marks EoSE- 40 Marks	CA- 04 Marks EoSE-16 Marks

Objectives of the Course:	The main objective of this course is to provide students with hands-on training in Inorganic, Organic, and Physical Chemistry experiments. Students will learn quantitative estimation of water quality parameters, synthesis of important organic compounds through classical reactions, and determination of physicochemical properties using pH-metry, potentiometry, and spectrophotometry. The course aims to strengthen analytical skills, laboratory techniques, accuracy in experimental work, and safe handling of chemicals. It also helps students to correlate theoretical knowledge with practical applications and prepares them for viva voce and research-based learning.

Syllabus

CHM-76P-304 - Chemistry Lab-VI

Inorganic chemistry **10 marks**

Quantitative Analysis:

a. Determination of Dissolved Oxygen in water.
b. Determination of Chemical Oxygen Demand (COD)
c. Determination of Biological Oxygen Demand (BOD)
d. Percentage of available chlorine in bleaching powder.
e. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^{-}) using double titration method.
f. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).
g. Separation and estimation of Mg (II) and Fe (II) by solvent extraction method.
h. Separation and estimation of Mg (II) and Fe (II) by ion exchange method.

Organic Chemistry **10 marks**

Synthesis of Organic Compounds

a. **Acetylation:** acetylation of salicylic acid, aniline, glucose and hydroquinone.
b. **Benzoylation:** benzoylation of aniline and phenol.
c. **Aliphatic electrophilic substitution:** preparation of iodoform from ethanol or acetone **Nucleophilic addition elimination:** preparation of semicarbazone of acetone, ethyl methyl ketone, cyclohexanone and benzaldehyde.
d. **Aromatic electrophilic substitution:**
   - **Nitration:** Preparation of m-dinitrobenzene
   - Preparation of p-nitroacetanilide
   - **Halogenation:** Preparation of $p-bromoacetanilide$
   - Preparation of 2, 4, 6 – tribromophenol
   - **Diazotization/coupling:** Preparation of methyl orange or methyl red
e. **Oxidation:** Preparation of benzoic acid from toluene or benzaldehyde
f. **Reduction:**
   - Preparation of aniline from nitrobenzene
   - Preparation of m-nitroaniline from m-dinitrobenzene

Physical Chemistry **10 marks**

1. **pH-metry**

a. **pH metric titrations of**
   i. Strong acid vs. strong base
   ii. Weak acid vs. strong base
b. Determination of dissociation constant of a weak acid.
c. **Preparation of buffer solutions:**
   i. Sodium acetate-acetic acid
   ii. Ammonium chloride-ammonium hydroxide
d. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

2. **Potentiometry**
   a. Strong acid vs. strong base
   b. Weak acid vs. strong base
   c. Potassium dichromate vs. Mohr's salt

3. **Spectrophotometery or Colourimetry:**
   To verify Beer-Lambert law and determine the concentration of the given aqueous solution of $KMnO_4/K_2Cr_2O_7/CuSO_4$ of unknown concentration.

Viva voce **5 marks**

Practical Record **5 marks**

Suggested Books and References:

1. Vogel's Qualitative Inorganic Analysis, A. I. Vogel Prentice Hall.
2. Vogel's Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, ELBS.
3. Vogel's Textbook of Quantitative Chemical Analysis, A. I. Vogel, Pearson Education Ltd.
4. Advanced Practical Organic Chemistry by N. K. Vishnoi, Vikas Publishing House Pvt Ltd.
5. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K Ahluwalia. Universities Press, Hyderabad.
6. Laboratory Techniques in Organic Chemistry by V. K Ahluwalia, I K International, N
7. Advanced Practical Organic Chemistry J. B Yadav, Goel Publishing House.
8. Practical Physical Chemistry, by B. D Khosla, S. Chand & Company.
9. Advanced Practical Organic Chemistry by Amit Arora, Discovery Publishing House, New Delhi.

Suggested E-resources:

All the above suggested books are available as e- books.

Online Lecture Notes and Course Materials:

All prescribed courses are available in digital form in the form of e-books, Adobe Acrobat documents (PDF), web pages etc.

Course Learning Outcomes:

By the end of this course, students will get a clear understanding of bioinorganic chemistry including the role of metals in biological systems and their coordination environments. They will get acquainted with the structure, bonding, reactivity and the applications of organometallic complexes along with the synthesis, properties, and applications of heterocyclic compounds. Furthermore, the structure, functions and reactions of carbohydrates will provide knowledge in this field. Students will get knowledge in spectroscopic techniques through analysis of molecular rotation using the rotational spectrum, examine molecular vibrations through the vibrational spectrum and Raman spectrum and further interpret electronic spectra for electronic transitions in molecules. They will grasp the fundamentals of quantum mechanics and its application in quantum molecular orbital theory (MOT) to explain molecular bonding and structure.

This course provides students with both theoretical knowledge and practical skills, essential for advanced studies and research in modern chemistry

Syllabus

CHM-75T-311 - Metal ligand bonding, Heterocyclic Compounds, Polynuclear compound, Quantum mechanics, Electrogravimetric, Coulometry

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
V	CHM-75T-311	Metal ligand bonding, Heterocyclic Compounds, Polynuclear compound, Quantum mechanics, Electrogravimetric, Coulometry			7	4
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	4	0	4	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA +, EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	CHM-75T-311 Metal ligand bonding, Heterocyclic Compounds, Polynuclear compound, Quantum mechanics, Electrogravimetric, Coulometry	CA- 1Hrs EoSE -3Hrs	CA- 20 Marks EoSE- 80 Marks	CA- 08 Marks EoSE-32 Marks

Objectives of the Course:	The main aim of this course is to provide students with a theoretical and conceptual understanding of metal ligand bonding, heterocyclic compounds, polynuclear compounds and quantum mechanics aspects in addition to electro-gravimetric, coulometry analytical techniques.

Syllabus

CHM-75T-311 - Metal ligand bonding, Heterocyclic Compounds, Polynuclear compound, Quantum mechanics, Electrogravimetric, Coulometry

Unit-I

Metal-Ligand Bonding:

Limitations of crystal field theory, molecular orbital theory of octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory.

Metal Carbonyls: preparation, properties and bonding of transition metal carbonyls. Detailed study of mononuclear and polynuclear carbonyls.

15 Lecture

Unit-II

Heterocyclic Compounds: Nomenclature, Five and Six membered heterocyclic compounds, Aromatic Character, preparation, reactions, chemical reactivity, orientation (Electrophilic and nucleophilic substitution reactions) basicity of pyrrole, furan, thiophene and pyridine. Condensed five and six membered heterocycles, structure, preparation and reactions of indole, quinoline and isoquinoline.

Polynuclear Compounds: Structure of naphthalene, mechanism and orientation of electrophilic substitution in naphthalene, preparation and properties of naphthalene and anthracene, some important derivatives of naphthalene like naphthols and naphthyl amines. Preparation and reaction of diphenyl, diphenylmethane and triphenylmethane.

15 Lecture

Unit-III

Quantum Mechanics:

Black-body radiation, Planck's radiation law, Photoelectric effect, Heat capacity of solids, Bohr's mode of hydrogen atom (no derivation) and its defects. Compton effect.

De Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Operators and their applications, Schrodinger wave equation and its importance, Physical interpretation of the wave function, Normalization and orthogonality of wave functions. Postulates of quantum mechanics, quantum number and their importance, Particle in a one-dimensional box.

Schrodinger's wave equation for particle in three-dimensional box, H-atom, quantum number and their importance, hydrogen like wave functions, radial wave functions and angular wave functions.

M.O. theory, basic ideas, criteria for forming M. O from A.O. Construction of M. Os by LCAO–H_2^+ ion. Calculation of energy levels from wave functions, physical picture of bonding and anti-bonding wave functions, concept of σ, σ*, Π, Π* orbitals and their characteristics,

hybrid orbitals- sp, sp^2, sp^3, calculation of co-efficient of A.O.'s used in these hybrid orbitals. Introduction to Valence bond model of H_2, comparison of M.O. and V.B model.

15 Lecture

Unit-IV

Electrogravimetry: Theory, electrode reactions, overpotential, deposition, electrolytic separation of metals, character of the deposit and electrolytic separation of metals with controlled cathode potential. Electrolytic determinations at constant current—Copper and Lead. Electrolytic determinations with controlled cathode potential—Antimony, copper, lead and tin in an alloy.

Coulometry: Coulometry at controlled potential, separation of Ni and Co by coulometric analysis at controlled potential, coulometry at constant current, coulometry titrations.

15 Lecture

Suggested Books and References:

1. Concise Coordination Chemistry by R. Gopalan and V. Ramalingam, Vikas Publishing House Pvt, Ltd.
2. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson, & P.L Gaus, Willey.
3. Concise Inorganic Chemistry by J. D. Lee, Wiley-India.
4. Inorganic Chemistry by Catherine E. Housecroft, & Alan G Sharpe, Pearson Education Ltd.
5. Principles of Inorganic Chemistry by Puri, Sharma & Kalia, Vishal Publishing Co.
6. Concepts and Models of Inorganic Chemistry, B.E. Douglas, D. McDaniel, & J. Alexander, Wiley.
7. Organic Chemistry by R. T. Morrison & R. N. Boyed, Prentice Hall.
8. Reaction Mechanism in Organic Chemistry by S. M. Mukherji & S. P. Singh, TRINITY Press.
9. Organic Chemistry by I. L. Finar, (Vol. I & II) ELBS.
10. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, Vishal Publishing Co.
11. A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand, New Age International Publishers.
12. Elements of Physical Chemistry, P. Atkins and J. De Paula, Oxford.
13. Instrumental Methods of Chemical analysis by Gurdeep R. Chatwal & Sham K. Anand, Himalaya Publishing House.
14. Instrumental Methods of Chemical Analysis by V.K. Ahluwalia, Springer.
15. Instrumental Methods of Chemical analysis by B. K. Sharma, Goel Publishing House, Meerut.

16. Analytical Chemistry by Gary D. Christian, Purnendu K. Dasgupta & Kevin A. Schug, Wiley.
17. Fundamentals of Analytical Chemistry by F. James Holler, Stanley R Crouch, Donald M. West & Douglas A. Skoog, Cengage Learning India Pvt. Ltd

Suggested E-resources:

All the above suggested books are available as e- books.

Online Lecture Notes and Course Materials:

All prescribed courses are available in digital form in the form of e-books, Adobe Acrobat documents (PDF), web pages etc

Syllabus

CHM-75T-312 - Nuclear Chemistry, Amino acids, Peptides, Protein, Photochemistry, Physical properties and molecular structures, Polarography Amperometry, Modified voltammetric methods

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
V	CHM-75T-312	Nuclear Chemistry, Amino acids, Peptides, Protein, Photochemistry, Physical properties and molecular structures, Polarography Amperometry, Modified voltammetric methods			7	4
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	4	0	4	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	CHM-75T-312 Nuclear Chemistry, Amino acids, Peptides, Protein, Photochemistry, Physical properties and molecular structures, Polarography Amperometry, Modified voltammetric methods	CA- 1Hrs EoSE -3Hrs	CA- 20 Marks EoSE- 80 Marks	CA- 08 Marks EoSE-32 Marks

Objectives of the Course:	The main aim of this course is to provide clear understanding in the field of nuclear chemistry, amino acids, peptides and protein. Concepts and theories related to the field of photochemistry, physical properties and molecular structure along with polarography, amperometry and modified voltammetric methods are also included to enrich knowledge of students.

Syllabus

CHM-75T-312 - Nuclear Chemistry, Amino acids, Peptides, Protein, Photochemistry, Physical properties and molecular structures, Polarography Amperometry, Modified voltammetric methods

Unit I

Nuclear Chemistry:
Fundamental particles of nucleus (nucleon), concept of nuclides, representation of nuclides, isotopes, isobars and isotones with specific examples. Applications of radioisotopes, size concept in nucleus and atom. Qualitative idea of the stability of nucleus (n/p ratio). Shell and liquid drop model.
Radioactivity: Natural and artificial radioactivity, disintegration series, disintegration rates, half-life, average life, nuclear binding energy, mass defects, Einstein's mass energy relations, artificial transmutation, nuclear reactions, spallation's, nuclear fission and fusion, nuclear reactors, hazards of radioactive emanations.

15 Lecture

Unit II

Amino Acids, Peptides and Proteins: Classification, structure and stereochemistry of amino acids. Physical properties, zwitter ion structure, isoelectric point and electrophoresis. Preparation and reaction of α-amino acids.
Structure and nomenclature of peptides and proteins. Classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid- phase peptide synthesis. Structure of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation.

15 Lecture

Unit III

Photochemistry:
Absorption of light, Grothus –Dropper law. Einstein law of photochemical equivalence. Quantum yield of photochemical reactions, reasons for high and low quantum yield of photochemical equations. Primary and secondary processes, Photochemical reactions such as (1) $H_2 + Cl_2$ reaction (2) photolysis of ammonia (3) hydrolysis of monochloro acetic acid.
Consequences of light absorption phosphorescence, fluorescence, chemiluminescence and photosensitization.
Physical Properties and Molecular Structure:
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, Dipole moment and structure of molecules, magnetic properties paramagnetism, diamagnetism and ferromagnetism.

Unit-IV

Polarography: Principle and experimental set-up. Diffusion current and Half-wave potential. Qualitative and quantitative applications of polarography in analytical chemistry.

(i) Wave height concentration graph.
(ii) Internal standard (piloton method)
(iii) Standard addition method.
(iv) Use of polarography: Zn and Cu analysis in brass,
(v) Dissolved oxygen in sample.

Amperometry: Amperometric titrations, technique of amperometric titrations with the dropping mercury electrode, titration with the rotating platinum micro electrode, biamperiometric titrations.

Modified Voltammetric methods: Current sampled (TAST) Polarography, Pulse polarography, Differential pulse polarography, Cyclic Voltammetry, Sinusoidal, Alternating current polarography, Stripping Voltammetry.

15 Lecture

Suggested Books and References:

1. Essentials of Nuclear Chemistry by H.J. Arnikar, New Age International Publishers.
2. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson, & P.L Gaus, Willey.
3. Concise Inorganic Chemistry by J. D. Lee, Wiley-India.
4. Inorganic Chemistry by Catherine E. Housecroft, & Alan G Sharpe, Pearson Education Ltd.
5. Principles of Inorganic Chemistry by Puri, Sharma & Kalia, Vishal Publishing Co.
6. Concepts and Models of Inorganic Chemistry, B.E. Douglas, D. McDaniel, & J. Alexander, Wiley.
7. A.C. Deb, Fundamentals of Biochemistry.
8. M.N. Hughes, Inorganic Chemistry of Biological Processes.
9. Smith et.*al,* Principles of Biochemistry.
10. Christopher K. Mathews, Kensal E. van Holde and Kevin G Ahern, Biochemistry (2nd Edn)
11. Organic Chemistry by R. T. Morrison & R. N. Boyed, Prentice Hall
12. Reaction Mechanism in Organic Chemistry by S. M. Mukherji & S. P. Singh, TRINITY Press.
13. Organic Chemistry by I. L. Finar, (Vol. I & II) ELBS.
14. Physical Chemistry by R. J. Silbey, R. A. Alberty & M. G. Bawendi, John Wiley & Sons.

15. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, Vishal Publishing Co.
16. A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand, New Age International Publishers.
17. Advanced Physical Chemistry by Gurdeep Raj, Goel Publishing House.
18. Elements of Physical Chemistry, P. Atkins and J. De Paula, Oxford.
19. Instrumental Methods of Chemical analysis by Gurdeep R. Chatwal & Sham K. Anand, Himalaya Publishing House.
20. Instrumental Methods of Chemical Analysis by V.K. Ahluwalia, Springer.
21. Instrumental Methods of Chemical analysis by B. K. Sharma, Goel Publishing House, Meerut.
22. Analytical Chemistry by Gary D. Christian, Purnendu K. Dasgupta & Kevin A. Schug, Wiley.
23. Fundamentals of Analytical Chemistry by F. James Holler, Stanley R Crouch, Donald M. West & Douglas A. Skoog, Cengage Learning India.

Suggested E-resources:

All the above suggested books are available as e- books.

Online Lecture Notes and Course Materials:

All prescribed courses are available in digital form in the form of e-books, Adobe Acrobat documents (PDF), web pages etc.

Syllabus

CHM-75P-313 - Chemistry Lab-V

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
V	CHM-75P-313	Chemistry Lab-V			7	2
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	0	2	2	Practical	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Practical	CHM-75P-313 Chemistry Lab-V	CA- 1Hrs EoSE -4Hrs	CA- 10 Marks EoSE- 40 Marks	CA- 04 Marks EoSE-16 Marks

Objectives of the Course:	

Syllabus

CHM-75P-313 - Chemistry Lab-V

Inorganic Chemistry

Quantitative estimation of ***any three*** **of** the following mixtures by volumetric and gravimetric methods.

a) Copper-Zinc
b) Zinc-Nickel
c) Silver-Copper
d) Silver-Nickel
e) Silver-Zinc
f) Copper-Nickel

Organic Chemistry

Qualitative organic analysis

Analysis of an organic mixture containing two solid components using water, $NaHCO_3$ and NaOH for separation and preparation of suitable derivatives.

Physical Chemistry

Determine the velocity constant of hydrolysis of ethyl acetate by sodium hydroxide (saponification of an ester).

Viva voce	**5 marks**
Practical Record	**5 marks**

Suggested Books and References:

1. Advanced Practical Physical Chemistry J. B. Yadav, Goel Publishing House.
2. Practical Physical Chemistry B. D Khosla, S. Chand & Company.
3. Advanced Practical Organic Chemistry by N K Vishnoi, Vikas Publishing House PVT LTD
4. 4.Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K Ahluwalia. Universities Press, Hyderabad.
5. Advanced Practical Organic Chemistry by N K Vishnoi, Vikas Publishing House PVT LTD
6. Vogel's Qualitative Inorganic Analysis, A. I. Vogel Prentice Hall.
7. Vogel's Textbook of Quantitative Chemical Analysis, A. I. Vogel, Pearson Education Ltd.
8. Laboratory Techniques in Organic Chemistry by V. K Ahluwalia, I K International, N

Course Learning Outcomes

By the end of this degree programme, student will achieve the essential conceptual knowledge in the field of metal ligand bonding, heterocyclic compounds, polynuclear compound, quantum mechanics in addition to electro-gravimetric and coulometry analytical techniques.

Furthermore, student will gain knowledge related to nuclear chemistry, amino acids, peptides, protein, photochemistry along with physical properties and molecular structures. Concepts related to the field of basic and applied polarography, amperometry, modified voltammetric methods will enrich the knowledge of student and further they will be able to conduct experiments and demonstrate efficiency with appropriate lab skills, techniques and instrumentations. It will also fruitful for the students to gain awareness in physical science so that students will be benefited in the long run.

Syllabus

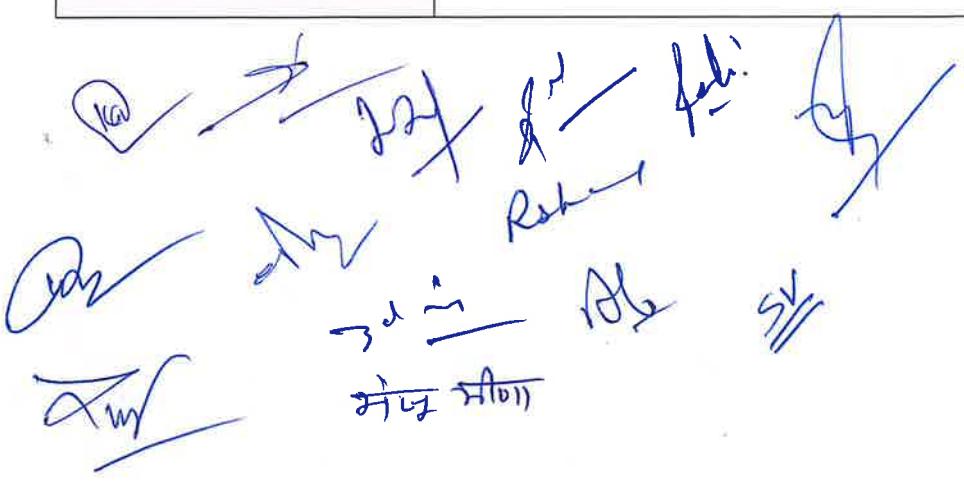
CHM-75T-314 - Bioinorganic Chemistry, Carbohydrate, Organometallic compounds, Phase equilibria, Surface Phenomenon, Diffraction Pattern, Automated methods of analysis

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
VI	CHM-75T-314	Bioinorganic Chemistry, Carbohydrate, Organometallic compounds, Phase equilibria, Surface Phenomenon, Diffraction Pattern, Automated methods of analysis			7	4
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	4	0	4	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	CHM-75T-314 Bioinorganic Chemistry, Carbohydrate, Organometallic compounds, Phase equilibria, Surface Phenomenon, Diffraction Pattern, Automated methods of analysis	CA- 1Hrs EoSE -3Hrs	CA- 20 Marks EoSE- 80 Marks	CA- 08 Marks EoSE-32 Marks

Objectives of the Course:	The main objective of this course is to provide deep understanding in the bioinorganic chemistry, carbohydrate, organometallic chemistry. Phase equilibria and surface phenomenon are also incorporated to provide interdisciplinary nature of the fields.



Syllabus

CHM-75T-314 - Bioinorganic Chemistry, Carbohydrate, Organometallic compounds, Phase equilibria, Surface Phenomenon, Diffraction Pattern, Automated methods of analysis

Unit-I

Bioinorganic Chemistry:
Role of bulk and trace metal ions in biological systems with special reference to Na, K, Mg, Ca, Fe, Cu and Zn.
Metalloporphyrin: Chlorophylls and their role in photosynthesis. Hemoglobin and Myoglobin and their role as oxygen carriers.
Nitrogen fixation: Mechanism, nitrogenase enzyme, dinitrogen complexes as models for nitrogen fixation.
Metalloenzymes: General discussion of enzymes, functions of metal ions, inhibition (explanation based on coordination chemistry), carboxypeptidase-A and cytochrome-C

15 Lecture

Unit-II

Carbohydrates: Introduction, classification, constitution and reaction of glucose and fructose, mutarotation and its mechanism, cyclic structure, pyranose and furanose forms, Haworth projection formulae, configuration of monosaccharides, determination of ring size, conformational analysis of monosaccharides, Epimerization, chain lengthening and chain shortening in aldoses. Interconversion of aldoses and ketoses.
Disaccharides: Structure determinations of maltose, lactose and sucrose.
Polysaccharides: Structure of starch and cellulose, glycosidic linkages.
Organometallic Compounds: Definition and classification of organometallic compounds. Synthesis, properties and structures of organometallic compounds of Lithium, Magnesium and Zinc.

Unit-III

Phase Equilibrium:
Solid solutions: Compound formation with congruent melting point (Mg-Zn) and benzophenone – dimethylamine, incongruent melting point NaCl-H_2O, picric acid and benzene, $FeCl_3$ – H_2O and $CuSO_4$- H_2O system.
Liquid-Liquid mixtures: Ideal liquid mixtures, Raoult's law and Henry's law, non – ideal system, azeotropes HCl-H_2O and ethanol-water system.
Particularly miscible liquids: Phenol-water, trimethylamine - water, nicotine-water system, lower and upper consulate temperature, effect of impurities on consulate temperature.
Immiscible liquids – Steam distillation.

Surface phenomenon, micelles: Surface active agents, classification of surface-active agents, micellization, hydrophilic interaction, critical micellar concentration (CMC), factors affecting CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization. Phase separation and mass action models, solubilization, micro emulsion, reverse micelles.

Adsorption: Gibbs adsorption isotherm, determination of surface area (BET) equation, surface films on liquids (electrokinetic phenomenon), catalytic activity at surface, electrode/electrolyte interface. **15 Lecture**

Unit-IV

Diffraction Pattern: Fundamental, principles, instrumentation, use of X-ray, electron and neutron in diffractometry and applications of X-ray, electron and neutron diffractometry in biological and analytical techniques. Applications of X-rays in CT scan.

Automated Methods of analysis: Automatic instruments and automation. Automation of sampling and preliminary sample treatment for air, water and soil, continuous flow method. Discrete methods, Automatic Anlaysis based on Multilayer Films.

NMR Spectroscopy: Theory of nuclear magnetic resonance, experimental methods of NMR spectroscopy, applications of proton NMR including applications in MRI technique. Structure elucidation of simple organic molecules on the basis of ^{1}H NMR and mass spectral data.

15 Lecture

Suggested Books and References:

Bioorganic, bioinorganic and supramolecular chemistry by Kalsi and Ashu , New Age

1. International.
2. Bioinorganic Chemistry by Ankita Das, Asim K Das and Mahua Das. Books & Allied.
3. Principal of bioinorganic Chemistry by Stphen J. Lippard, Jerem M. Berg, Universal Science Books
4. Basic Organometallic Chemistry by B D Gupta, A. J. Elias, Universities Press
5. Organometallic Chemistry and Catalysis by Didier Astruc, Springer.
6. Organic Chemistry by S. S, Gupta, Oxford University Press.
7. Organic Reaction Mechanisms by V. K. Ahluwalia, Narosa Publishing House, New Delhi.
8. Organic Chemistry – Reactions and Reagents Complete Theoretical Organic Chemistry, by O. P Agarwal, Covering Goel Publishing House, Meerut.
9. Organic Chemistry by R.T Morrison. & R. N Boyed., Prentice Hall.
10. Organic Chemistry by I. L Finar, (Vol. I & II) ELBS.
11. Advanced Organic Chemistry by A Bahl. & B. S Bahl., S. Chand.
12. Organic Chemistry by C. N Pillai., Oxford University Press.

13. Modern Organic Chemistry by M. K Jain & S.C. Sharma, Vishal Publishing Co.
14. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure by J March, & M. B Smith Wiley.
15. Solutions, Phase Equilibrium, Conductance & Electrochemistry by Puri, Sharma, Pathania and Kaur, Vishal Publishing Co.
16. Phase equilibrium, Phase Diagrams and Phase transformations: Their thermodynamic Basis 2nd edition Cambridge University Press.
17. Fundamentals of Molecular Spectroscopy by C. N. Banwell, Campus Book House.
18. Spectrometric Identification of Organic Compounds by Robert Silverstein, Wiley.
19. Fundamentals of Molecular Spectroscopy by P. S. Sindhu, New Age International.
20. Introduction to Spectroscopy – Fifth Edition by Pavia, Lampman, Kriz & Vyvyan Cengage India Private Limited.
21. Modern Spectroscopy – Fourth Edition by J. Michael Hollas, John Wiley & Sons.\
22. Spectroscopy by B. K. Sharma, Goel Publishing House.

Syllabus

CHM-75T-315 - Inorganic Polymers, Synthetic Dyes & Drugs, Organic Polymers, Macromolecules, Mass spectrometry, Gas Chromatography HPLC

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
VI	CHM-75T-315	Inorganic Polymers, Synthetic Dyes & Drugs, Organic Polymers, Macromolecules, Mass spectrometry, Gas Chromatography HPLC			7	4
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	4	0	4	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	CHM-75T-315 Inorganic Polymers, Synthetic Dyes & Drugs, Organic Polymers, Macromolecules, Mass spectrometry, Gas Chromatography HPLC	CA- 1Hrs EoSE -3Hrs	CA- 20 Marks EoSE- 80 Marks	CA- 08 Marks EoSE-32 Marks

Objectives of the Course:	The main aim of this course is to provide clear understanding in the field of inorganic polymers, synthetic dyes & drugs, organic polymers, mass spectrometry, electrochemistry, gas chromatography and HPLC. are also incorporated to provide interdisciplinary nature of the fields.

Syllabus

CHM-75T-315 - Inorganic Polymers, Synthetic Dyes & Drugs, Organic Polymers, Macromolecules, Mass spectrometry, Gas Chromatography HPLC

Unit-I

Inorganic Polymers: Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones, phosphonitrilic halides and condensed phosphates.

Metal Clusters: Higher boranes, carboranes, metalloboranes and metallocarboranes, metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

15 Lecture

Unit-II

Synthetic Dyes: Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

Sulpha drugs and their mechanism of action, Synthesis of sulphadiazine, sulphapyridine, sulphalhiazole, sulphaguanidine and sulphamethazole.

Polymers and polymerization: Addition and condensation polymerization, their mechanism, copolymerization, coordination polymerization, Ziegler-Natta catalyst, plastics, thermoplastic and thermosetting resins, plasticizers, polystyrene, PVC, polyacrylates, polyacrylonitrile, dacron, terylene, nylon-66, bakelite, melamine and polyurethanes. Synthetic and natural rubber.

15 Lecture

Unit-III

Macromolecules: Linear, branches, network and homopolymer. Polymer classification, number average and weight average, molecular weight determination methods of polymers by (1) osmotic pressure (2) viscosity (3) light scattering. Properties of macromolecules

Catalysis: The simple catalysis mechanism $S + C \rightarrow SC \rightarrow P + C$. Its mathematical treatment and its consequences. Specific and general acid – base catalysis, enzyme catalysis, surface catalysis and Langmuir adsorption isotherm, mechanism of surface catalysis.

15 Lecture

Unit-IV

Mass spectrometry: Instrumentation and technique, Elementary idea about electron impact, chemical ionization and matrix assisted laser desorption ionization (MALDI), mass spectrometer techniques. Determination of molecular formula, mass spectra of simple organic compounds.

Factors affecting fragmentation, ion analysis, ion abundance, fragmentation modes, mass spectral fragmentation of simple organic compounds: alkanes, primary alcohols, aliphatic ketones, aldehydes and carboxylic acids, Types of peaks- molecular ion peak, isotopic peak, base peak, metastable peak, doubly charged ion, Mc Lafferty rearrangement and retro Diels-Alder reaction, nitrogen rule.

Gas Chromatography and HPLC: Introduction, gas chromatographs, detectors, programmed temperature gas chromatography, quantitative analysis by GLC, gas-solid chromatography. High performances liquid chromatographic methods - Adsorption Chromatography. Liquid-liquid partition chromatography, Ion exchange, HPLC, exclusion chromatography

15 Lecture

Suggested Books and References:

1) Concise Inorganic Chemistry by J.D. Lee, Wiley.
2) Inorganic Chemistry by Catherine E. Housecraft and Alan G. Sharpe, Pearson.
3) Selected Topics in Inorganic Chemistry by Wahid U. Malik, G. D. Tuli and R. D. Madan, S. Chand, New Delhi.
4) Advanced Inorganic Chemistry: Volume I & II by Satya Prakash, G. D. Tuli, S. K. Basu and R. D. Madan, S. Chand, New Delhi.
5) Principles of Inorganic Chemistry by Puri, Sharma & Kalia, Vishal Publishing Co.
6) Organic Chemistry by I. L. Finar, Pearson.
7) Organic Chemistry by R.T. Morrison, R.N. Boyd & S.K. Bhattacharjee, Pearson.
8) Dyes and Drugs by Harold H. Trimm, William Hunter Jr., Taylor & francs Ltd.
9) Introduction synthetic drugs and dyes by R.S. Rao, Gomathi Shridhar, Himalya Publishing House.
10) Polymer Chemistry: Synthesis and Charactrisation By Prashant D. Ashtaputrey & Santosh D. Ashtaputrey, Prints Publication PVT. Ltd.
11) Principles of Physical Chemistry by B. R. Puri, L. R. Sharma & M. S. Pathania, Vishal Publishing Co.
12) Advanced Physical Chemistry by Gurdeep Raj, Goel Publishing House.
13) Physical Chemistry by W. Atkins, Oxford University Press.
14) Physical Chemistry by R. J. Silby and R. A. Alberty, John Wiley & Sons.
15) Fundamentals of Molecular Spectroscopy by C. N. Banwell, Campus Book House.
16) Spectrometric Identification of Organic Compounds by Robert Silverstein, Wiley.
17) Fundamentals of Molecular Spectroscopy by P. S. Sindhu, New Age International.
18) Introduction to Spectroscopy – Fifth Edition by Pavia, Lampman, Kriz & Vyvyan Cengage India Private Limited.
19) Modern Spectroscopy – Fourth Edition by J. Michael Hollas, John Wiley & Sons.
20) Spectroscopy by B. K. Sharma, Goel Publishing House.
21) Instrumental Methods of Chemical analysis (Analytical Chemistry), Chatwal, RGurdeep, S Anand, Himalaya Publishing House.
22) Analytical Chemistry Chatwal, R. Gurdeep, Himalaya Publishing House.
23) Skoog and West's Fundamentals of Analytical Chemistry by M. Donald, A Douglas, F. Holler James, F. West et al, 2022, Cengage Learning India Pvt. Ltd.

Syllabus

CHM-75P-316 - Chemistry Lab-VI

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
VI	CHM-75P-316	Chemistry Lab-VI			7	2
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	0	2	2	Practical	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Practical	CHM-75P-316 Chemistry Lab-VI	CA- 1Hrs EoSE -4Hrs	CA- 10 Marks EoSE- 40 Marks	CA- 04 Marks EoSE-16 Marks

Objectives of the Course:	

Syllabus

CHM-75P-316 - Chemistry Lab-VI

Ex. 1 Inorganic Preparations and its characterization (*any four*):

a) Bis (dimethylglyoximato) nickel(II) complex, $[Ni(dmg)_2]$

b) Potassium trioxalatochromate(III), $K_3[Cr(C_2O_4)_3]$

c) Potassium trioxalatoferrate(III), $K_3[Fe(C_2O_4)_3]$

a) Tetraamminecopper(II) sulphate, $[Cu(NH_3)_4]SO_4$

b) Potassium c*is*-diaquabis(oxalato)chromate(III) dihydrate, K[*cis*-$Cr(H_2O)_2(C_2O_4)_2].2H_2$

Ex.2 Two step preparations of simple compounds: The students are expected to perform at least three of the following preparations.

- (i)Preparation of p-aminoazobenzene from aniline.
- (ii)Preparation of p-nitroaniline from acetanilide.
- (iii)Preparation of sym-tribromobenzene from aniline.
- (iv)Preparation of m-nitroaniline from nitrobenzene.
- (v) Preparation of acetanilide from acetophenone (Beckmann rearrangement).
- (vi) Preparation of anthranilic acid from phthalic anhydride.
- (vii) Preparation of eosin from phthalic anhydride.

Physical Chemistry:
Spectrophotometery or Colourimetry:

Verify Lambert Beer Law & determine the concentration of the given aqueous solution of unknown concentration of salt. ($KMnO_4$, $CuSO_4$, $K_2Cr_2O_7$)

(any two exercise, $2 \times 15 = 30$ marks)

Viva voce	**5 marks**
Practical Record	**5 marks**

Suggested Books and References:

1. Advanced Practical Physical Chemistry J. B. Yadav, Goel Publishing House.

2. Practical Physical Chemistry B. D Khosla, S. Chand & Company.
3. Advanced Practical Organic Chemistry by N K Vishnoi, Vikas Publishing House PVT LTD
4. 4.Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K Ahluwalia. Universities Press, Hyderabad.
5. Advanced Practical Organic Chemistry by N K Vishnoi, Vikas Publishing House PVT LTD
6. Vogel's Qualitative Inorganic Analysis, A. I. Vogel Prentice Hall.
7. Vogel's Textbook of Quantitative Chemical Analysis, A. I. Vogel, Pearson Education Ltd.
8. Laboratory Techniques in Organic Chemistry by V. K Ahluwalia, I K International

Course Learning Outcomes:

By the end of this course, students will be able to understand bioinorganic chemistry including the role of metals and their coordination environments. Students will also achieve the essential knowledge in the fields of carbohydrates, organometallic chemistry along with phase equilibria and surface phenomenon, some instrumental methods of chemical analyses such as diffraction pattern, automated methods of analysis.

Furthermore, they will get awareness about syntheses and applications of inorganic polymers, synthetic dyes & drugs and organic polymers including uses of mass spectrometry, electrochemistry, gas chromatography and HPLC analytical techniques in chemistry.

With the completion of this degree programme, student will achieve the essential conceptual knowledge in the field of chemical sciences and will be able to conduct experiments and demonstrate efficiency with appropriate lab skills, techniques and instrumentations.