ACHARYA NAGARJUNA UNIVERSITY: CENTRE FOR DISTANCE EDUCATION

M.Sc. – Chemistry - Program code: 04

Program Structure

Program code	Program	Internal assessment	External exams	Max. Marks	credits
SEMISTER 1					
101CH24	Inorganic Chemistry-I	30	70	100	4
102CH24	Organic Chemistry-I	30	70	100	4
103CH24	Foundation for Chemistry	30	70	100	4
104CH24	Physical Chemistry-I	30	70	100	4
105CH24	Inorganic & Physical Chemistry **Practical-I**	30	70	100	4
106CH 24	Organic Chemistry **Practical-II**	30	70	100	4
SEMISTER 2					
201CH24	Physical Chemistry-II	30	70	100	4
202CH24	Organic Chemistry-II	30	70	100	4
203CH24	Essential Lab Techniques for Industry	30	70	100	4
204CH24	Inorganic Chemistry-II	30	70	100	4
205CH24	Inorganic & Physical Chemistry **Practical-I**	30	70	100	4
206CH24	Organic Chemistry **Practical-II**	30	70	100	4
SEMISTER 3					
301CH24	Applied Inorganic Analysis	30	70	100	4
302CH24	Analysis of Applied Industrial Products	30	70	100	4
303CH24	Optical Thermal & Radiochemical Methods of Analysis	30	70	100	4
304CH24	Principles and Techniques in Classical Analysis	30	70	100	4
305CH24	Classical Methods of Analysis **Practical-I**	30	70	100	4
306CH24	Instrumental Methods of Analysis **Practical-II**	30	70	100	4
SEMISTER 4					
401CH24	Advanced Methods of Analysis	30	70	100	4
402CH24	Analysis of Drugs, Foods, Diary Products & Biochemical Analysis	30	70	100	4
403CH24	Separation Techniques & Electro Analytical Techniques	30	70	100	4
404CH24	Environmental Chemistry & Analysis	30	70	100	4
405CH24	Classical & Instrumental Methods of Analysis **Practical-I**	30	70	100	4
406CH24	Spectral Problems **Practical-II**	30	70	100	4

MSS

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ACHARYA NAGARJUNA UNIVERSITY

CENTRE FOR DISTANCE EDUCATION

M.Sc. CHEMISTRY: SEMESTER–I

101CH24: INORGANIC CHEMISTRY-I

SYLLABUS

Learning Objectives:

- ✓ To know the fundamentals in VSEPR theory.
- ✓ To know the Crystal field theory.
- ✓ To know the Molecular Orbital Theory.
- ✓ To know the Hard and Soft Acids and Bases and Macro Cyclic complexes.
- ✓ To know the higher boranes, Isopoly and heteropoly anions.

UNIT-I

- **Structure and Bonding:** VSEPR theory and its role in explaining the structures of inorganic molecules. Walsh diagrams for linear molecule (BeH_2) and bent molecule (H_2O). Molecular Orbital theory - Symmetry of Molecular orbitals, Molecular orbitals in triatomic ($_2BeH_2$) molecules and ions (NO^-) and energy level diagrams.

Participation of p and d orbitals in pπ - dπ bonding- Evidences from both non transition and transition metal compounds.

Non-valence cohesive forces, Hydrogen bonding - Symmetric and unsymmetric hydrogen bonds in inorganic molecules.

UNIT-II

Metal-Ligand Bonding: Crystal Field Theory of bonding in transition metal complexes Splitting of d-orbitals in Octahedral, tetrahedral, trigonal bipyramidal and Square pyramidal fields and energy orders of orbitals.

Tetragonal distortions - Jahn Teller effect. Static and dynamic Jahn - Teller effects. Chelates and Jahn - Teller effect

Spectrochemical series. Nephelauxetic effect. Calculation of crystal field stabilization energies. Factors affecting crystal field splitting energies. Applications and limitations of CFT.

UNIT-III

Molecular Orbital Theory: Evidence for covalence in complexes - Experimental evidences from both σ and π bonded complexes.

Molecular Orbital Theory of bonding for octahedral, tetrahedral and square planar complexes. π- bonding and MOT - Effect of π-donor and π-acceptor ligands on Δ_o. Experimental evidence for π-bonding in complexes .

MOT and Resonance. Resonance in homoatomic molecules (H_2) and hetero atomic ions.
Molecular Orbital Theory and Hybridization. Bents Rule and energetic of Hybridization.

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UNIT-IV

Metal-Ligand Equilibria in Solutions: Step wise and over all formation constants. Trends in stepwise constants, statistical effect and statistical ratio. Determination of formation constants by Spectrophotometric method (Job's method) and Limitations to Jobs method. Determination of formation constants by pH metric method (Bjerrum's method).

Stability correlations and Irwing -William's series for transition metal ions.

Hard and soft acids and bases (HSAB) – Acid-base strength and HSAB , Electro negetivity and HSAB.

Macrocyclic complexes - Crown ethers and Cryptates.

UNIT-V

Non Metal Cages and Ring Compounds: Preparation and structures of higher boranes, Electron counting rules in boranes-Wades rules and Polyhedral skeletal electron pair theory. Heterocyclic inorganic ring systems Boron-Nitrogen (B-N), Phosphorus–Nitrogen (P-N) and Sulphur-Nitrogen (S-N) cyclic compounds.

Cage compounds of Phosphorous-Oxygen (P-O) and Phosphorous-Sulphur (P-S).

Preparation and structures of Isopoly and heteropoly anions and their sats.

Reference Books:

1) Inorganic Chemistry Huheey, Harper and Row.
2) Physical methods in Inorganic Chemistry, R.S. Drago. Affiliated East-West Pvt. Ltd.
3) Concise Inorganic Chemistry, J. D. Lee, ELBS.
4) Modern Inorganic Chemistry, W. L. Jolly, McGrawHill.
5) Inorganic Chemistry, K. F. Purcell and J. C. Kotz Holt Saunders international.
6) Concepts and methods of inorganic chemistry, B.E. Douglas and D.H.M.C. Daniel.
7) Introductory Quantum mechanics, A. K. Chandra.
8) Quantum Chemistry, R. K. Prasad.
9) Inorganic Chemistry, Atkins, ELBS.
10) Advanced Inorganic Chemistry, Cotton and Wilkinson, Wiley Eastern.
11) Quantum Chemistry, R. K. Prasad.
12) Concise Coordination Chemistry, R.Gopalan and V.Ramalingam.

Learning Outcomes:

- ✓ The student will understand the VSPER theory, symmetric and unsymmetric Hydrogen bonds in inorganic molecules.
- ✓ Understanding the Crystal field theory and Jahn Teller Effects.
- ✓ The Students are able to understand the basics of molecular orbital theory and energetic of hybridization.
- ✓ The Students are able to understand the Jobs method, hard and soft acids and bases.
- ✓ The Students are able to understand the study of age compounds of oxygen, phosphorous and sulphar compounds and also isopoly and heteropoly anions.

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ACHARYA NAGARJUNA UNIVERSITY

CENTRE FOR DISTANCE EDUCATION

M.Sc. CHEMISTRY: SEMESTER–I

102CH24: ORGANIC CHEMISTRY-I

SYLLABUS

Learning Objectives:

- ✓ To Know about Aromaticity in Benenoid compounds and Non-Benzenoid compounds.
- ✓ To know about basics on heterocyclic compounds, their synthesis and importance.
- ✓ To know the importance of natural products, their medicinal use.
- ✓ To know particularly about terpenoids and their classification and synthesis.
- ✓ To discuss stereochemistry more elaborately.
- ✓ To know about the conformations of acyclic, monocyclic and fused ring systems.

UNIT-I

Aromaticity Benzenoid & Non-Benzenoid: Concept of aromaticity, Huckel's rule for aromaticity in benzenoid compounds, Aromaticity of five membered, six membered rings and fused systems.

***Non benzonoid aromatic compounds*:** Cyclopropenyl cation, Cyclobutadienyl dication, cyclopentadienyl anion, tropyllium cation and cyclooctatetraenyl dianion. Ferrocene. Azulenes, Fulvenes, Annulenes, Fullerenes. Homo aromaticity, and Anti aromaticity.

UNIT-II

Heterocyclic Compounds and Natural Products:

a) Synthesis, Properties and Reactions of furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline and indole; Skraup synthesis, Fisher indole synthesis.
b) Heterocyclic compounds more than one hetero atom-: synthesis, properties and reactions of Pyrazole, Imidazole, Oxazole Iso-Oxazole, Thiazole.

Natural Products: Importance of natural products as drugs.

Terpenoids: General methods in the structure determination of terpenes. Isoprene rule. Structure determination and synthesis of α-terpeniol, β-carotene, and camphor.

UNIT-III

Stereochemistry

a) *Molecular representations of organic molecules* –Wedge, Fischer, Newman and Saw-horse formulae, their description and inter-conservation. Stereoisomerism-Definition, classification.
b) *Concept of Chirality and Molecular Symmetry*: Symmetry operations, Recognition of symmetry elements (Cn, Ci and Sn), Dissymmetric and asymmetric molecules. Chiral structures (one and more than one chiral centers); D-L and R–S nomenciature, diastereoisomerism; Threo and Erythro isomers, Racemic mixture, racemization and methods of resolution, stereo specific and stereoselective synthesis. Stereochemistry of compounds containing nitrogen, sulphur and phosphorous.
c) *Geometrical isomerism*–E, Z- nomenclature–Spectral and chemical methods of determining the configuration of geometrical isomers. Determination of configuration in aldoximes and ketoximes.

MSR

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UNIT-IV

Conformational Analysis-I

a) *Conformation of acyclic molecules* –alkanes and substituted alkanes (Ethane and 1,2-disubstituted ethane derivatives like butane, dihalobutane halohydrin, ethylene glycol, butane-2,3-diol, amino alcohols and 1,1,2,2-tetrahalobutanes). Klyne-Prelog terminology for conformers and torsion angles.

b) Factors affecting the conformational stability and conformation equilibrium-Attractive and Repulsive interactrions. Use of Physical and Spectral methods in conformational analysis.

c) Conformational effects on the stability and reactivity of diastereomers in cyclic molecules-steric and stereo electronic factors-examples.

UNIT-V

Conformational Analysis-II

a) *Conformations of monocyclic compounds*–cyclohexane-chair, boat and twist boat cyclohexanes, energy profile diagram–mono-and di-substituted cyclohexanes–conformations. Effect of conformation on stability and reactivity in mono and disubstituted cyclohexane derivatives.

b) *Conformations of unsaturated acyclic compounds*: Propylene, and 1-Butene

c) *Elementary treatment of fused and bridged ring systems* –Decalines and Bornanes. Conformation of sugars. Steric strain due to unavoidable crowding.

Reference Books:

1) Advanced organic chemistry – reaction, mechanism and structure, Jerry March, John Wiley.
2) Advanced organic chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3) A guide book to Mechanism in organic chemistry, Peter Sykes, Longman.
4) Organic chemistry, I.L.Finar, Vol. I & II, Fifth ed. ELBS, 1975.
5) Organic chemistry, Hendrickson, Cram and Hammond (Mc Graw – Hill).
6) Stereo Chemistry of carbon compounds – E.L. Eliel.
7) Modern organic Reactions, H.O. House, Benjamin.
8) An introduction to chemistry of Heterocyclic compounds, R.M.Acheson.
9) Structure and mechanism in organic chemistry, C.K.Ingold, Cornell University Press.
10) Principles of organic synthesis, R.O.C.Norman and J.M.Coxon, Blakie Academic & Professional.
11) Reaction Mechanism in Organic Chemistry, S.M.Mukherji and S.P.Singh, Macmillan.
12) Basic Principles of Organic Chemistry by J. B. Roberts and M. Caserio.
13) Stereo Chemistry of Organic compounds, P. S. Kalsi, New Age International pubs.

Learning Outcomes:

- ✓ Students can able to understand aromaticity in Benenoid compounds and Non-Benzenoid compounds.
- ✓ Students are able to understand formation of various heterocyclic compounds and their synthesis and importance.
- ✓ Students can understand the importance of natural products in medicinal chemistry
- ✓ Students can able to write the stereo chemical forms for different organic molecules.
- ✓ Understand the conformations of acyclic, monocyclic and fused ring systems and applying it to organic compounds.

MSL

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ACHARYA NAGARJUNA UNIVERSITY
CENTRE FOR DISTANCE EDUCATION

M.Sc. CHEMISTRY :: SEMESTER–I

103CH24: FOUNDATION FOR CHEMISTRY

SYLLABUS

Learning Objectives:

- ✓ To know the fundamentals in analytical & inorganic estimations.
- ✓ To know the possible intermediates formed during course of chemical reactions.
- ✓ To know the type of bonding in organic molecules.
- ✓ To know about molecular symmetry, molecular representations and their applicational aspects.
- ✓ To know the types & characterisation of environmental segments.

UNIT-I

Titrimetric analysis: Acid-base titrations, redox titrations, complexometric titrations, precipation titrations-principle, example and corresponding indicators, Pri., Sec.-standards.

UNIT-II

Treatment of analytical data: Errors, classification, accuracy, precision, SD, MD, Student-T test F-test, Gassian distributation

UNIT-III

Reactive Intermediates: Generation, Structure, Stability and reactivity of Carbocations, Carbanions, free radicals, Carbenes, nitrenes and Benzyne; Electrophiles, Nucleophiles, Catalysts-definition and examples.

Nature of bonding in organic molecules: Localised and Delocalized covalent bonds, Delocalised chemical bonding conjugation, cross conjugation, hyper conjugation, tautomerism.

UNIT-IV

Symmetry and Group theory in Chemistry - Symmetry elements, symmetry operation, definition of group, suib group, relation between order of a finite group and its sub group. Point symmetry group. Schonfiles symbols, representation of groups by Matrices (representation for the Cn, Cnv, Cnh, Dn etc. groups to be worked out, explicitely). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use. Application of group theory in IR and Raman spectroscopy.

MSR

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UNIT-V

Environmental chemistry:

Classification of environmental segments, types of pollutions, acid rains, Global warming.

Chemistry of Biomolecules: Definition, functional uses and examples for Carbohydrates, lipids (fats and oils), enzymes. Chemistry of purines and pyrimidines, Nucleic acids - Structure and functions of DNA & RNA.

Reference Books:

1) Advanced organic chemistry – reaction, mechanism and structure, Jerry March, John Wiley.
2) Advanced organic chemistry, F.A.Carey and R.J.Sundberg, Plenum.
3) A guide book to Mechanism in organic chemistry, Peter Sykes, Longman.
4) Organic Chemistry, I.L.Finar, Vol. I & II, Fifth ed. ELBS, 1975.
5) Organic Chemistry, Hendrickson, Cram and Hammond (Mc Graw – Hill).

Learning Outcomes:

- ✓ The student will understand the required tools in analytical and inorganic estimations.
- ✓ Understanding of various types of reaction intermediates and the bonding present in various organic compounds.
- ✓ Students are able to understand the basics on various environmental concerns.
- ✓ Students know about types of various biomolecules and their functions with reference to structure.
- ✓ Student understa the types of pollutions.

MSC

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ACHARYA NAGARJUNA UNIVERSITY
CENTRE FOR DISTANCE EDUCATION

M.Sc. CHEMISTRY :: SEMESTER–I

104CH24: PHYSICAL CHEMISTRY-I

SYLLABUS

Learning Objectives:

- ✓ To know the first and second law of thermo dynamics.
- ✓ To know the surface tension, Gibbs-Adsorption, X-ray flouresence and Augar electron spectroscopy.
- ✓ To know the micelles-Hydrophobic interaction.
- ✓ To know the Nernst equation and Debye Huckel-Onsagar equation.
- ✓ To know the complex reactions, Collision theory and chain reactions.

UNIT-I

Thermodynamics-I: Classical thermodynamics-Brief review of first and second laws of thermodynamics - Entropy change in reversible and irreversible processes-Entropy of mixing of ideal gases-Entropy and disorder-Free energy functions-Gibbs-Helmoboltz equation - Maxwell partial relations-Conditions of equilibrium and spontaneity-Free energy changes in chemical reactions: Van't Hoff reaction isotherm-Van't Hoff equation - Classiuss Clapeyron equation - partial molar quantities-Chemical potential - GibbsDuhem equation - partial molar volume-determination of partial molar quantities – Fugacity - Determination of fugacity-Thermodynamic derivation of Raoult's law.

UNIT-II

Surface Phenomena and Phase Equilibria: Surface tension-capillary action-pressure difference- across curved surface (young - Laplace equation) - Vapour pressure of small droplets (Kelvin equation)- Gibbs-Adsorption equation - BET equation-Estimation of surface area-catalytic activity of surfaces - ESCA , X-ray flouresence and Augar electron spectroscopy.

UNIT-III

Surface Active Agents: Classification of surface active agents - Micellisation - critical Micelle concentration (CMC) - factors affecting the CMC of surfactants, microemulsions - reverse micelles-Hydrophobic interaction.

UNIT-IV

Electrochemistry-I: Electrochemical cells - Measurement of EMF - Nernst equation - Equilibrium constant from EMF Data - pH and EMF data-concentration cells with and without transference - Liquid junction potential and its determination - Activity and activity coefficients-Determination by EMF Method - Determination of solubility product from EMF measurements. Debye Huckel limiting law and its verification. Effect of dilution on equivalent conductance of electrolytes - Anamolous behaviour of strong electrolytes. Debye Huckel - Onsagar equation - verification and limitations - Bjerrum treatment of electrolytes-conductometric titrations.

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UNIT-V

Chemical Kinetics: Methods of deriving rate laws - complex reactions - Rate expressions for opposing, parallel and consecutive reactions involving unimolecular steps. Theories of reaction rates - collision theory - Steric factor - Activated complex theory - Thermodynamic aspects - Unimolecular reactions - Lindemann's theory - Lindemann-Hinshelwood theory. Reactions in solutions - Influence of solvent - Primary and secondary salt effects - Elementary account of linear free energy relationships - Hammet - Taft equation - Chain reactions - Rate laws of H_2-Br_2, photochemical reaction of H2 - Cl2 Decomposition of acetaldehyde and ethane - Rice-Hertzfeld mechanism.

Reference Books:

1) Physical Chemistry P.W. Atkins, ELBS
2) Chemical Kinetics - K.J.Laidler, McGraw Hill Pub.
3) Text Book of Physical Chemistry. Samuel Glasstone, Mcmillan Pub.
4) Physical Chemistry, G.W.Castellan. Narosa Publishing House
5) Thermodynamic for Chemists. Samuel Glasstone
6) Electrochemistry, Samuel Glasstone, Affiliated East West
7) Physical Chemistry, W.J. Moore, Prentice Hall
8) Atomic structure and chemical bond. Manas Chanda. Tata McGraw Hill Company Limited.

Learning Outcomes:

- ✓ Students can able to understand the classical thermo dynamics, fugacity.
- ✓ Students are able to understand Kelvin equation, Gibbs-Adsorption equation - BET equation.
- ✓ Students are able to understand the Classification of surface active agents.
- ✓ Students are able to understand the Electrochemical cells, Liquid junction potential.
- ✓ Understand the complex reactions, chain reactions.

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M.Sc. CHEMISTRY:: SEMESTER–I

105CH24: PRACTICAL I: INORGANIC & PHYSICAL CHEMISTRY

LIST OF EXPERIMETNS:

SECTION-I: INORGANIC CHEMISTRY

1) Determination of Zn^{2+} with potassium ferrocyanide (Volumetric).
2) Complexomatric titrations: Determination of Mg^{2+}, Ni^{2+} and hardness of water using EDTA.
3) Determination of Fe^{3+} by photochemical reduction.
4) Argentometry: Determination of chloride by argent metric titration using.
   a) K_2CrO_4 (b) Fluorescein as indicators.

SECTION-II: PHYSICAL CHEMISTRY

1) Relative strengths of acids by studying the hydrolysis of ethylacetate / methyl acetate.
2) Determination of equilibrium constant of KI3 x KI + I2 by partition coefficient method and determination of unknown concentration of potassium iodide.
3) Distribution coefficient of Benzoic acid between Benzene and water.
4) Determination of critical solution temperature of phenol-water system Study of the effect of eletrolyteon the miscibility of phenol-water system.

Reference Books:

1) Vogels Text Books of Quantitative Analysis, Revised. J. Asset, R.C. Denny, G.H. Jeffery and J. Mendhan. ELBS.
2) Synthesis and Characterisation of Inorganic Compounds, W.L. Jolly. Prentice Hall.
3) Practical Inorganic Chemistry by G. Pass and H. Sutcliffe Chapman and Hall.
4) Practicle Inorganic Chemistry by. K. Somasekhar Rao and K.N.K. Vani.

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M.Sc. CHEMISTRY :: SEMESTER–I

106CH24: PRACTICAL-II: ORGANIC CHEMISTRY

LIST OF EXPERIMENTS:

1) One step & Two step Organic compounds preparation–Yield of crude and crystallized samples and reporting of the melting point/Boiling points.
   Preparations: i) Iodoform ii) n-Dinitroderivative iii) Asprin iv) p-Nitroaniline v) Bezophenone vi) Benzoic acid vii) p-Bromo Acetanilide viii) Acetanilide ix) any other organic compound.
2) Purification of organic compound-The student has to do Recryastallization to final compound(s) (for both steps) and submit the sample.
3) Distillation of Alcohol, Toluene.
4) Chromatography- The student has to submit purity of the final product with TLC
5) Chromatographic separation of impurities by TLC.
6) Student should practice solvent extraction methods.

Note: Apart from (1) & (2) each student must practice S.No. (3) to (6).

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M.Sc. CHEMISTRY :: SEMESTER–II

201CH24: PHYSICAL CHEMISTRY-II

SYLLABUS

Learning Objectives:

- ✓ To know the Third law and Statistical thermodynamics and Nernst Heat theorem, Entropy and probability.
- ✓ To know the classification of polymers, molecular weights determination.
- ✓ To know the Butler-Volmer equation, polarography and Amperometric titrations.
- ✓ To know the Hydrogen-oxygen reaction, Quantum yield and Stern - Volmer equation.
- ✓ To know the hydrolysis of ATP, thermodynamics of biopolymer solutions.

UNIT-I

Thermodynamics II: Third law and Statistical thermodynamics-Nernst Heat theorem - Third law of thermodynamics - Its limitations - Determination of absolute entropy - Concept of distribution - Thermodynamic probability and most probable distribution - Ensemble-ensemble averaging - Maxwell-Boltzmann distribution law - Partition function - Fermi-Dirac statistics - Bose Einstein statistics - Entropy and probability - Boltzmann-Plank equation - Calculation of thermodynamic properties in terms of partition function - Application of partition function - Chemical equilibrium and partition function - Translational, rotational and electronic partition function - Entropy of Monoatomic gases (Sackur - Tetrode equation).

UNIT-II

Polymer Chemistry: Classification of polymers - Free radical, ionic and Zeigler -Natta Polymerisation - kinetics of free radical polymerisation - Techniques of polymerisation - Glass transition temperature - Factors influencing the glass transition temperature - Number average and Weight average, Molecular weights - molecular weights determination - End group analysis - Osmometry - Light scattering and ultra centrifugation methods.

UNIT-III

Electro Chemistry II: Electrode potentials - Double layer at the interface - rate of charge transfer - Decomposition potential - Over potential - Tafel plots - Derivation of Butler - Volmer equation for one electron transfer - electro chemical potential. Electro catalysis - Fuel cells-Theory of polarography - Diffusion current - Ilkovic equation - Equation for half- wave potential – Applications of polarography - Amperometric titrations -Corrosion - Forms of corrosion - prevention methods.

UNIT-IV

Chemical Kinetics: Branching Chain Reactions - Hydrogen-oxygen reaction - lower and upper explosion limits - Fast reactions - Study of kinetics by flow methods - Relaxation methods - Flash photolysis - Acid base catalysis - protolytic and prototropic mechanism - Enzyme catalysis.

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Photo Chemistry: Quantum yield and its determination - Actinometry - Reactions with low and high quantum yields - Photo sensitisation - Exciplexes and Excimers - Photochemical equilibrium – Chemieluminescence - Kinetics of collisional quenching-Stern - Volmer equation - Photo Galvanic cells.

UNIT-V

Biophysical Chemistry: Standard free energy change in biochemical reactions, exergonic and endergonic reactions, hydrolysis of ATP, thermodynamics of biopolymer solutions, chain configuration of bio polymers, calculation of average dimensions. Membrane equilibrium, ion transport through cell membrance, dialosis and its function. Structure and functions of proteins, enzymes, DNA and RNA in living systems, forces involved in bio polymer interactions, electrostatic forces, hydrophobic forces, molecular expansion and dispersion forces.

Reference Books:

1) Physical chemistry, G.K. Vemulapalli (Prentice Hall of India).
2) Physical chemistry, P.W. Atkins. ELBS
3) Chemical kinetics - K.J. Laidler, McGraw Hill Pub.
4) Text book of Physical Chemistry, Samuel Glasstone, Macmillan pub.
5) Statistical Thermodynamics - M.C. Gupta.
6) Polymer Science, Gowriker, Viswanadham, Sreedhar
7) Elements of Nuclear Science, H.J. Arniker, Wiley Eastern Limited.
8) Quantitative Analysis, A.I. Vogel, Addison Wesley Longmann Inc.
9) Physical Chemistry-G.W. Castellan, Narosa Publishing House, Prentice Hall
10) Physical Chemistry, W.J. Moore, Prentice Hall
11) Polymer Chemistry - Billmayer
12) Fundamentals of Physical Chemistry, K K Rohatgi-Mukherjee. Wiley Eastern Limited Publications.
13) Statistical Thermodynamics - M.Dole.
14) M.N. Hughes, The Inorganic chemistry of Biological Processes, John Wiley and Sons, New York 2nd Edition, 1981.
15) A text book of Biochemistry, AV.S.S. Rama Rao.
16) Physical Chemistry by Atkenes.

Learning Outcomes:

- ✓ Students understand the Third law of thermodynamics, Maxwell-Boltzmann distribution law and Sackur - Tetrode equation.
- ✓ Students understand the Free radical, ionic and Zeigler -Natta Polymerisation.
- ✓ Students understand the Butler - Volmer equation and Ilkovic equation.
- ✓ Students understand the Branching Chain Reactions, Enzyme catalysis and Photochemical equilibrium.
- ✓ Students understand the free energy change in biochemical reactions, exergonic and endergonic reactions, DNA and RNA in living systems in biopolymer interactions.

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CENTRE FOR DISTANCE EDUCATION
M.Sc. CHEMISTRY :: SEMESTER–II

202CH24: ORGANIC CHEMISTRY-II
SYLLABUS

Learning Objectives:

- ✓ To know the general methods of synthesis involving carbon-carbon multiple bonds.
- ✓ To know various mechanisms involved in aliphatic and aromatic Nucleophilic/electrophilic substitution reactions.
- ✓ To know about various elimination mechanisms in different types of substrates.
- ✓ To know the importance of functional group protection in organic synthesis.
- ✓ To know the mechanisms involved in various types of named reactions and their applications in organic synthesis.

UNIT-I

General Methods for Synthesis: Addition reactions involving electrophiles (Br_2, HBr, HOBr, and H_2O/H_2SO_4); nucleophilic additions (Michael addition, Mannich, and Grignard reactions); Addition to C-C multiple bonds-stereo chemistry of addition, formation and reactions of epoxides, syn and anti hydroxylation; hydrogenation (catalytic and Non catalytic).

UNIT-II

Aliphatic Nucleophilic Substitutions: The SN_2, and SN_1: Mechanisms, energy profile diagram and stereochemistry; SNi, mixed SN_1 & SN_2, and SET mechanisms; Factors influencing nucleophilic substitution reactions: Effect of structure, nucleophile, solvent, and leaving group.

The neighbouring group mechanism: Neighbouring group participation by O, N, S, halogens, in nucleophilic substitution reactions..Concept of classical and Non-classical carbocations-Participation of Pi and Sigma bonds as neighbouring groups. Anchimeric assistance-steric requirement.

UNIT-III

Aromatic Nucleophilic Substitutions: The SNAr, SN1 mechanisms and benzyne mechanism. Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The Von-Ritcher, Sommelet-Hauser and Smiles rearrangements.

Aromatic Electrophillic Substitution reactions -Friedel Crafts Alkylation, Acylation, Halogenations.

UNIT-IV

Elimination and Protecting Groups:

a) Types of elimination (E1, E1CB, E2) reactions, mechanisms, stereochemistry and orientation, Hofmann and Saytzeff's rules, Syn elimination versus anti elimination. Competitions between elimination and substitution.

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b) Dehydration, dehydrogenation, decarboxylative elimination, pyrolytic elimination, molecular rearrangement during elimination.

c) *Importance of functional group protection in organic Synthesis:* Protecting agents for the protection of functional groups- Hydroxyl group, Amino group, Carbonyl group and Carboxylic acid group.

UNIT-V

Familiar Named Reactions: Benzoin, Perkin, Cannizaro, Dieckmann and Stobbe condensations; Hofmann, Schmidt, Lossen, Curtius, Clasien, Backmann and Fries rearrangements; Reformatsky, Favoursky, Wittig reaction, Baeyer Villiger reaction and Chichibabin reaction, Oppenaur oxidation, Clemmensen, Wolff-Kishner, Meerwein–Ponndorf–Veriey and Birch reductions..

Reference Books:

1) Advanced organic chemistry – reaction, mechanism and structure, Jerry March, John Wiley.
2) Advanced organic chemistry, F.A.Carey and R.J.Sundberg, Plenum.
3) A guide book to Mechanism in organic chemistry, Peter Sykes, Longman.
4) Organic chemistry, I.L.Finar, Vol. I & II, Fifth ed. ELBS, 1975.
5) Organic chemistry, Hendrickson, Cram and Hammond (Mc Graw – Hill).
6) Stereo Chemistry of carbon compounds – E.L. Eliel.
7) Modern organic Reactions, H.O.House, Benjamin.
8) An introduction to chemistry of Heterocyclic compounds, R.M.Acheson.
9) Structure and mechanism in organic chemistry, C.K.Ingold, Cornell University Press.
10) Principles of organic synthesis, R.O.C.Norman and J.M.Coxon, Blakie Academic & Professional.
11) Reaction Mechanism in organic chemistry, S.M.Mukherji and S.P.Singh, Macmillan.

Learning Outcomes:

- ✓ Students understand the mode of addition reactions involving addition by electrophile and nucleophiles over unsaturated bonds between carbons
- ✓ Students understand and apply the substitution and elimination reaction mechanisms at aliphatic and aromatic substrates for various reactions leading to research
- ✓ Understand how to protect various functional groups in organic synthesis and can apply the same to novel molecules useful for research also.
- ✓ Students understand the mechanisms of studied named reactions and their applications in organic synthesis.
- ✓ To learn the molecular rearrangements.

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ACHARYA NAGARJUNA UNIVERSITY
CENTRE FOR DISTANCE EDUCATION
M.Sc. CHEMISTRY :: SEMESTER–II
203CH24: ESSENTIAL LAB TECHNIQUES FOR INDUSTRY
SYLLABUS

Learning Objectives:

- ✓ To know the fundamentals in separation analysis using various chromatographic techniques.
- ✓ To know the techniques involving reliable separation by HPLC & amp; GC instrumental techniques.
- ✓ To know the purification by ion exchange chromatography.
- ✓ To know the instrumentation and applications of AAS & amp; ICP-OES.
- ✓ To know the basic principles, instrumentation and advantages UV, IR, NMR, ESR, TEM, SEM-techniques in structural analysis.

UNIT-I

Chromatography–Adsorption and Partition

1) **Introduction to Chromatography:** Different types of Chromatography. Adsorption chromatography- adsorbents, solvents, solutes, apparatus. Column Chromatography-stationary phase, Mobile phase, packing of column, advantages and disadvantages.
2) **Thin Layer Chromatography:** Basic Principles. Common stationary phases, Methods of preparing TLC plates, Selection of mobile phase, Development of TLC plates, Visualization methods, R_f value. Application of TLC in monitoring organic reactions.
3) **Paper Chromatography:** Basic Principles. Ascending and descending types. Selection of mobile phase, Development of chromatograms, Visualization methods. Application of paper chromatography in the identification of sugars and amino acids. One and two dimensional paper paper chromatography.

UNIT-II

High Performance Liquid Chromatography (HPLC): Basic Principles. Normal and reversed Phases. Selection of column and mobile phase. Instrumentation. detectors; RT values. Applications in the separation, identification and quantitative estimation of organic compounds. Concepts on HPLC method development.

UNIT-III

Gas Chromatography: Basic Principles. Different types of GC techniques. Selection of columns and carrier gases. Instrumentation. detectors; RT values. Applications in the separation, identification and quantitative analysis of organic compounds.

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Ion Exchange Chromatography: Basic Principles. Preparation of cross linked polystyrene resins. Different types of cation and anoin exchange resins. Application in the purification of carboxylic acids and amines.

UNIT-IV

AAS: Principle, instrumentation and applications

ICP-OES: Principle, instrumentation, applications and advantages over AAS.

UNIT-V

UV, IR, NMR, ESR, TEM, SEM-Basic principles, instrumentation and advantages.

Reference Books:

1) Principles of Instrumental Analysis by D. A. Skoog, F. J. Holler and T. A. Nieman, Harcourt College Pub.
2) Separation Techniques by M. N. Sastri, Himalaya Publishing House (HPH), Mumbai.
3) Bio Physical Chemistry by A. Upadhyay, K. Upadhyay and N. Nath, (HPH), Mumbai.
4) A Hand Book of Instrumental Techniques for Analytical Chemistry- Ed-F. A. Settle, Prearson Edn.,
5) Delhi. Introduction to Organic Laboratory Techniques-D. L. Pavia, G. M. Lampman, G. S. Kriz and R. G. Engel, Saunders College Pub. (NY).
6) Instrumental methods of Chemical Analysis by B. K. Sharma, Goel Publish House, Meerut.
7) Instrumental methods of Chemical Analysis by H. Kaur, Pragati Prakasan, Meerut.

Learning Outcomes:

- ✓ The student will understand advantage of cheromatographic separation and application on various reactions.
- ✓ The student will understand the advantage of HPLC & GC techniques over conventional separation techniques.
- ✓ The student will know the exchange of ions taking place in ion exchange chromatography.
- ✓ The student will know the procedure of analysing the elements using AAS & ICP-OES.
- ✓ The students understand the working principles and advantages of the UV, IR, NMR, ESR, TEM, SEM- techniques.

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ACHARYA NAGARJUNA UNIVERSITY

CENTRE FOR DISTANCE EDUCATION

M.Sc. CHEMISTRY :: SEMESTER-II

204CH24: INORGANIC CHEMISTRY-II

SYLLABUS

Learning Objectives:

- ✓ To know the Classification and Applications of Metal Clusters.
- ✓ To know the reactions of organo metallic compounds.
- ✓ To know the Anation Reactions and Trans effects.
- ✓ To know the Selection rules, Correlation diagrams and Orgel diagrams.
- ✓ To know the Cotton effect and Faraday effect, structures of Hemoglobin and Myoglobin, Vitamin B_{12}, Photo Chemical Laws.

UNIT-I

Metal Clusters Classification: LNCs and HNCs, Isoelectronic and Iso lobal relationships, electron counting rules: Wade's and Lauher's rules. M-M multiple bonding; Preparation, structure and bonding in di nuclear $[Re_2Cl_8]^{2-}$, tri nuclear $[Re_3Cl_9]$, tetra nuclear $[W_4OR_{16}]$ and hexa nuclear $[Mo_6Cl_8]^{4+}$, $[Nb_6Cl_{12}]^{2+}$ cluster molecules and ions.

Poly atomic Zintle ions and Chevrel phases. Applications of clusters

Metal π-Complexes Preparation, structure and bonding in Nitrosyl, Dinitrogen and Dioxygen complexes.

UNIT-II

Organometallic Complexes of Transition Metals: Classification and electron counting rules. Metallocenes with four, five, six, seven and eight (η^4 - η^8) membered rings. Synthesis, structure and bonding of Ferrocene. Cyclopenta dienyl, Arene, Cyclohepta triene and Tropylium complexes of transition metals.

Reactions of organometallic compounds-oxidative addition, reductive elimination, insertion and elimination.

Applications of organometallic compounds-Catalytic hydrogenation, Hydroformylation and polymerization of olefin using Zeigler- Nutta catalyst.

UNIT-III

Reaction Mechanism in Transition Metal Complexes: Kinetics of octahedral substitution, acid hydrolysis, base hydrolysis-conjugate base (CB) mechanism. Direct and indirect evidences in favour of CB mechanism.

Anation Reactions: Reactions without metal-ligand bond cleavage. Factors affecting the substitution reactions in octahedral complexes. Trans effect on substitution reactions in square planar complexes.

Mechanism of redox reactions, outer sphere mechanism, cross reactions and Marcus –Hush equation, inner sphere mechanism, complementary and non - complementary reactions.

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UNIT-IV

Electronic Spectra of Transition Metal Complexes: Electronic configurations of metal ions and Spectroscopic terms. Selection rules, Breakdown of selection rules, Slator – Condon repulsion parameters, Racah parameters, Term separation energies for d^n electronic configurations.
Correlation diagrams and Orgel diagrams. Tanabe-Sugano diagrams for configurations from d^1 to d^9 octahedral and tetrahedral transition metal complexes of 3d series.
Calculations of Dq, B and β parameters. Charge transfer spectra.

UNIT-V

Magnetic Properties of Transition Complexes: Types of magnetism, anomalous magnetic moments - Orbital and spin contribution, spin - orbit coupling and magnetic moments. Chiroptical properties, Cotton effect and Faraday effect.
Biochemical Aspects of Iron and Cobalt: Binding, storage and transport of dioxygen by Hemoglobin and Myoglobin, Vitamin B_{12} and its importance.
Photo Inorganic Chemistry: Introduction, Photochemical laws, photo redox reactions and photo anation reactions. Photo chemical decomposition of water.

Reference Books:

1) Inorganic Chemistry, Huheey. Harper and Row.
2) Concise Inorganic Chemistry, J. D. Lee, ELBS.
3) Inorganic chemistry, K.F. Purcell and J.C. Kotz, Holt Saunders international
4) Organometallic chemistry, R.C. Mehrotra and A. Singh. New Age International.
5) Advanced Inorganic Chemistry, Cotton and Wilkinson, Wiley Eastern
6) Inorganic Reaction Mechanism, Basolo and Pearson, Wiley Eastern
7) Bioinorganic Chemistry, K. Hussan Reddy
8) Biological Aspects of inorganic chemistry, A. W. Addiso, W. R. Cullen, D. Dorphin and G. J. James. Weliey Interscience.
9) Photochemistry of coordination compounds, V.Balzaniand V.Carassiti. Academic Press.

Learning Outcomes:

- ✓ The student will understand the various metal clusters and metal π complexes.
- ✓ Understanding the reactions of organo metallic compounds and its applications.
- ✓ The Students are able to understanding the reaction mechanism in transition metal complexes, anation reactions, and complementary reactions.
- ✓ The Students are able to understand the orgel diagrams and electronic spectra of transition metal complexes.
- ✓ The study of magnetic properties and anamolous magnetic moments of transition complexes.
- ✓ The Students are able to understanding structure and functions of hemoglobin, myoglobin and vitamin B12, photochemical laws.

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CENTRE FOR DISTANCE EDUCATION

M.Sc. CHEMISTRY: SEMESTER-II

205CH24: PRACTICAL–I: INORGANIC & PHYSICAL CHEMISTRY

LIST OF EXPERIMETNS:

SECTION-I: INORGANIC CHEMISTRY

Semimicro analysis of six radical mixtures containing one interfering radical and one less familiar cation each.

Interfering Anions : Oxalate, tartrate, phosphate, chromate.

Less familiar Cations : Thallium, molybdenum, thorium, zirconium,vanadium, uranium. (Minimum three Mixtures)

SECTION-II: PHYSICAL CHEMISTRY

1) Potentiometric determination of Fe(II) with Cr(VI)
2) pH-metric determination of strong acid with strong base.
3) Conductometric titration of strong acid with strong base
4) Verification of Beers Law using potassium permanganate.

Reference Books:

1) Vogels Text Books of Qualitative analysis, Revised. J. asset, R.C. Denny, G.H. Jeffery and J. Mendhan. ELBS.
2) Synthesis and Characterisation of Inorganic Compounds, W.L.Jolly. Prentice Hall.
3) Practical Inorganic chemistry by G. Pass and H. Sutcliffe Chapman and Hall.
4) Practical Inorganic Chemistry by. K. Somasekhar Rao and K.N.K. Vani.

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M.Sc. CHEMISTRY :: SEMESTER–II

206CH24: PRACTICAL–II: ORGANIC CHEMISTRY

1) **Identification Functional Groups in Organic Compounds:** Phenol, bases, organic acid, ketone, aldehyde, amide and carbohydrate with preparation of two solid derivatives.
   i) Identification of given two compounds with preparation of two solid derivatives and
   ii) Reporting of the melting points for derivatives.

2) **Purification of Derivatives**: The student has to do recryastallization to final derivatives(s) and submit the sample. If the sample is impure liquid must carryout distillation process.

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ACHARYA NAGARJUNA UNIVERSITY

CENTRE FOR DISTANCE EDUCATION

M.Sc. CHEMISTRY :: SEMESTER–III

301CH24 : APPLIED INORGANIC ANALYSIS

Learning Objectives:

- ✓ To get knowledge about the industrial valuable minerals and ores.
- ✓ To know about the various constituents and their determinations present in Lime stone, phosphate rock, pyrolusite, feldspar etc.
- ✓ To know about the various constituents and their determinations present in ferrous and non-ferrous alloys.
- ✓ To know about the various constituents and their determinations present in non-ferrous alloys.
- ✓ To know about the various constituents and their determinations present in complex materials like cement and glass.

UNIT-I

Analysis of Limestone: Moisture, loss on ignition, insoluble matter (silica), determination of combined oxides (R2O3), calcium, magnesium, carbon dioxide.

Analysis of Hematite - Moisture, volatile matter, silica, iron, oxide iron,

Analysis of Pyrolusite - Moisture, volatile matter, silica, manganese, combined oxides

Analysis of Clay Materials: Moisture, volatile matter, silica, R_2O_3, Fe_2O_3.

UNIT-II

Analysis of Phosphate Rock: Moisture, loss on ignition, SiO_2, allumina, Fe_2O_3, toal CaO, magnesium.

Analysis of Feldspar: Silica, sodium, potassium, sulphate.

Analysis of Monozite: Oxides of calcium, magnesium, iron, aluminum, sulphur, silica.

Analysis of Arsenic ores, Barium ores, Chrome ores, Vanadium ores.

UNIT-III

Analysis of Ferrous Alloys: Analysis of Steels - types of steels- digestion methods for different types of steels - determination of contents of carbon, silicon, sulphur, phosphorous, manganese, nickel magnesium, vanadium, molybdenum, nickel, aluminum, chromium and tungsten in steel samples.

UNIT-IV

Analysis of Non - Ferrous Alloys: Brass, bronze and solder. Compositions of different alloys-digestion procedures of alloys - Procedures for the determination of contents like tin, copper, lead, zinc and iron, aluminum, manganese, antimony.

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UNIT-V

Analysis of Complex Materials: Analysis of cement - loss on ignition, insoluble residue, total silica, sesqui oxides, lime, magnesia, ferric oxide.

Analysis of Glasses: Determination of silica, sulphur, barium, arsinic, antimony, total R_2O_3, calcium, magnesium, total alkalies, aluminum, chloride, fluoride colouring agents in glass-chromium, cobalt, copper, total iron, manganese, nickel, titanium, lead, barium, sodium, potassium, cerium, zirconium, arsenic.

Reference Books:

1) F.J.Welcher-Standard methods of analysis
2) I.M.Kolthoff-Volumetric analysis V.A. Strenger Vols I to III,
3) A.I.Vogel - A text Book of quantitative Inorganic analysis - ELBS,
4) H.P.Walton- Principles and methods of chemical analysis-Prentice Hall,
5) Laitnen & Harris -Chemical Analysis,
6) C.W.Wilson and D.W.Wilson-Comprehensive analytical Chemistry,
7) F.D.Snell & F.M.Biffen-Commercial methods of analysis-D.B. Taraporavala & sons,
8) Manual of procedures for Chemical and instrumental analysis of Ores, Minerals and Ore Dressing Products Published by Indian Bureau of Mines, Ministry of Steel and Mines, Nagpur.

Learning Outcomes:

- ✓ The student will understand the methods of analysis of ores and minerals in industries.
- ✓ Understanding the methods of analysis of various industrial products.
- ✓ Students are able to understand the methods of analysis of various constituents and their determinations present in the ferrous and non-ferrous alloys.
- ✓ Students are able to understand the methods of analysis of various constituents and their determinations present in the non-ferrous alloys.
- ✓ Students know about types of various constituents and their determinations present in the cement and glasses.

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M.Sc. CHEMISTRY :: SEMESTER–III

302CH24: ANALYSIS OF APPLIED INDUSTRIAL PRODUCTS

SYLLABUS

Learning Objectives:

- ✓ To get knowledge about the analysis of pesticides present in the food samples by using chromatography methods.
- ✓ Provides knowledge on analysis of oils.
- ✓ Having an idea about analysis of different industrial solvents and determination of methoxyl and N-methyl groups.
- ✓ To know about the analysis of fertilizers, pesticides and other materials starch, sugars, cellulose and paper.
- ✓ To get knowledge about the analysis of gases, gaseous fuels and coal.

UNIT-I

Pesticide analysis of Food Products: Purification of food samples, Gas chromatography for organophosphates in food,
Thin layer chromatography for chlorinated pesticides in food products, Microscopic examination food.

UNIT-II

Analysis of Oils: Saponification value, iodine value, acid value, ester value, bromine value, acetyl value

UNIT-III

Analysis of industrial solvents like benzene, acetone, methanol and acetic acid, Determination of methoxyl and N-methyl groups.

UNIT-IV

Analysis of Fertilizers: Urea, NPK fertilizer, super phosphate,
Analysis of DDT, BHC, endrin, endosulfone, malathion, parathion,
Analysis of starch, sugars, cellulose and paper.

UNIT-V

Gas Analysis: Carbon dioxide, carbon monoxide, oxygen, hydrogen, saturated hydro carbon, unsaturated hydrocarbons, nitrogen, octane number, cetane number.
Analysis of Fuel Gases like: Water gas, producer gas, kerosene (oil) gas.
Ultimate Analysis: Carbon, hydrogen, nitrogen, oxygen, phosphorus and sulfur.

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Reference Books:

1) F.J.Welcher - Standard methods of analysis,
2) A.I.Vogel - A text book of quantitative Inorganic analysis – ELBS.
3) H.H.Willard and H.Deal - Advanced quantitative analysis - Van Nostrand Co.
4) F.D.Snell & F.M.Biffen - Commercial methods of analysis - D.B.Taraporavala & sons.
5) J.J.Elving and I.M.Kolthoff - Chemical analysis - A series of monographs on analytical chemistry and its applications - Inter Science- Vol. I to VII.
6) G.Z.Weig - Analytical methods for pesticides, plant growth regulators and food additives – Vol. I to VII.
7) Analytical Agricultural Chemistry by S.L.Chopra & J.S.Kanwar - Kalyani Publishers.
8) Manual of soil, plant, water and fertilizer analysis, R.M. Upadhyay and N.L Sharma, Kalyani Publishers, New Delhi.
9) Analytical Chemistry, H. Kaur – A Pragathi Edition.

Learning Outcomes:

- ✓ Imparts students with the core skills to assess measures and interpret data extracted from real life applications.
- ✓ By applying this knowledge they can establish numerical value in order to determine the various components present in an oil samples.
- ✓ Can analyze the different solvent for the industrial purpose.
- ✓ Can identify different chemical compound used as fertilizers and also can analyze those fertilizers.
- ✓ It explores various methods and techniques to analyze different gas that are present in the fuels.

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M.Sc. CHEMISTRY :: SEMESTER–III

303CH24: OPTICAL THERMAL & RADIOCHEMICAL METHODS OF ANALYSIS

SYLLABUS

Learning Objectives:

- ✓ To gain knowledge about spectroscopic techniques like IR, Raman etc.
- ✓ Provide knowledge about Nephelometry & Turbidimetry and Flourimetry & Phosphorimetry.
- ✓ Have an idea about basic analytical techniques like flame photometer, AAS etc.
- ✓ To know about thermal analysis.
- ✓ Must have basic idea about radio chemical methods of analysis.

UNIT-I

Infrared Spectroscopy: Theory – Molecular Vibrations – Instrumentation- Limitations – Structure determination – Quantitative Analysis: Base line techniques.

Raman Spectroscopy: Theory – Properties of Raman lines – Differences between Raman & IR Spectra – Rayleigh Scattering – Mechanism of Raman effect – Instrumentation – Applications.

UNIT-II

Nephelometry & Turbidimetry: Theory – Instrumentation – Difference between Nephelometry & Turbidimetric titrations – Applications.

Flourimetry & Phosphorimetry: Theory – Flourescence & Phosphorescence – factors effecting Flourescence & Concentration – Limitations – Comparison of Flourimetry & Phosphorimetry – Applications.

UNIT-III

Emission Spectroscopy: Principle – Theory – Instrumentation – Types responsible for Line Spectra – Merits & Demerits – Applications.

Flame Photometry: Principle – Theory – Instrumentation – Experimental Procedures – errors in Flame Photometry – Applications.

UNIT-IV

Atomic Absorption Spectroscopy: Principle – Theory – Limitations – Relation between Atomic absorption& Flame emission – Instrumentation Estimation of cation & anions – Applications.

Inductively Coupled Spectrometer: Principles – Instrumentation – Advantages over Atomic Absorption Spectroscopy – Applications with specific examples like Chromium, Molybdenum, Zirconium and Aluminium.

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UNIT-V

Thermal Analysis Techniques: Thermogravimetric Analysis – Types of Thermal balances. **Differential Thermal Analysis:** Differential scanning calorimetry-Thermometric Titrations. **Radio Chemical Methods:** Objectives, introduction, principles and theoretical aspects, technique/ method, gas counter, scintillation counter, errors and correction, liquid scintillation counting, sample preparation, applications.

Reference Books:

1) B.K.Sharma - Instrumental methods of chemical analysis, Goel Publishers.
2) G.Chatwal and S.Anand --Instrumental methods of chemical analysis.
3) A.I.Vogel - A text Book of Quantitative Inorganic Analysis-ELBS.
4) H.H.Willard, LL Merrit and JA Dean -- Instrumental Methods of Analysis.
5) Peace-Instrumental Methods of Analysis.
6) J.W. Robbinson- Under graduate Instrumental Analysis.
7) G.W Eving- Instrumental Methods of Chemical Analysis.
8) D.A.Skoog, D.M.West and F.J.Holler -Fundamentals of Analytical Chemistry.
9) H.Kaur-Instrumental methods of chemical analysis, Pragathi Prakasan.
10) D.A.Skoog, F.J.Holler and Nieman-Instrumental Methods of Analysis.

Learning Outcomes:

- ✓ Students able to understand vibrational spectroscopic techniques.
- ✓ Understand the principles of Nephelometer and Turbidity meter.
- ✓ Student gets knowledge about emission spectroscopic methods.
- ✓ Student gets knowledge about principle & instrumental techniques of AAS, ICP-MS.
- ✓ To get the knowledge about Thermal analysis techniques and radio chemical methods.

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M.Sc. CHEMISTRY :: SEMESTER–III

304CH24: PRINCIPLES AND TECHNIQUES IN CLASSICAL ANALYSIS

SYLLABUS

Learning Objectives:

- ✓ To get knowledge about acid-base titration and titrations of non-aqueous solvents.
- ✓ To get knowledge about the various types of oxidants, reductants, and redox titrations.
- ✓ To get knowledge on Complexometric Titrations and Precipitation Titrations.
- ✓ To get knowledge on Gravimetric analysis and Complexing agents.
- ✓ To get knowledge on enzymatic catalyzed and uncatalyzed reactions.

UNIT-I

Theory and Principles of Titrimetric Analysis:

Acid - Base Titrations: Titrimetric procedures involved in the neutralisation of acids and bases; Acid base indicators-indicator action-preparation of indicator solutions-mixed and universal indicators. Precipitation Equilibria, Types of precipitates, Surface absorption, optimum conditions for precipitation.

Titration in Non-Aqueous Solvents: Choice of solvents for non-aqueous titrations. End point detection - Applications of non-aqueous titrations using glacial acetic acid as titre.

UNIT-II

Redox Titrations: Theoretical principles - redox indicators - Indicator action.

Analytical chemistry of some selected oxidants / reductants, selection of suitable indicators for various oxidant / reductant titration systems.

Oxidants: Mn(III), Mn(VII), Ce(IV), Cr(VI), V(V), Ti(III), Iodimetry and iodometry,

Reductants: Cr(II), V(II), Ti(III, Sn(II),

Use of Karl-Fisher reagent in the estimation of moisturecontent.

UNIT-III

Complexometric Titrations: Theoretical principles involved in complexometric titrations - role of indicators, EDTA titrations, Silver cyanide titration, Direct titration, back titration, substitution titration, total hardness of water, fluoride ion as demasking agent- analysis of nickel alloy.

Precipitation Titrations: Theoretical principles involved in argentometric titrations-use of normal and adsorption indicators -Indicator action.

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UNIT-IV

Gravimetric Analysis: Role of organic precipitants in Gravimetric Analysis.

Analytical Applications of organic precipitants in gravimetric analysis - Structural requirements of an organic precipitant - Specificity, selectivity, sensitivity, masking.

Complexing precipitants like DMG, Oxine, Salicylaldoxime, α-Benzoinoxime. Ion association precipitants: Benzidene, Sodium tetra phenyl boron, arsonium salts.

UNIT-V

Catalysed and Induced Reactions and Kinetic Methods of Analysis:

Kinetic aspects of the analytical use of chemical reactions-Kinetics of chemical reactions-Kinetic effects in oxidation reduction reactions

Application of Kinetic Methods: Catalytic reactions.

Uncatalysed Reactions: determination of components, determination of the rate with change of concentration, Types of kinetic methods: single point method, Differential method, Integral method, Rate determination by complex decomposition, by steady state condition, Kinetics of enzyme catalysed reactions- Factor effecting- activators, inhibitors, hydrogen ion concentration, temperature-Principles of the analytical use of enzyme reactions.

Reference Books:

1) I.M.Kolthoff - Volumetric analysis V.A. Strenger Volume I to III,
2) A.I.Vogel - A text Book of quantitative Inorganic analysis - ELBS,
3) H.P.Walton - Principles and methods of chemical analysis-Prentice Hall,
4) Laitnen-Chemical Analysis,
5) C.W.Wilson and D.W.Wilson-Comprehensive analytical Chemistry,
6) R.A.Day Jr and A.L.Underwood-Quantitative analysis-Prentice Hall,
7) K.B.Yarstimiskii - Kinetic Methods of Analysis,
8) D.A.Skoog, D.M.West and F.J.Holler - Fundamentals of Analytical Chemistry,
9) A Textbook of Analytical Chemistry. Y. Anjaneyulu - Published by PharmaMed Press.

Learning Outcomes:

- ✓ Student able to understand acid-base titration and non-aqueous solvents.
- ✓ Students able to understand role of the various types of oxidants, reductants, and redox titrations.
- ✓ Student able to understand the complexometric and precipitation titrations.
- ✓ Student able to understand the gravimetric analysis and role of complexing precipitants.
- ✓ Students able to understand enzymatic catalysed and uncatalyzed reactions.

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ACHARYA NAGARJUNA UNIVERSITY
CENTRE FOR DISTANCE EDUCATION

M.Sc. CHEMISTRY :: SEMESTER–III

305CH24: PRACTICAL–I: CLASSICAL METHODS OF ANALYSIS

1) Analysis of iron ore.
2) Analysis of pyrolusite.
3) Analysis of synthetic mixture copper and nickel.
4) Analysis of synthetic mixture of iron and zinc.
5) Analysis of cement.
6) Analysis of total hardness in waters.
7) Analysis of chloride in water samples.

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M.Sc. CHEMISTRY: SEMESTER–III

306CH24: PRACTICAL–II: INSTRUMENTAL METHODS OF ANALYSIS

1) Determination of alkalinity in industrial or environmental samples using pH metric procedures.
2) Assay of commercial acids by pH metric titrations using suitable base.
3) Conductometric titrations with individual acids and mixtures of acids.
4) Potentiometric titration of Fe(II) with Cr(VI).
5) Estimation of mixture of Mn(VII) and V(V) with Fe(II) using potentiometric techniques.
6) Mixture analysis of Ce(IV) and V(V) with Fe(II) by a potentiometric method.
7) Estimation of potassium thiocyanate with silver nitrate by potentiometric method.

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M.Sc. CHEMISTRY :: SEMESTER– IV

401CH24: ADVANCED METHODS OF ANALYSIS

SYLLABUS

Learning Objectives:

- ✓ To provide knowledge about interpretation of Mass spectrum.
- ✓ To know about principle, theory X-RAY Spectroscopy as well as identification of substances.
- ✓ To understand about principle, theory, instrumentation and applications of EPR.
- ✓ To understand about principle, theory, instrumentation and applications of Mossbauer Spectroscopy.
- ✓ To know about principle, theory, instrumentation and applications of NMR Spectroscopy.

UNIT-I

Mass Spectrometry: Principle - Theory - Instrumentation - Interpretation of spectra of metal compounds-identification of compounds of metal compounds from fragmentation pattern. Types of Ions produced in mass spectrometer - Nitrogen rule, thermodynamic studies-molecular structure Analytical aspects of the mass spectrometry, applications.

UNIT-II

X- RAY Spectroscopy: Principles - Theory, X-ray diffraction – Instrumentation - X-ray fluorescence - applications-identification of substances by the powder diffraction method-applications.

UNIT-III

Electron Paramagnetic Resonance Spectroscopy (EPR): Principle-Theory-Instrumentation - hyperfine interactions-determination of 'g' value - endor and eldor, applications - Study of free radicals, Determination of Manganese, Determination of Vanadium.

UNIT-IV

Mossbauer Spectroscopy: Principle, Instrumentation and Mossbauer Spectra, Applications.

UNIT-V

Nuclear Magnetic Resonance Spectroscopy (NMR): Principles-theory-instrumentation-differences between NMR and EPR-chemical shift-spin-spin coupling effect of chemical exchange on spin-spin interactions-spin decoupling-limitations of NMR-cause of chemical shift and shielding-applications-qualitative and quantitative analysis-kinetic studies.

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Reference Books:

1) Becky - Ionization mass spectrometry.
2) Physical methods of Analytical Chemistry Vol. I - III,
3) J.Roilly and W.N.Ray -Physical Chemical Methods.
4) Advances in Analytical Chemistry and Instrumentation. Vol. I – IV.
5) T.H.Gouw- Guide to modern methods of instrumental analysis,
6) A.I.Vogel - A text Book of Quantitative Inorganic Analysis-ELBS.
7) P.Delahay -New instrumental methods in Analytical Chemistry.
8) H.H.Willard, LL Merrit and JA Dean -- Instrumental Methods of Analysis.
9) Banwell- Fundamentals of molecular spectroscopy.
10) D.M.Willium and I.Fleming - Spectroscopic methods of Inorganic Chemistry.
11) J.Charalambous - Mass spectrometry of metal compounds.
12) J.W.Robbinson- Under graduate Instrumental Analysis.
13) D.A.Skoog, F.J.Holler and Neman-- Instrumental Methods of Analysis.
14) Instrumental Methods of Chemical Analysis: Analytical Chemistry.
15) Gurdeep R.Chatwal and Sham K. Anand, 5th edn.

Learning Outcomes:

- ✓ Be able to use the mass spectrum of a compound to find the molecular mass & to help identify the structure of a compound
- ✓ Students learn the principles of different X-ray spectroscopic method's and application.
- ✓ Make Students aware of the fine structure of ESR absorption, Hyperfine structure, Double resonance in ESR, Techniques of ESR spectroscopy.
- ✓ Be able to use NMR spectra to determine the structures of compounds, given other information such as a molecular formula.
- ✓ Understand Principles and Applications of Mossbauer spectroscopy.

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M.Sc. CHEMISTRY :: SEMESTER– IV

402CH24: ANALYSIS OF DRUGS, FOODS, DAIRY PRODUCTS & BIOCHEMICAL ANALYSIS

SYLLABUS

Learning Objectives:

- ✓ To know the different drugs used for anlgesic, antipyretics and infections.
- ✓ Provides the basic knowledge about antihistamine and sedative drugs.
- ✓ Having an idea of anti-epileptic, anticonvulsant and cardiovascular drugs.
- ✓ To know the various dairy products, preservatives, flavoring agents and food adulterants.
- ✓ Provides the knowledge about biochemical and clinical analysis of blood.

UNIT-I

Analysis of the following Drugs and Pharmaceuticals Preparations: (Knowledge of molecular formula, structure and analysis) Analysis of analgesics and antipyretics like aspirin and paracetamol Analysis of antimalerials like choloroquine. Analysis of drugs in the treatment of infections and infestations: Amoxycillin., chloramphenicol, metronidazole, penicillin, tetracycline. Anti tuberculous drug- isoniazid.

UNIT-II

Analysis of the following Drugs and Pharmaceuticals Preparations: (Knowledge of molecular formula, structure and analysis) Analysis of antihistamine drugs and sedatives like: allegra, zyrtec(citirizine), alprazolam, trazodone, lorazepem.

UNIT-III

Analysis of anti epileptic and anti convulsant drugs like phenobarbital and phenacemide. Analysis of drugs used in case of cardiovascular drugs:atenolol, norvasc (amlodipine), Analysis of Lipitor (atorvastatin) a drug for the preventin of productin of cholesterol.

Analysis of diuretics like: furosemide (Lasix), triamterene Analysis of prevacid (lansoprazole) a drug used for the prevention of production of acids in stomach.

UNIT-IV

Analysis of Milk and Milk Products: Acidity, total solids, fat, total nitrogen, protenines, lactose, phosphate activity, casein, chloride Analysis of food materials.

Preservatives: Sodium carbonate, sodium benzoate sorbic acid Flavoring agents - Vanilla, diacetyl, isoamyl acetate, limonene, ethylpropionate, allyl hexanoate and Adulterants in rice and wheat, wheat flour, sago, coconut oil, coffee powder, tea powder, milk.

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UNIT-V

Clinical Analysis of Blood: Composition of blood, clinical analysis, trace elements in the body. Estimation of blood cholesterol, glucose, enzymes, RBC & WBC, Blood gas analyser.

Reference Books:

1) F.J.Welcher-Standard methods of analysis,
2) A.I.Vogel-A text book of quantitative Inorganic analysis-ELBS,
3) F.D.Snell & F.M.Biffen-Commercial methods of analysis-D.B.Taraporavala & sons,
4) J.J.Elving and I.M.Kolthoff- Chemical analysis - A series of monographs on
5) Analytical chemistry and its applications -- Inter Science- Vol I to VII.,
6) Aanalytical Agricultrual Chemistry by S.L.Chopra & J.S.Kanwar - Kalyani Publishers
7) Quantitative analysis of drugs in pharmaceutical formulations by P.D.Sethi, CBS Publishers and Distributors, New Delhi.
8) G.Ingram- Methods of organic elemental micro analysis- Chapman and Hall.
9) H.Wincciam and Bobbles (Henry J)-Instrumental methods of analysis of food additives.,
10) H.Edward-The Chemical analysis of foods; Practical treatise on the examination of food stuffs and the detection of adulterants,
11) The quantitative analysis of drugs- D.C.Garratt-Chapman & Hall,
12) A text book of pharmaceutical analysis by K.A.Connors-Wiley- International, Comprehensive medicinal chemistry-Ed Corwin Hansch Vol 5, Pergamon Press.

Learning Outcomes:

- ✓ Imparts students with the core skills to interpret in real life applications.
- ✓ Gives the knowledge about pharmaceutical preparation of various sedative drugs and some other drugs.
- ✓ By applying this knowledge they can analyze and utilize various drugs.
- ✓ It explores various methods and techniques to asses and identify matter.
- ✓ Can detect the core analytes that are existing in the sample.

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M.Sc. CHEMISTRY :: SEMESTER– IV

403CH24:SEPARATION TECHNIQUES AND ELECTRO ANALYTICAL TECHNIQUES

SYLLABUS

Learning Objectives:

- ✓ To get knowledge on Separation Techniques in Chemical Analysis.
- ✓ To know basic concepts of chromatography.
- ✓ To get knowledge on advance chromatography techniques.
- ✓ To get knowledge on electro separation techniques.
- ✓ To get knowledge on electro analytical techniques.

UNIT-I

Separation Techniques in Chemical Analysis:

Solvent Extraction: Introduction, principle, techniques, factors affecting solvent extraction, quantitative treatment of solvent extraction Equilibria - chelate and ion association systems-synergism,

ION EXCHANGE: Introduction, action of ion exchange resins, separation of inorganic mixtures, applications.

UNIT-II

Chromatography-I: Basics of chromatography, methods of development-Elution development, Gradient elution development. Principles of chromatography, adsorption, partition coefficient. Terms: retention time and volume, resolution, Separation Factor.

Dynamics of chromatography- High Equivalent Theoretical Plate (HETP), Van Deempter equation.

Introduction, equipment and applications of Column, paper chromatography and Thin layer chromatography.

UNIT-III

Chromatography -II:

Introduction, instrumentation and applications: HPLC and Gas chromatography.

Size Exclusion Chromatography – Principles of gel – filtration Chromatography, Instrumentation, retention behavior, resolution, selection of gel type, applications, Ion exclusion – Principle and applications.

Supercritical fluid chromatography (SFC) – Instrumentation of SFC, stationary and mobile phases used in SFC, Detectors, Advantages of SFC. Technique and applications of SFC.

UNIT-IV

Electrogravimetry:

Theory of electro analysis–Polarisation–Over voltage–Principles involved in electrogravimetric analysis–current–voltage curves – separation of metals by electrolysis – constant current – controlled potential electrolysis.

MSC

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Coulometry: Coulometry at controlled potential – separation of Nickel and Cobalt – coulometres – types of coulometric analysis –
constant current coulometry of coulometric titrations.

UNIT-V

Voltametry, Polarography and Amperometric Titrations:

Voltametry – Principle of Polarography – dropping mercury electrode; working; factors effecting the limiting current;residual current, migration current – diffusion current – kinetic current – polarographic maximum – Half wave potential – Organic Polarography, Rapid Scan polarography – cyclic voltametry – qualitative and quantitative polarographic analysis – Amperometric titrations – its advantages and disadvantages – Bi Amperometric titrations – Chrono potentiometry.

Reference Books:

1) B.K.Sharma - Instrumental methods of chemical analysis, Goel Publishers,
2) G.Chatwal and S.Anand -Instrumental methods of chemical analysis,
3) J.J.Lingane- Electroanalytical Chemistry - Inter Science,
4) A.I.Vogel - A text Book of Quantitative Inorganic Analysis-ELBS,
5) H.H.Willard, LL Merrit and JA Dean - Instrumental Methods of Analysis,
6) Peace-Instrumental Methods of Analysis,
7) J.W. Robbinson- Under graduate Instrumental Analysis,
8) R.A.Day and A.L. Underwood- Quantitative Analysis,
9) G.W Eving- Instrumental Methods of Chemical Analysis,
10) D.A.Skoog,D.M.West and F.J.Holler--Fundamentals of Analytical Chemistry,
11) H.Kaur- Instrumental methods of chemical analysis, Pragathi Prakasan,
12) D.A.Skoog, F.J.Holler and Neman-- Instrumental Methods of Analysis,
13) G.H.Morrison and H.Frieser- Solvent extraction in Analytical Chemistry,
14) Chemical Separation methods- JA Dean, D.Vannostrand Company, New York,
15) Physical and Chemical Methods of Separation by E.W.Berg, MC Graw Hill Book Company, New York.

Learning Outcomes:

- ✓ Student able to understand Solvent Extraction and Ion Exchange separation methods.
- ✓ Students know about basics and fundamental concepts of chromatography.
- ✓ Understand the basic principles, procedure, instrumentation and applications of advance chromatographic techniques.
- ✓ Students able to understand separation and quantification of ions of a substance through Electrogravimetry and Coulometry.

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404CH24: ENVIRONMENTAL CHEMISTRY AND ANALYSIS

SYLLABUS

Learning Objectives:

- ✓ To get knowledge about soil formation, properties and constituents.
- ✓ To know about the various pollutants causing water pollution and their effects.
- ✓ To know about the various pollutants causing air pollution and their effects. And also methods of waste water treatment.
- ✓ To know about the waste water treatment methods.
- ✓ To know about the various constituents present in air and water samples and their analysis.

UNIT-I

Significance of basic segments of Environment: Nomenclature in the study of Environmental Chemistry. Soil Chemistry & Pollution Studies: Principles of weathering - effect of temperature, water, air, plants and animals on weathering., Soil formation / development-factors affecting soil development - physical properties of soil; soil colloids-ion exchange properties. Soil fertility, productivity - Soil nutrients-micro and macro.

UNIT-II

Study of Water Pollution and Monitoring and Treatment Methods of Water Pollutants: Hydrosphere-water resources-hydrological cycle-unique properties of water- water quality parameters., Pollution from Domestic water, industrial, agricultural, solid waste, shipping, radioactive waste & thermal pollution.

UNIT-III

Effect of specific pollutants like mercury, lead, arsenic, selenium, nitrates, oil., Effects of soaps, detergents, pesticides, hydrocarbon with regard to water pollution., Techniques of water treatment-Primary, secondary and tertiary methods-use of coagulants-flash distillation-solar stills, ion exchange reverse osmosis, electro dialysis.

UNIT-IV

Study of Air Pollution and Monitoring and Treatment Methods in case of Air Pollution: Atmospheric sources and emission of air pollutants-carbon monoxide-sulphur, oxides-oxides of nitrogen, organic pollutants and photo chemical smog-particulates-acid rain and radioactive substances. Continuous monitoring of air pollutants - Principles, Monitoring instruments, monitoring of sulphur dioxide, hydrogen sulphide, oxides of nitrogen, oxides of carbon, hydrocarbons, ozone and suspended particulate matter and radioactive substances.

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UNIT-V

Environmental Chemical Analysis:

Analysis of Soil: Sampling, determination of moisture, total nitrogen, phosphorus, silicon, lime, humus, nitrogen, alkali salts.

Analysis of Water Samples: Dissolved oxygen, Chemical oxygen demand, Biological oxygen demand, Phosphates, nitrogen compounds.

Analysis of metallic constituents,

Analysis of Air Samples: Carbon mono oxide, carbon dioxide, sulphur dioxide, hydrogen sulphide, oxides of nitrogen, ammonia, ozone, hydrocarbons and aromatic hydrocarbons.

Reference Books:

1) Environmental Chemistry by A.K.De, Wiley Eastern Limited, New Delhi
2) A Text Book of Environmental Chemistry by O.D.Tyagia and M.Mehra-Anmol Publicaitons,
3) Environmental Pollution Control and Engineering by C.S.Rao , Wiley Eastern Limited,
4) Environmental Chemistry by P.S. Sindhu -New Age International Publishers
5) A Text Book of Environmental Chemistry and Pollution Control by S.S.Dara, S.Chand & Co.,
6) Environmental Pollution Analysis by S.M. Khopkar, Wiley Eastern Limited, New Delhi
7) Analytical Agricultural Chemistry by S.L.Chopra & J.S.Kanwar - Kalyani Publishers
8) Manual of soil, plant, water and fertilizer analysis, R.M. Upadhyay and N.L 5harma, Kalyani Publishers, New Delhi.
9) Environmental Chemistry by B.K.Sharma - Goel Publishing House, Meerut.
10) Soil Chemical Analysis by M.L. Jackson, Prentice-Hall India Pvt. Ltd., New Delhi.

Learning Outcomes:

- ✓ The student will understand the soil development and various nutrients present in the soil.
- ✓ Understanding the water quality parameters and various pollutants causing water pollution.
- ✓ Students are able to understand effects of specific pollutants.
- ✓ Students are able to understand waste water treatment methods.
- ✓ Understanding the methods for analysis of soil, air and water samples.

MSR

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M.Sc. CHEMISTRY :: SEMESTER–IV

405CH24: PRACTICAL-I: CLASSICAL & INSTRUMENTAL METHODS OF ANALYSIS

1) Estimation of total iron with different procedures using various reductants.
2) Analysis of zinc in zinc containing alloy using EDTA.
3) Analysis of nickel by EDTA.
4) Estimation of glucose.
5) Analysis of oil for the determination of saponification value, acid value and iodine value.
6) Estimation of chloride and iodide in a mixture by potentiometric method.
7) Determination of Fe(III) colorimetrically using potassium thiocyanate.
8) Estimation of amount of manganese by colorimetric procedure.

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M.Sc. CHEMISTRY :: SEMESTER–IV

406CH24: PRACTICAL-II: PROJECT WORK / SPECTRAL PROBLEMS

Title Selection: 1) Project Work / 2) Spectral Problems

1) **Project Work:** For University students- Project Work / Internship is compulsory and have to submit a dissertation containing Back ground of the work, Experimental, Results and Discussion and Summary.

   In respect of Affiliated Colleges-Project work is optional for only colleges having doctorate degree faculty and students may opt for project work and others have to select *Spectral Problems paper.*

2) **Spectral Problems:** For students who selected spectral problems will be given spectra of two different compounds for structural elucidation along with Viva-voce. (A minimum of 10 representative examples should be studied in regular practical hours).

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