**A.S.D. GOVERNMENT DEGREE COLLEGE FOR WOMEN (A)**

**KAKINADA – 533 002, EAST GODAVARI, A.P.**

**DEPARTMENT OF CHEMISTRY**



**SYLLABUS**

**2021-22**

**A.S.D. GOVERNMENT DEGREE COLLEGE FOR WOMEN (A), KAKINADA**

**DEPARTMENT OF CHEMISTRY**

**SEMESTER – I**

**Course I (Inorganic & Physical Chemistry) 60 hrs. (4h/w)**

**Course outcomes:**

**At the end of the course, the student will be able to;**

1. Understand the basic concepts of p-block elements.

2. Explain the difference between solid, liquid and gases in terms of intermolecular interactions.

3. Apply the concepts of gas equations, pH and electrolytes while studying other chemistry courses.

**INORGANIC CHEMISTRY 24 h**

**UNIT –I**

**CHEMISTRY OF P-BLOCK ELEMENTS (8h)**

Group 13: Preparation & structure of Diborane.

Group 14: Preparation, classification and uses of silicones.

Group 15: Preparation & structures of Phosphonitrilic halides {(PNCl2)n where n = 3, 4.

Group 16: Oxides and Oxoacids of Sulphur (structures only).

Group 17: Pseudo halogens.

**UNIT-II**

**1. CHEMISTRY OF d-BLOCK ELEMENTS: 6h**

Characteristics of d-block elements with special reference to electronic configuration, variable valence, magnetic properties, catalytic properties and ability to form complexes.

**2. CHEMISTRY OF f-BLOCK ELEMENTS: 6h**

Chemistry of lanthanides - electronic structure, oxidation states, lanthanide contraction, Chemistry of actinides - electronic configuration, oxidation states, actinide contraction, comparison of lanthanides and actinides.

**3. THEORIES OF BONDING IN METALS: 4h**

Valence bond theory and free electron theory, explanation of thermal and electrical conductivity of metals based on these theories, Band theory- formation of bands, explanation of conductors, semiconductors and insulators.

**PHYSICAL CHEMISTRY 36 h**

**UNIT-III**

**SOLIDSTATE: 10h**

Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. The law of symmetry. Definition of lattice point, space lattice, unit cell. Bravais lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law. Powder method. Defects in crystals. Stoichiometric and non-stoichiometric defects.

**UNIT-IV**

**1. GASEOUS STATE: 6h**

van der Waal's equation of state. Andrew's isotherms of carbon dioxide, continuity of state. Critical phenomena. Relationship between critical constants and Vander Waal's constants. Law of corresponding states. Joule- Thomson effect. Inversion temperature.

**2. LIQUID STATE: 4h**

Liquid crystals, mesomorphic state. Differences between liquid crystal and solid/liquid. Classification of liquid crystals into Smectic and Nematic. Application of liquid crystals as LCD devices.

**UNIT-V**

**SOLUTIONS, IONIC EQUILIBRIUM & DILUTE SOLUTIONS**

**1. SOLUTIONS: 6h**

Azeotropes- ethanol-water system. Partially miscible liquids-phenol water system. Critical solution temperature (CST). Immiscible liquids and steam distillation. Nernst distribution law. Calculation of

the partition coefficient.

**2. IONIC EQUILIBRIUM: 3h**

Ionic product, common ion effect, solubility and solubility product. Calculations based on solubility product.

**3. DILUTE SOLUTIONS: 7h**

Colligative properties- RLVP, Osmotic pressure, Elevation in boing point and depression in freezing point. Experimental methods for the determination of molar mass of a non-volatile solute using osmotic pressure, Elevation in boing point and depression in freezing point. Abnormal colligative properties. Van't Hoff factor.

**List of Reference Books**

1. Principles of physical chemistry by Prutton and Marron

2. Solid State Chemistry and its applications by Anthony R. West

3. Text book of physical chemistry by K L Kapoor

4. Text book of physical chemistry by S Glasstone

5. Advanced physical chemistry by Bahl and Tuli

6. Inorganic Chemistry by J .E. Huheey

7. Basic Inorganic Chemistry by Cotton and Wilkinson

8. A textbook of qualitative inorganic analysis by A.I. Vogel

9. Atkins, P. W. & Paula, J. de Atkin’s Physical Chemistry Ed., Oxford University Press, 10th Ed (2014).

10. Castellan, G.W. Physical Chemistry4th Ed. Narosa (2004).

11. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

12. Barrow, G.M. Physical Chemistry.

**LABORATORY COURSE –I 30hrs (2 h / w)**

**Practical-I Analysis of SALT MIXTURE**

(At the end of Semester-I)

**Qualitative inorganic analysis (Minimum of Six mixtures should be analysed): 50 M**

**Course outcomes:**

**At the end of the course, the student will be able to;**

1. Understand the basic concepts of qualitative analysis of inorganic mixture

2. Use glassware, equipment and chemicals and follow experimental procedures in the Laboratory

3. Apply the concepts of common ion effect, solubility product and concepts related to qualitative analysis

**ANALYSIS OF SALT MIXTURE(50 M)**

Analysis of mixture salt containing two anions and two cations (From two different groups) from the following:

**Anions:** Carbonate, Sulphate, Chloride, Bromide, Acetate, Nitrate, Borate, Phosphate.

**Cations:** Lead, Copper, Iron, Aluminium, Zinc, Nickel, Manganese, Calcium, Strontium, Barium, Potassium and Ammonium. 13

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**SEMESTER – II**

**Course II – (Organic & General Chemistry) 60 h (4 h/w)**

**Course Outcomes:**

**At the end of the course, the student will be able to;**

1. Understand and explain the differential behavior of organic compounds based on fundamental concepts learnt.

2. Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.

3. Learn and identify many organic reaction mechanisms including Free Radical Substitution, Electrophilic Addition and Electrophilic Aromatic Substitution.

4. Correlate and describe the stereochemical properties of organic compounds and reactions.

**UNIT-I**

**Carbon-Carbon sigma bonds (Alkanes and Cycloalkanes) 12h**

General methods of preparation of alkanes- Wurtz and Wurtz Fittig reaction, Corey House synthesis, physical and chemical properties of alkanes, Isomerism and its effect on properties, Free radical substitutions; Halogenation, concept of relative reactivity v/s selectivity. Conformational analysis of alkanes (Conformations, relative stability and energy diagrams of Ethane, Propane and butane). General molecular formulae of cycloalkanes and relative stability, Baeyer strain theory, Cyclohexane conformations with energy diagram.

**UNIT-II**

**Carbon-Carbon pi Bonds (Alkenes and Alkynes) 12h**

General methods of preparation, physical and chemical properties. Mechanism of E1, E2, Saytzeff, Electrophilic Additions, mechanism (Markownikoff / Antimarkownikoff addition) with suitable examples, syn and anti-addition; Diels Alder reaction,1,2-and 1,4-addition reactions in conjugated dienes. Reactions of alkynes, acidity, Alkylation of terminal alkynes.

**UNIT-III**

**Benzene and its reactivity 12h**

Concept of aromaticity, Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non - Benzenoid compounds (cyclopropenylcation, cyclopentadienyl anion and tropyliumcation) Reactions - General mechanism of electrophilic aromatic substitution, mechanism of nitration, Friedel- Craft's alkylation and acylation. Orientation of aromatic substitution - ortho, para and meta directing groups. Ring activating and deactivating groups with examples (Electronic interpretation of various groups like NO2 and Phenolic).

**GENERAL CHEMISTRY (24 h)**

**UNIT-IV**

**Surface chemistry and chemical bonding**

**1. Surface chemistry (6h)**

Colloids- Coagulation of colloids- Hardy-Schulze rule. Stability of colloids, Protection of Colloids, Gold number.

**Adsorption** - Physical and chemical adsorption, Langmuir adsorption isotherm, applications of adsorption.

**2. Chemical Bonding (6h)**

Valence bond theory, hybridization, VB theory as applied to ClF3, Ni(CO)4, Molecular orbital theory -LCAO method, construction of M.O. diagrams for homo-nuclear and hetero-nuclear diatomic molecules (N2, O2, CO and NO).

**UNIT-V**

**Stereochemistry of carbon compounds (10h)**

Molecular representations- Wedge, Fischer, Newman and Saw-Horse formulae. Optical isomerism: Optical activity- wave nature of light, plane polarized light, optical rotation and specific rotation. Chiral molecules- definition and criteria (Symmetry elements)- Definition of enantiomers and diastereomers – Explanation of optical isomerism with examples- Glyceraldehyde, Alanine, Tartaric acid. D, L, R, S and E, Z- configuration with examples.

**Reference Books**

**Theory:**

Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Eliel, E. L. &Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.

Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

**Practical:**

Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

**LABORATORY COURSE-II 30hrs (2 h / w)**

**Practical-II Volumetric Analysis**

**(At the end of Semester-II)**

**Volumetric analysis 50 M**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

2. Determination of Fe (II) using KMnO4 with oxalic acid as primary standard.

3. Determination of Cu (II) using Na2S2O3 with K2Cr2O7 as primary standard.

4. Estimation of water of crystallization in Mohr’s salt by titrating with KMnO4

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**SECOND YEAR, SEMESTER– III**

**Paper III (ORGANIC & SPECTROSCOPY) 60 h (4 h / w)**

**ORGANIC CHEMISTRY 30 h (2h / w)**

**UNIT I:**

1. **Chemistry of Halogenated Hydrocarbons:**

Alkyl Halides: Methods of preparation and properties, nucleophilic substitution reactions– SN1, SN2 mechanisms with stereo chemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination, Williamson’s synthesis. Aryl Halides: Preparation (including preparation from diazonium salts) and properties, nucleophilic aromatic substitution; Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

1. **Alcohols & Phenols Alcohols:**

Preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouveault-Blanc Reduction; Oxidation of Diols by Periodic Acid and lead Tetraacetate, Pinacol- Pinacolone Rearrangement; Phenols: Preparation and Properties; Acidity and Factors Affecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe’s–Schmidt Reactions.

**UNIT II:**

**Carbonyl Compounds:**

Structure, reactivity, preparation and properties; Nucleophilic Addition, Nucleophilic Addition-elimination reactions with ammonia derivatives, Mechanisms of Aldol and Benzoin Condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann Haloform Reaction and Baeyer-Villiger oxidation, α- substitution reactions, oxidations and reductions (Clemmensen, Wolf–Kishner, with LiAlH4 & NaBH4).

**UNIT III:**

**Carboxylic Acids and their Derivatives:**

General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituent acidic strength. Typical reactions of carboxylic acids, hydroxy acids and unsaturated acids. Preparation and Reactions of Acid Chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group-Mechanism of acidic and alkaline hydrolysis of esters, Claisen Condensation**,** Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schmidt reaction, Arndt- Eistert synthesis, halogenation by Hell- Volhard- Zelensky reaction.

**SPECTROSCOPY 30 h (2h / w)**

**UNIT IV:**

**Molecular Spectroscopy:** Interaction of electromagnetic radiation with molecules and various types of spectra.

**Rotation spectroscopy:** Selection rules, intensities of spectral lines.

**Vibrational Spectroscopy:** Classical Equation of Vibration, computation of force constant, Harmonic and unharmonic oscillator, Morse Potential curve, vibrational degrees of freedom for polyatomic molecules, modes of vibration. Selection rules for vibrational transitions, Fundamental Frequencies and overtones.

**Electronic spectroscopy:** Energy levels of molecular orbitals (σ, π, n). Selection rules for electronic spectra. Types of electronic transitions in molecules, effect of conjugation. Concept of chromophore. bathochromic and hypsochromic shifts. Beer-Lambert’s law and its limitations.

**Nuclear Magnetic Resonance (NMR) spectroscopy:** Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals - spin-spin coupling, coupling constants. Applications of NMR with suitable examples – ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate and acetophenone.

**UNIT V:**

**Application of Spectroscopy to Simple Organic Molecules**

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Application of

electronic spectroscopy and Woodward rules for calculating λmax of conjugated dienes and α, β –

unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR

Spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones and carboxylic acids.

**REFERENCE BOOKS:**

1. A TextBook of Organic Chemistry by Bahl and Arunbahl

2. A Textbook of Organic chemistry by I L FinarVol I

3. Organic chemistry by Bruice

4. Organic chemistry by Clayden

5. Spectroscopy by William Kemp

6. Spectroscopy by Pavia

7. Organic Spectroscopy by J. R. Dyer

8. Elementary organic spectroscopy by Y.R. Sharma

9. Spectroscopy by P.S.Kalsi

10. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)

11. Spectrometric Identification of Organic Compounds by Robert M Silverstein, Francis X Webster

12. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry,5th Ed. Pearson (2012)

13. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,

**LABORATORY COURSE -III** 30**hrs (2 h / w)**

Practical Paper-III (At the end of Semester-III)

**Organic Preparations and IR Spectral Analysis Lab: 50 Marks**

**Organic preparations: 40M**

i. Acetylation of one of the following compounds:

amines (aniline, o-, m-, p- toluidine and o-, m-, p-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method:

a. Using conventional method.

b. Using green approach

ii. Benzoylation of one of the following amines

(aniline, o-, m-, p- toluidine and o-, m-, p-anisidine)

a. Nitration of any one of the following:Acetanilide/nitrobenzene by conventional method

b. Salicylic acid by green approach (using ceric ammonium nitrate).

**IR Spectral Analysis: 10M**

IR Spectral Analysis of the following functional groups with examples

a) Hydroxyl groups

b) Carbonyl groups

c) Amino groups

d) Aromatic groups

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**SECOND YEAR, SEMESTER– IV**

**Paper IV (Course 4) INORGANIC, ORGANIC & PHYSICAL CHEMISTRY**

 **60 h (4 h / w)**

**Course Outcomes:**

1. To learn about the laws of absorption of light energy by molecules and subsequent photochemical reactions.

2. To understand the concept of quantum efficiency and mechanisms of photochemical reactions.

**UNIT I:**

**Organometallic Compounds:**

Definition and classification of organometallic compounds on the basis of bond type, Concept of hapticity of organic ligands. Metal Carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation of mono and binuclear carbonyls of 3d series. P-acceptor behaviour of carbon monoxide.

**UNIT II:**

**Carbohydrates:**

Occurrence, classification and their biological importance, Monosaccharides: Constitution and absolute configuration glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth Projection and Conformational Structures; Interconversions of aldoses and ketoses; Kiliani-Fischer synthesis and Ruff degradation.

**UNIT III:**

**Amino acids and proteins:**

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples - Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Gabriel Phthalimide synthesis c) Strecker’s synthesis. Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point. Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating- peptide bond (amide linkage).

**Heterocyclic Compounds:**

Introduction and definition: Simple five membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole - Aromatic character – Preparation from 1, 4, - dicarbonyl compounds, Paul-Knorr synthesis. Properties: Acidic character of pyrrole - electrophilic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions - Diels Alder reaction in furan. Pyridine – Structure - Basicity - Aromaticity-

**UNIT IV:**

**Nitrogen Containing Functional Groups:**

Preparation, properties and important reactions of nitro compounds, amines and diazonium salts.

**1. Nitro hydrocarbons**

Nomenclature and classification-nitro hydrocarbons, structure -Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes, reactivity -halogenation, reaction with HONO (Nitrous acid), Nef reaction and Mannich reaction leading to Michael addition and reduction.

**2. Amines:**

Introduction, classification, chirality in amines (pyramidal inversion), importance and general methods of preparation.

Properties: Physical properties, Basicity of amines: Effect of substituent, solvent and steric effects. Distinction between Primary, secondary and tertiary amines using Hinsberg's Method and Nitrous Acid. Discussion of the following reactions with emphasis on the mechanistic pathway: Gabriel Phthalimide synthesis, Hoffmann- Bromamide Reaction, Carbylamine Reaction.

**Diazonium Salts:** Preparation and synthetic applications of diazonium salts including preparation of arenes, haloarenes, phenols, amino and nitro compounds. Coupling Reactions of Diazonium Salts (preparation of azo dyes).

**UNIT V:**

**Photochemistry:** Difference between thermal and photochemical processes, Laws of photochemistry- Grothus- Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield- Photochemical reaction mechanism- hydrogen- chlorine and hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Jablonski diagram. Photosensitized reactions- energy transfer processes (simple example).

**Thermodynamics:** The first law of thermodynamics-statement, definition of internal energy and enthalpy, Heat capacities and their relationship, Joule-Thomson effect- coefficient, Calculation of work for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes, State function. Temperature dependence of enthalpy of formation- Kirchoff s equation, Second law of thermodynamics Different Statements of the law, Carnot cycle and its efficiency, Carnot theorem, Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes.

**Continuous Evaluation:** Monitoring the progress of student’s learning Class Tests, Worksheets and Quizzes Presentations, Projects and Assignments Group Discussions: Enhances Critical Thinking Skills And personality

**REFERENCE BOOKS:**

1. Concise coordination chemistry by Gopalan and Ramalingam

2. Coordination Chemistry by Basalo and Johnson

3. Organic Chemistry by G.Mareloudan, Purdue Univ

4. Text book of physical chemistry by S Glasstone

6. Concise Inorganic Chemistry by J.D.Lee

7. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan

8. A Text Book of Organic Chemistry by Bahl and Arunbahl

9. A Text Book of Organic chemistry by I L FinarVol I

10. A Text Book of Organic chemistry by I L FinarVol II

11. Advanced physical chemistry by Gurudeep Raj

**LABORATORY COURSE -IV** 30**hrs (2 h / w)**

Practical Paper-IV (At the end of Semester-IV)

**(Course-4L) Organic Qualitative analysis Lab: 50 Marks**

**Course Outcomes:**

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory

2. Determine melting and boiling points of organic compounds

3. Understand Application of concepts of different organic reactions studied in theory part of organic chemistry

**Organic Qualitative analysis 50 M**

Analysis of an organic compound through systematic qualitative procedure for functional group identification including the determination of melting point and boiling point with suitable derivatives.

Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic primary amines, amides and simple sugars

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**SECOND YEAR, SEMESTER– IV**

**Paper IV (Course 5) (INORGANIC & PHYSICAL CHEMISTRY) 60 h (4 h / w)**

**INORGANIC CHEMISTRY**

**UNIT I:**

**Coordination Chemistry:**

IUPAC nomenclature of coordination compounds, Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Valence Bond Theory (VBT): Inner and outer orbital complexes. Limitations of VBT, Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry, Factors affecting the magnitude of crystal field splitting energy.

**UNIT II:**

**1. Inorganic Reaction Mechanism:**

Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Labile and inert complexes, ligand substitution reactions -SN1 and SN2, Substitution reactions in square planar complexes, Trans-effect, theories of trans effect and its applications

**2. Stability of metal complexes:** Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method.

**3. Bioinorganic Chemistry:**

Metal ions present in biological systems, classification of elements according to their action in biological system. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine, Cis-platin as an anti-cancer drug. Iron and its application in bio-systems, Haemoglobin, Myoglobin.

**PHYSICAL CHEMISTRY**

**UNIT-III:**

**Phase rule:**

Concept of phase, components, degrees of freedom. Thermodynamic derivation of Gibbs phase rule. Phase diagram of one component system - water system, Study of Phase diagrams of Simple eutectic systems i) Pb-Ag system, desilverisation of lead ii) NaCl-Water system.

**UNIT IV:**

**Electrochemistry:**

Specific conductance, equivalent conductance and molar conductance- Definition and effect of dilution. Cell constant. Strong and weak electrolytes, Kohlrausch's law and its applications, Definition of transport number, determination of transport number by Hittorf’s method. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only), Application of conductivity measurements- conduct metric titrations. Electrochemical Cells- Single electrode potential, Types of electrodes with examples: Metal- metal ion, Glass electrode, Inert electrode, Redox electrode, Metal-metal insoluble salt- salt anion. Determination of EMF of a cell, Nernst equation.

**UNIT V:**

**Chemical Kinetics:**

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction, Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

**REFERENCE BOOKS:**

1. Text book of physical chemistry by S Glasstone

2. Concise Inorganic Chemistry by J.D.Lee

3. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan

4. Advanced physical chemistry by Gurudeep Raj

5. Principles of physical chemistry by Prutton and Marron

6. Advanced physical chemistry by Bahl and Tuli

7. Inorganic Chemistry by J.E.Huheey

8. Basic Inorganic Chemistry by Cotton and Wilkinson

9. A textbook of qualitative inorganic analysis by A.I. Vogel

10. Atkins, P.W. & Paula, J.de Atkin’s Physical Chemistry Ed., Oxford UniversityPress 10thEd(2014)

11. Castellan, G.W. Physical Chemistry, 4thEd .Narosa(2004)

12. Mortimer,R. G.PhysicalChemistry3rdEd. Elsevier:NOIDA,UP(2009).

**LABORATORY COURSE -IV** 30**hrs (2 h / w)**

Practical Paper-IV (At the end of Semester-IV)

**(Course-5L) Conductometric and Potentiometric Titrimetry Lab : 50 Marks**

**Course Outcomes:**

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory

2. Apply concepts of electrochemistry in experiments

3. Be familiar with electroanalytical methods and techniques in analytical chemistry which study an analyte by measuring the potential ( volts) and/or current ( amperes) in an electrochemical cell containing the analyte

**Conductometric and Potentiometric Titrimetry 50 M**

1. **Conductometric titration**- Determination of concentration of HCl solution using standard NaOH solution.

2. **Conductometric titration**- Determination of concentration of CH3COOH Solution using standard NaOH solution.

3. **Conductometric titration**- Determination of concentration of CH3COOH and HCl in a mixture using standard NaOH solution.

4. **Potentiometric titration**- Determination of Fe (II) using standard K2Cr2O7 solution.

5. Determination of rate constant for acid catalyzed ester hydrolysis.

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**THIRD YEAR, SEMESTER – V**

**Paper - V (INORGANIC, PHYSICAL & ORGANIC CHEMISTRY) 45 h (3 h / w)**

**INORGANIC CHEMISTRY**

**UNIT – I**

Coordination Chemistry: 8**h**

IUPAC nomenclature - bonding theories - Review of Werner's theory and Sidgwick's concept of coordination - Valence bond theory - geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, crystal filed theory - splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes - low spin and high spin complexes - factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds - structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers.

UNIT-II

**1. Hard and Soft acids and bases:4h**

Classification, Pearson’s concept of hardness and softness- HSAB Principle and applications of HSAB Principle-stability of complexes, predicting the feasibility of a reaction.

2. Stability of metal complexes: **3h**

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method.

**ORGANIC CHEMISTRY**

**UNIT- III**

**Nitro hydrocarbons**: **3h**

Nomenclature and classification-nitro hydrocarbons, structure -Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes, reactivity -halogenation, reaction with HONO (Nitrous acid),Nef reaction.

**UNIT – IV**

**Nitrogen compounds** **:** **12h**

Amines (Aliphatic and Aromatic): Nomenclature, Classification into 1°, 2°, 3° Amines and Quarternary ammonium compounds. Preparative methods –

1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism).

Physical properties and basic character - Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline - comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophillic substitution of Aromatic amines – Bromination and Nitration. Oxidation of aryl and tertiary amines, Diazotization.

**PHYSICAL CHEMISTRY**

**UNIT- V**

**Thermodynamics** **15h**

The first law of thermodynamics-statement, definition of internal energy and enthalpy. Heat capacities and their relationship. Joule-Thomson effect- coefficient. Calculation of w, for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. State function. Temperature dependence of enthalpy of formation-Kirchoff s equation. Second law of thermodynamics. Different Statements of the law. Carnot cycle and its efficiency. Carnot theorem. Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes.

**LABORATORY COURSE – V**

**Practical Paper –V Organic Chemistry 30 h (2 h / W)**

**Organic Qualitative Analysis: 50M**

Analysis of an organic compound through systematic qualitative procedure for functional groupidentification including the determination of melting point and boiling point with suitable derivatives.

Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic Primary Amines, Amides and Simple sugars.

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**THIRD YEAR, SEMESTER - V**

**Paper - VI (INORGANIC, ORGANIC & PHYSICAL CHEMISTRY) 45 hrs (3 h / w)**

**INORGANIC CHEMISTRY**

**UNIT-I**

1. Reactivity of metal complexes: **4h**

Labile and inert complexes, ligand substitution reactions - SN1 and SN2, substitution reactions of square planar complexes - Trans effect and applications of trans effect.

2. Bioinorganic chemistry: **4h**

Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and Cl-. Metalloporphyrins – Structure and functions of hemoglobin, Myoglobin and Chlorophyll.

**PHYSICAL CHEMISTRY**

**UNIT-II**

**1. Chemical kinetics 8h**

Rate of reaction - Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time half change. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

**2. Photochemistry 5h**

Difference between thermal and photochemical processes. Laws of photochemistry- Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield-Photochemical reaction mechanism- hydrogen- chlorine, hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Photosensitized reactions- energy transfer processes (simple example)

**ORGANIC CHEMISTRY**

**UNIT- III**

**Heterocyclic Compounds** **7h**

Introduction and definition: Simple five membered ring compounds with one hetero atom Ex.Furan. Thiophene and pyrrole - Aromatic character – Preparation from 1,4,-dicarbonyl compounds, Paul-Knorr synthesis.

Properties : Acidic character of pyrrole - electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions - Diels Alder reaction in furan.

Pyridine – Structure - Basicity - Aromaticity - Comparison with pyrrole - one method of preparation and properties –Reactivity towards Nucleophilic substitution reaction.

**UNIT-IV**

**Carbohydrates 8h**

Monosaccharides: (+) Glucose (aldo hexose) - Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation) - Proof for the ring size (methylation, hydrolysis and oxidation reactions) - Pyranose structure (Haworth formula and chair conformational formula).

(-) Fructose (ketohexose) - Evidence of 2 - ketohexose structure (formation of pentaacetate, formation of cyanohydrin its hydrolysis and reduction by HI). Cyclic structure for fructose (Furanose structure and Haworth formula) - osazone formation from glucose and fructose – Definition of anomers with examples.

Interconversion of Monosaccharides: Aldopentose to Aldohexose (Arabinose to

D- Glucose, D-Mannose) (Kiliani - Fischer method). Epimers, Epimerisation - Lobry de bruyn van Ekenstein rearrangement. Aldohexose to Aldopentose (D-Glucose to

D- Arabinose) by Ruff degradation. Aldohexose to Ketohexose

[(+) Glucose to (-) Fructose] and Ketohexose to Aldohexose (Fructose to Glucose)

**UNIT- V**

**Amino acids and proteins 7h**

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples - Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.

**LABORATORY COURSE – VI**

**Practical Paper – VI Physical Chemistry 30 h (2 h/W)**

1**.** Determination of rate constant for acid catalyzed ester hydrolysis**.**

2. Determination of molecular status and partition coefficient of benzoicacidin Benzene     and water.

3. Determination of Surface tension of liquid

4. Determination of Viscosity of liquid.

5**.** Adsorption of acetic acid on animal charcoal, verification of Freundlich isotherm.

**A.S.D.GOVERNMENT DEGREE COLLEGE FOR WOMEN (A), KAKINADA**

**DEPARTMENT OF CHEMISTRY**

**THIRD YEAR, SEMESTER-VI**

**ELECTIVE PAPER – VII-(B) : ENVIRONMENTAL CHEMISTRY**

**UNIT-I**

**Introduction 9h**

Concept of Environmental chemistry-Scope and importance of environment in now adays – Nomenclature of environmental chemistry – Segments of environment - Natural resources – Renewable Resources – Solar and biomass energy and Non-renewable resources -Thermal power and atomic energy – Reactions of atmospheric oxygen and Hydological cycle.

**UNIT-II**

**Air Pollution 9h**

Definition – Sources of air pollution – Classification of air pollution – Acid rain – Photochemical smog – Green house effect – Formation and depletion of ozone – Bhopal gas disaster – Controlling methods of air pollution.

**UNIT-III**

**Water pollution 9h**

Unique physical and chemical properties of water – water quality and criteria for finding of water quality – Dissolved oxygen – BOD, COD, Suspended solids, total dissolved solids, alkalinity – Hardness of water – Methods to convert temporary hard water into soft water – Methods to convert permanent hard water into soft water – eutrophication and its effects – principal wastage treatment – Industrial waste water treatment.

**UNIT-IV**

**Chemical Toxicology 9h**

Toxic chemicals in the environment – effects of toxic chemicals – cyanide and its toxic effects – pesticides and its biochemical effects – toxicity of lead, mercury, arsenic and cadmium.

**UNIT-V**

**Ecosystem and biodiversity 9h**

**Ecosystem** Concepts – structure – Functions and types of ecosystem – Abiotic and biotic components – Energy flow and Energy dynamics of ecosystem – Food chains – Food web – Tropic levels – Biogeochemical cycles (carbon, nitrogen and phosporus)

**Biodiversity**

Definition – level and types of biodiversity – concept - significance – magnitude and distribution of biodiversity – trends - biogeographical classification of india – biodiversity at national, global and regional level.

**List of Reference books**

1. Fundamentals of ecology by M.C.Dash

2. A Text book of Environmental chemistry by W. Moore and F.A. Moore

3. Environmental Chemistry by Samir k. Banerji

**LABORATORY COURSE – VII-B**

**Practical Paper – Elective VII B (at the end of semester VI) 30 hrs (2 h / W)**

 **50 Marks**

1.Determination of carbonate and bicarbonate in water samples (acidity and     alkalinity)

2. Determination of hardness of water using EDTA

 a) Permanent hardness

 b) Temporary hardness

3. Determination of Acidity

4. Determination of Alkalinity

5. Determination of chlorides in water samples

**SYLLABUS FOR VI SEMESTER**

**CHEMISTRY CLUSTER ELECTIVE-VIII-A-1**

**PAPER – VIII-A-1: POLYMER CHEMISTRY**

**UNIT-I 12h**

**Introduction of polymers:**

Basic definitions, degree of polymerization ,classification of polymers- Natural and Synthetic polymers, Organic and Inorganic polymers, Thermoplastic and Thermosetting polymers, Plastics, Elastomers, Fibers and Resins, Linear ,Branched and Cross Linked polymers, Addition polymers and Condensation Polymers, mechanism of polymerization. Free radical and Zeigler – Natta polymerization.

**UNIT-II 10h**

**Techniques of Polymerization:** Bulk polymerization, solution polymerization, suspension and Emulsion polymerization.

**Molecular weights of polymers:** Number average and weight average molecular weights Determination of molecular weight of polymers by Viscometry, Osmometry methods.

**UNIT-III 6h**

Kinetics of Free radical polymerization, Glass Transition temperature(Tg) and Determination of Tg:

Free volume theory, WLF equation, factors affecting glass transition temperature (Tg).

**UNIT-IV 9h**

**Polymer additives:**

Introduction to plastic additives – fillers, Plasticizers and Softeners, Lubricants and Flow Promoters, Anti aging additives, Flame Retardants, Colourants, Blowing agents, Cross linking agents,

 **UNIT-V 8h**

**Polymers and their applications:**

Preparation and industrial applications of Polyethylene, Polyvinyl chloride, Teflon, Polyacrylonitrile, Terelene, Nylon6.6 silicones.

**Reference Books:**

1. Seymour, R.B. & Carraher, C.E. *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.
2. Odian, G. *Principles of Polymerization*, 4th Ed. Wiley, 2004.
3. Billmeyer, F.W. *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
4. Ghosh, P. *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991.34
5. Lenz, R.W. *Organic Chemistry of Synthetic High Polymers.* Interscience Publishers, NewYork, 1967.

**SYLLABUS FOR VI SEMESTER**

**CHEMISTRY CLUSTER ELECTIVE-VIII-A-2**

**PAPER – VIII-A-2: INSTRUMENTAL METHODS OF ANALYSIS**

**45 hrs (3 h / w)**

**UNIT – I**

**Introduction to spectroscopic methods of analysis: 4 h**

Recap of the spectroscopic methods covered in detail in the core chemistry syllabus; Treatment of analytical data including error analysis (viz., Absolute and Relative error; Accuracy and Precision; Significant figures; Determinate and Indeterminate errors). Classification of analytical methods, and types of instrumental methods. Characteristics of electromagnetic radiation.

**UNIT – II**

**Molecular spectroscopy: 8h**

***Infrared spectroscopy:***

Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Qualitative and Quantitative.

**UNIT – III 10h**

***UV-Visible/ Near IR*** – emission, absorption, fluorescence and photoaccoustic effect. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (Barrier layer cell/ photovoltaic cell, phototubes or photocells, photomultiplier tubes), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence).

**UNIT – IV**

**Separation techniques 15h**

***Chromatography:* (08h)**

Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid). Electrophoresis.

***Mass spectrometry****:* (**07h)**

Making the gaseous molecule into an ion (electron ionization, chemical ionization), Making liquids and solids into ions (Electro Spray Ionization (ESI), fast atom bombardment), Mass Analyzers – Magnetic Sector Analyzers (MSA), Time of flight, Electric quadruple. Characteristics of Molecular Ions – The Nitrogen Rule.

**UNIT – V**

**Elemental analysis: Atomic spectroscopy: 8h**

Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique),

**NMR spectroscopy**: Principle, Instrumentation, Factors affecting chemical shift, Spin coupling.

**Reference books:**

1. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. P.W. Atkins: Physical Chemistry.
4. G.W. Castellan: Physical Chemistry.
5. C.N. Banwell: Fundamentals of Molecular Spectroscopy.Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.W.J. Moore: Physical Chemistry

**SYLLABUS FOR VI SEMESTER**

**CHEMISTRY CLUSTER ELECTIVE-VIII-A-3**

**PAPER – VIII-A-3 : Analysis of drugs, foods , dairy products &**

 **Bio-CHEMICAL ANALYSIS**

**45 hrs (3 h / w)**

**UNIT- I 10 h**

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

**UNIT – II 6 h**

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, diazepam.

**UNIT – III 10 h**

Analysis of anti epileptic and anti convulsant drugs like phenobarbital and phenacemide.

Analysis of cardiovascular drugs: atenolol,

Analysis of lipitor(atorvastatin) a drug for the prevention of productin of cholesterol.

Analysis of diuretics like: furosemide (Lasix).

Analysis of prevacid(lansoprazole) a drug used for the prevention of production of acids in stomach.

**UNIT – IV 10 h**

Analysis of Milk and milk products: Acidity, total solids, fat, total nitrogen, proteins,lactose, phosphate activity, casein, choride. Analysis of food materials- Preservatives: Sodium carbonate, sodium benzoate sorbic acid Coloring matters, - Briliant blue FCF, fast green FCF, sunset yellow FCF.

Flavoring agents - Vanilla , diacetyl, limonene,

Adulterants in rice and wheat, wheat floor,coconut oil, coffee powder, tea powder, milk..

**UNIT – V 9 h**

Clinical analysis of blood:Composition of blood,clinical analysis, trace elements in the body.Estimation of blood chlolesterol, glucose.

**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

 analytical chemistry and its applications -- Inter Science- Vol I to VII.,

5.Aanalytical Agricultrual Chemistry by S.L.Chopra & J.S.Kanwar -- Kalyani
 Publishers

6. Quantitative analysis of drugs in pharmaceutical formulations by P.D.Sethi, CBS
 Publishers and Distributors, New Delhi

7. G.Ingram- Methods of organic elemental micro analysis- Chapman and Hall.,

8. H.Wincciam and Bobbles (Henry J)- Instrumental methods of analysis of food
 additives.,

9. H.Edward-The Chemical analysis of foods;practical treatise on the examination
 of food stuffs and the detection of adulterants,

10. The quantitative analysis of drugs- D.C.Garratt-Chapman & Hall.,

11. A text book of pharmaceutical analysis by K.A.Connors-Wiley-International.,

12. Comprehensive medicinal chemistry-Ed Corwin Hansch Vol 5,Pergamon Press.

**CHEMISTRY LABORATORY COURSE – VIII-A-1**

 **Practical Paper – VIII-A-1: (at the end of semester VI) 30 hrs (2 h/w)**

 **50 Marks**

1. Preparation of Aspirin

2. Preparation of Paracetamol

3. Preparation of Acetanilide

4. Preparation of Barbutiric Acid

5. Preparation of Phenyl Azo β-naphthol

**CHEMISTRY LABORATORY COURSE – VIII-A-2**

 **Practical Paper – VIII-A-2: (at the end of semester VI) 30 hrs (2 h/w)**

1. **Marks**
2. **Electrochemistry:**

 Determination of redox potential of Fe+2/ Fe+3 by potentiometric titration of ferrous ammonium sulphate vs. potassium dichromate.

1. **pH metry:**

 i) Preparation of phosphate buffer solutions.

ii) pH metric titration of weak acid, acetic acid with strong base NaOH and calculation of dissociation constant.

1. **Colorimetry**

 i) Verification of Beer-Lambert law for KMnO4 and determination of concentration of the given solution

 ii) Verification of Beer -Lambert law for K2Cr2O7 and determination of concentration of the given solution

**List of Reference Books**

**1.** Green Chemistry Theory and Practice. P.T.Anatas and J.C. Warner

2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.

3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly

4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry
 (London)

5. Green Chemistry: Introductory Text, M.Lancaster

6. Principles and practice of heterogeneous catalysis, Thomas J.M.,Thomas  M.J., John      Wiley

**VII- A-3 Practical : Project Work**