**SKR & SKR GOVT. COLLEGE FOR WOMEN (A), KADAPA**

**B.Sc. 1Ind Semester Chemistry Syllabus under CBCS**

**Paper I: Inorganic & Physical Chemistry**

## SEMESTER - III

**Course III (ORGANICCHEMISTRY&SPECTROSCOPY) 60hrs (4 h / w)**

**Course outcomes:**

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

* 1. Understand preparation, properties and reactions of haloalkanes, haloarenes and oxygen containing functional groups.
  2. Use the synthetic chemistry learnt in this course to do functional group transformations.
  3. To propose plausible mechanisms for any relevant reaction

## ORGANIC CHEMISTRY 34h

**UNIT – I**

1. **Chemistry of Halogenated Hydrocarbons: 6h** Alkyl halides: Methods of preparation and properties, nucleophilic substitution reactions– SN1, SN2 with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination, Williamson’s synthesis. Aryl halides: Preparation (including preparation from diazonium salts) and properties.

Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

## Alcohols &Phenols 6h

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Oxidation of diols by periodic acid and leadtetra acetate,Pinacol- Pinacolonerearrangement;

Phenols: Preparation and properties; Acidity and factors effecting by mesomeric effect, Ring substitution reactions, Reimer–Tiemann and Kolbe’s–Schmidt Reactions, Fries and Claisen rearrangements with mechanism;

## UNIT-II

**Carbonyl Compounds 10h**

Mechanisms of Aldol and Benzoin condensation, Claisan-Schmidt, Perkin, Cannizzaro and Wittig reaction, Reactions of Beckmann haloform reaction and Baeyer Villiger oxidation, α-

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| Substitution reactions, oxidations and reductions (Clemmensen, wolf –kishner, | with | LiAlH4 |
| & NaBH4). Addition reactions of α,β-unsaturated carbonyl compounds: Michael addition.  Active methylene compounds: Keto-  Enol-tautomerism. Preparation and synthetic applications of diethyl  Malonate and ethyl acetoacetate.  **UNIT-III** | | |
| **Carboxylic Acids and their Derivatives** |  | **12h** |

General methods of preparation, physical properties and reactions of monocarboxylic

acids, effect of substituents on acidic strength.

Comparative study of nucleophilic substitution at acyl group-Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Reformatsky reactions and Curtius rearrangement

Reactions involving H, OH and COOH groups- salt formation, anhydride formation, acid chloride formation, amide formation and esterification (mechanism). Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schimdt reaction, Arndt- Eistert synthesis, halogenation by Hell- Volhard- Zelinsky reaction.

## SPECTROSCOPY 26 h

**UNIT-IV**

**Molecular Spectroscopy-I**: **18h**

Interaction of electromagnetic radiation with molecules and various types of spectra;

**Microwave spectroscopy:** Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules.

**IR spectroscopy:** Classical equation of vibration, computation of force constant, Harmonic oscillator, vibrational degrees offered for polyatomic molecules, modes of vibration. Selection rules for vibrational transitions, Fundamental frequencies, overtones and Fermi resonance, Finger print region.

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

**UNIT-V 8h**

**UV-Visible 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 and auxochrome. bathochromic and hypso, hypo & Hyper chromic 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-multiplicities and signal intensities- spin-spin coupling, coupling constants. Applications of NMR with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene, acetophenone and propene.

**Application of Spectroscopy to Simple Organic Molecules**

**Application of visible, ultraviolet spectroscopy in organic molecules.** Application of electronic spectroscopy and Woodward rules for calculating λmax of conjugated dienes and α, β – unsaturated carbonyl compounds-eg: α-naphthol and cinnamaldehyde.

**Co-curricular activities and Assessment Methods** Continuous Evaluation: Monitoring the progress of student’s learning Class Tests, Work sheets and Quizzes Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality Semester-end Examination: critical indicator of student’s learning and teaching methods adopted by teachers throughout the semester.

## List of Reference Books

1. A Text Book of Organic Chemistry by Bahl and Arun bahl
2. A Text Book 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. Spectrometric Identification of Organic Compounds by Robert M Silverstein, Francis X Webster
11. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
12. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. &Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012)

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

**Practical Course-III Organic preparations and IR Spectral Analysis**

(At the end of Semester- III)

## Course outcomes:

On the completion of the course, the student will be able to do the following**:**

* 1. how to use glassware, equipment and chemicals and follow experimental procedures in the laboratory
  2. how to calculate limiting reagent, theoretical yield, and percent yield
  3. how to engage in safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents appropriately
  4. how to dispose of chemicals in a safe and responsible manner
  5. how to perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration.
  6. how to create and carry out work up and separation procedures
  7. how to critically evaluate data collected to determine the identity, purity, and percent yield of products and to summarize findings in writing in a clear and concise manner

**BRIDGE COURSE ON Laboratory practices----5 hours**

## Organic preparations: 20 hours 40M

1. Acetylation of one of the following compounds:

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

* 1. Using conventional method.
  2. Using green approach

1. Benzolyation of one of the following amines

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

1. Nitration of any one of the following:
   1. Acetanilide/nitrobenzene by conventional method
   2. Salicylic acid by green approach (using ceric ammonium nitrate).

## IR Spectral Analysis- 5 hours 10M

IR Spectral Analysis of the following functional groups with examples

1. Hydroxyl groups
2. Carbonyl groups
3. Amino groups
4. Aromatic groups

# MODEL PAPER

SECOND YEAR B.Sc., DEGREE EXAMINATION

**SEMESTER-III**

**CHEMISTRY COURSE-III: ORGANIC CHEMISTRY & SPECTROSCOPY**

Time: 3 hours Maximum Marks: 75

**PART- A** 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each carries **FIVE** marks

* 1. Discuss two methods for preparation of aryl halides.
  2. Explain the mechanism for Pinacol-Pinacolone rearrangement.
  3. Discuss the mechanism for Bayer-villiger oxidation reaction.
  4. Explain the effect of substituents on acidic strength of mono-carboxylic acids.
  5. Write the mechanism for Claisen Condensation reaction.
  6. Write the selection rules in rotational spectroscopy.
  7. Explain Spin – Spin coupling and Coupling Constant.
  8. Explain types of electronic transitions in UV spectroscopy.

**PART- B** 5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

1. (a). Give the mechanism & stereochemistry of SN1& SN2 reactions of alkyl halides with suitable example.

(or)

1. Explain the following reactions with mechanism.
   1. Reimer-Tiemann reaction (ii) Fries rearrangement.
2. (a). Discuss the mechanism for following reactions.
   1. Perkin reaction. (ii) Cannizaro reaction

(or)

(b). Write the preparation and any three synthetic applications of diethyl malonate.

11.(a). Explain acid and base hydrolysis reaction of esters with mechanism.

(or)

(b). Explain the mechanisms of Curtius rearrangement & Arndt –Eistert reaction. 12.(a). (i) Write a note on vibrational degrees of freedom for polyatomic molecules.

* 1. Explain different modes of vibrations & selection rules in IR spectroscopy.

(or)

(b).(i) Define Bathochromic shift. Explain the effect of conjugation in U.V. spectroscopy.

(ii) Discuss the principle of NMR spectroscopy.

13.(a). Write Woodward-Fieser rules for calculating λmax for conjugated dienes and α,β – unsaturated carbonyl compounds , and apply them for one example each.

(or)

(b).(i) What is Fingerprint region. Explain its significance with an example.(ii) Write IR spectral data for any one alcohol, aldehyde and ketone

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## SEMESTER - IV

**Course IV (INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY) 60hrs (4 h / w)**

**Course outcomes:**

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

1. To learn about the laws of absorption of light energy by molecules and the subsequent photochemical reactions.
2. To understand the concept of quantum efficiency and mechanisms of photochemical reactions.

## UNIT - I

**Organo metallic Compounds 8h**

Definition and classification of organometallic Compounds on the basis of bond type, Concept of hapticity of organic ligands. Metalcarbonyls:18 electron rule, electron count of mononuclear metal carbonyls. General methods of preparation of mono and binuclear carbonyls of 3dseries. P-acceptor behaviour of carbon monoxide (Back bonding).

## UNIT – II

**Carbohydrates 8h**

Occurrence, classification and their biological importance, Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation;

## UNIT- III

**Amino acids and proteins 6h**

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). Structure and nomenclature of peptides and proteins.

## 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

**Nitrogen Containing Functional Groups**

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

## 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

**Amines: 11h**

Introduction, classification, chiralityin 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, Mannich reaction,

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

## UNIT- V

**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 and hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Jablonski diagram, Photosensitized reactions- energy transfer processes (simple example).

**Thermodynamics 12 h**

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- Kirch off 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. Entropy changes in spontaneous and equilibrium processes. Third law of thermodynamics, Nernst heat theorem, Spontaneous and non- spontaneous processes, Helmholtz and Gibbs energies -Criteria for spontaneity.

**Co-curricular activities and Assessment Methods** Continuous Evaluation: Monitoring the progress of student’s learning Class Tests, Work sheets and Quizzes Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality Semester-end Examination: critical indicator of student’s learning and teaching methods adopted by teachers throughout the semester.

## List of 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

1. Concise Inorganic Chemistry by J.D.Lee
2. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
3. A Text Book of Organic Chemistry by Bahl and Arunbahl
4. A Text Book of Organic chemistry by I L FinarVol I
5. A Text Book of Organic chemistry by I L FinarVol II

## SEMESTER - IV

## Course V (INORGANIC & PHYSICAL CHEMISTRY) 60 hrs (4 h / w)

**Course outcomes:**

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

1. Understand concepts of boundary conditions and quantization, probability distribution, most probable values, uncertainty and expectation values
2. Application of quantization to spectroscopy.
3. Various types of spectra and the irusein structure determination.

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| **INORGANIC CHEMISTRY**  **UNIT –I** |  | **26 h** |
| **Coordination Chemistry**  IUPAC nomenclature of coordination | compounds, Structural | **12 h**  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, Spectrochemical series, Comparison of CFSE for Octahedral and Tetrahedral complexes, Tetragonal distortion of octahedral geometry, Jahn-Teller distortion, square planar coordination.

## UNIT –II

1. **Inorganic Reaction Mechanism**: **4h**

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

## Stability of metal complexes: 2h

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

## Bioinorganic Chemistry: 8h

Metal ions present in biological systems, classification of elements according to their action in biological system. Sodium/K- pump, carbonic anhydrase and carboxypeptidase.

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, Cisplatin as an anti-cancer drug. Iron and its application in bio-systems, Haemoglobin, Myoglobin. Storage and transfer of iron.

## PHYSICAL CHEMISTRY 34 h

**UNIT-III**

1. **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, de-silverisation of lead ii) NaCl-Water system, Congruent and incongruent melting point- Definition and examples for systems having congruent and incongruent melting point , freezing mixtures.

## UNIT-IV

**Electrochemistry 14h**

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-Onsagar's equation for strong electrolytes (elementary treatment only), Application of conductivity measurements- conductometric titrations.

Electrochemical Cells- Single electrode potential, Types of electrodes with examples: Metal- metal ion, Gas electrode, Inert electrode, Redox electrode, Metal-metal insoluble salt- salt anion. Determination of EMF of a cell, Nernst equation, Applications of EMF measurements

- Potentiometric titrations.

## UNIT-V

**Chemical Kinetics: 14 h**

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. Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Enzyme catalysis- Specificity,

factors affecting enzyme catalysis, Inhibitors and Lock & key model. Michaels- Menten equation- derivation, significance of Michaelis-Menten constant.

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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.deAtkin’sPhysicalChemistryEd.,OxfordUniversityPress 10thEd(2014).
11. Castellan,G.W.PhysicalChemistry4thEd.Narosa(2004).
12. Mortimer,R. G.PhysicalChemistry3rdEd. Elsevier:NOIDA,UP(2009).
13. Barrow,G.M.PhysicalChemistry

## SEMESTER - IV

**Course V LABORATORY COURSE 30**hrs (2 h / w)

## Practical-Course -V Conductometric and Potentiometric Titrimetry 50 M Course outcomes:

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

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
2. Apply concepts of electrochemistry in experiments
3. Be familiar with electro analytical 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.

# MODEL PAPER

SECOND YEAR B.Sc., DEGREE EXAMINATION

**SEMESTER-IV**

**CHEMISTRY COURSE V: INORGANIC & PHYSICAL CHEMISTRY**

Time: 3 hours Maximum Marks: 75

**PART- A**5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each carries **FIVE** marks

* 1. Write note on Jahn-Teller distortion.
  2. Explain Labile & inert complexes.
  3. Explain Job’s method for determination of composition of complex.
  4. Explain Thermodynamic derivation of Gibb’s phase rule.
  5. Explain any two conductometric titrations.
  6. Write note on Fuel Cells with examples and applications.
  7. What is enzyme catalysis? Write any three factors effecting enzyme catalysis.
  8. Derive Michaels- Menten equation.

**PART- B** 5 X 10 = 50

Marks

Answer **ALL** the questions. Each carries **TEN** marks

1. (a). Explain Valence Bond theory with Inner and Outer orbital complexes. Write limitations of VBT.

(or)

(b). Define CFSE. Explain the factors effecting the magnitude of crystal field splitting energy.

1. (a). Explain Trans effect. Explain the theories of trans effect and write any two applications of trans effect.

(or)

(b). (i) Write the biological functions of Haemoglobin and Myoglobin.

(ii) Write note on use of chelating agents in medicines.

11.(a). Define Phase rule and terms involved in it. Explain phase diagram of Pb-Ag system.

(or)

(b). (i) Explain phase diagram for NaCl-water system.

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

**Practical Course-IV Organic Qualitative analysis 50 M**

(At the end of Semester- IV)

## Course outcomes:

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

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
2. Determine melting and boiling points of organic compounds
3. Understand the 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