

SRI VENKATESWARA UNIVERSITY
B.Sc. DEGREE COURSE IN CHEMISTRY
SEMESTER SYSTEM WITH CBCS
SEMESTER IV
W.E.F. 2021-2022

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 lightener gyby molecules and the subsequent photo chemical reactions.
2. To understand the concept of quantum efficiency and mechanisms of photo chemical reactions.

UNIT -I

Organ o metallic Compounds

8h

Definition and classification of organ o metallic Compounds on the basis of bondtype, Concept of hapticity of organic ligands. Metalcarbonyls:18electronrule,electron count of mononuclear, poly nuclear and substituted metal carbonyls of 3dseries. General methods of preparation of mono and binuclear carbonyls of 3d series.P-acceptor behaviour of carbon monoxide. Synergic effects (VB approach) - (MO diagram of CO can be referred to for synergic effect to IR frequencies).

UNIT - II

Carbohydrates

8h

Occurrence, classification and their biological importance, Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimer sandanomers, mutarotation, determination of ringsize of glucose and fructose, Haworth projections and conformational structures; Interconversios of aldoses and ketoses; Killiani-Fischer synthesis and Ruffdegradation; Disaccharides–Elementary treatment of maltose, lactose and sucrose. Polysaccharides–Elementary treatmet of starch.

UNIT- III

Amino acid 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.

HeterocyclicCompounds

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 - electrophilic 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

NitrogenContainingFunctionalGroups

Preparation, properties and important reactions of nitrocompounds, amines and diazoniumsalts.

1. Nitrohydrocarbons

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 and Mannich reaction leading to Micheal addition and

reduction.

2.Amines:

11h

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 Phthalimides synthesis, Hoffmann Bromamide reaction, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction and Cope elimination.

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- 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. 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, Worksheets 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 through out 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. Mareoudan, 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 Finar Vol I
10. A Text Book of Organic chemistry by I L Finar Vol II
11. Advanced physical chemistry by Gurudeep Raj

LABORATORYCOURSE-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

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MODEL PAPER

**CHEMISTRY COURSE -IV: INORGANIC, ORGANIC &
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. Describe the 18 electron rule of mono nuclear and polynuclear metal carbonyls with suitable examples.
2. What are epimers and anomers. Give examples.
3. Discuss about iso electric point and zwitterion.
4. Discuss the Paul-Knorr synthesis of five membered heterocyclic compounds.
5. Explain Tautomerism shown by nitroalkanes
6. Discuss the basic nature of amines.
7. Write the differences between thermal and photochemical reactions.
8. Derive heat capacities and derive $C_p - C_v = R$

PART-B

5 X 10 = 50 Marks

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

- 9 (a). What are organometallic compounds? Discuss their Classification on the basis of type of bonds with examples.
(or)
- (b). Discuss the general methods of preparations of mono & bi-nuclear carbonyls of 3d series.
- 10 (a). Discuss the constitution, configuration and ring size of glucose. Draw the Haworth and Conformational structure of glucose.
(or)
- (b). (i) Explain Ruff's degradation.
(ii) Explain Kiliani- Fischer synthesis.
- 11.(a). What are amino acids? Write any three general methods of preparation of amino acids.
(or)
- (b). Discuss the aromatic character of Furan, Thiophene

and Pyrrole. 12.(a). Write the mechanism for the following.

(i) Nef reaction

(ii) Mannich
reaction (or)

(b).(i) Explain Hinsberg separation of amines.

(ii) Discuss any three synthetic applications of diazonium salts.

13.(a). What is quantum yield? Explain the photochemical combination of Hydrogen- Chlorine and Hydrogen -Bromine.
(or)

(b). Define entropy. Describe entropy changes in the reversible and irreversible process.

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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 their use in structure determination.

INORGANIC CHEMISTRY

26 h

UNIT -I

Coordination Chemistry

12 h

IUPAC nomenclature of compounds, and stereoisomerism
coordination Structural 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 - SN^1 and N^2 , Substitution reaction in square planar complexes, Trans-effect, theories of trans effect and its applications

2. 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. Geochemical effect on the distribution of metals, Sodium/K- pump, carbonic dehydratase and carboxy peptidase.

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****6h**

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, 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-Onsager'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.

Fuel cells- Basic concepts, examples and applications

UNIT-V

Chemical Kinetics:

14h

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. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). Enzyme catalysis- Specificity,

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

Co-curricular activities and Assessment Methods; Continuous Evaluation: Monitoring the progress of student's learning Class Tests, Worksheets and Quizzes Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality

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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 University Press 10th Ed (2014).
11. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
12. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
13. Barrow, G.M. Physical Chemistry

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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 theanalyte

Conductometric and PotentiometricTitrimetry**50 M**

1. **Conductometric titration**- Determination of concentration of HCl solution using standard NaOHsolution.
2. **Conductometric titration**- Determination of concentration of CH₃COOH Solution using standard NaOHsolution.
3. **Conductometric titration**- Determination of concentration of CH₃COOH and HCl in a mixture using standard NaOHsolution.
4. **Potentiometric titration**- Determination of Fe (II) using standard K₂Cr₂O₇solution.
5. Determination of rate constant for acid catalyzed esterhydrolysis.

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 Michaelis-Menten equation.

PART-B

5 X 10 = 50 Marks

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

- 9 (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.
- 10 (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.
(ii) Explain briefly about Freezing mixtures.

12.(a). Define Transport number. Write experimental method for the determination of transport number by Hittorf method.

(or)

(b).(i) Define single electrode potential.

(ii) Explain four types of electrodes with examples.

13.(a). Explain general methods for determination of order of a reaction.

(or)

(b).Explain Collision theory and Activated complex theory of bimolecular reactions.
