

ANDHRA UNIVERSITY
Department of Engineering Chemistry, AU College of Engineering (A)
5 YEAR INTEGRATED M.Sc. CHEMISTRY
(Specialization: APPLIED CHEMISTRY)
 (With Effect from the Admitted Batch of 2016-2017 Academic Year)
SCHEME OF INSTRUCTION AND EXAMINATION
SEMESTER VII (15 Weeks Duration)

Code Number	Course Title	Teaching/ Lab hours per week	Allotment of Marks		Total Marks	Credits
			External	Internal		
7T1/ Paper – I	Inorganic Chemistry	4	70	30	100	4
7T2/ Paper – II	Organic Chemistry	4	70	30	100	4
7T3/ Paper – III	Physical Chemistry	4	70	30	100	4
7T4/ Paper – IV	Quantum Chemistry	4	70	30	100	4
7T5/ Paper – V	Mineral Based Industries And Corrosion	4	70	30	100	4
7P1/ Practical- I	Inorganic Chemistry Practical	6	100	50	150	4
7P2/ Practical- II	Organic Chemistry Practical	6	100	50	150	4
7S1	Seminar Presentation	-----	-----	50	50	2
				Total	850	30

Total Credits for VII Semester
Theory : 20
Practical & Seminar : 10
Total : 30

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SYLLABUS
VII Semester
7T1/ PAPER-I: INORGANIC CHEMISTRY

Reaction Mechanism of Transition Metal Complexes:

Ligand Substitution Reactions in Octahedral Complexes: Transition state or activated complex – substrate –Attacking reagents: Electrophilic reagents, Nucleophilic reagents –Types of Substitution of Reactions (S_N) - Electrophilic or Metal Substitution Reactions (S_E). S_N1 or dissociation mechanism; or S_N2 or association or displacement mechanism. Acid and base hydrolysis reactions of Cobalt (III) complexes

Ligand Substitution Reactions in Square Planar Complexes : The trans effect –uses of trans effect –different theories of trans effect –mechanism and the factors involved in the substitution reactions in square planar complexes

Electron Transfer Reactions in Coordination Complexes

Mechanism of one electron transfer reactions –Inner sphere (atom or group transfer) mechanism –outer sphere (or Electron transfer) mechanism .Structure and bonding in some binuclear metal atom clusters

Chemistry of Lanthanides and Actinides: Separation of Lanthanides and actinides, uses of lanthanides and their compounds.

Recommended Books :

1. Inorganic chemistry, principles of structure and reactivity, 4thEdition by James E. Huheey; Elleu A. Keiter; Richard L. Keiter.
2. Advanced inorganic chemistry by F. A. Cotton and G. Wilkinson.
3. Theoretical Inorganic Chemistry by Day and Selbin.
4. Concepts and Models in Inorganic Chemistry by Douglas, B; McDaniel, D and Alexander, J. Wiley: New York Third Edition 1994
5. Introductory Quantum Chemistry by A. K. Chandra (Tata McGrawhill)
6. Chemistry of Lnathanides by T. Healler, chapman and Hall.
7. Chemical Applications of Group Theory by B.A. Cotton.
8. Basic concepts of Nuclear Chemistry by R.T. Overmann.
9. Introduction to Nuclear Science by M.N.Sastri, East West Press, Madras.

7T2/ PAPER-II: ORGANIC CHEMISTRY

Aliphatic Electrophilic Substitution: Bimolecular mechanisms- SE_2 and SE_i - Unimolecular Mechanism - SE_1 , Electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity. The Haloform reaction and Haller-Bauer Reaction

Mechanisms of Some Typical Name Reactions: Favorskii, Wagner-Meerwein, Neber, Hofmann, Schmidt, Lossen, Curtius, Beckmann, Baeyer-Villiger, Fries, Stevens, Wittig Rearrangements; Michael and Mannich Reactions; Pinacol-Pinacolone Rearrangements. The Von Richter, Sommelet-Hauser and Smiles Rearrangements

Free Radicals: Basic concept of Free radical formation, their stability and polymerisation.

Organic Photochemistry: Jablonski diagram - Cis-Trans Isomerism, Paterno-Buchi Reaction, Norrish Type I and II reactions-Barton reaction- Photoreduction of ketones- Di-Pi methane rearrangement, Photochemistry of Arenes.

Pericyclic Reactions: Definition – Classification - Selection Rules and Stereochemistry of Electrocyclic Reactions, Cycloaddition and Sigmatropic Shifts, Cope and Claisen Rearrangements – Diels–Alder Reaction.

Chemistry Of Natural Products: Classification, Isolation, Synthesis and Structural Elucidation of the following:

- Terpenoids: Farnesol and Santonin
- Alkaloids : Morphine and Reserpine
- Steroids : Cholesterol
- Purines : Caffeine

Recommended Books :

1. A Guide book to Mechanisms in Organic Chemistry by Peter Sykes : ELBS.
2. Organic chemistry, Vol. I (6th Edn.) and Vol. II (5th Edn.) by I. L. Finar, ELBS.
3. Organic Chemistry by Mukherjee, Singh and Kapoor, Vols. I. and II, Wiley Eastern
4. Reaction Mechanism in Organic chemistry by Mukherjee and Singh, Macmillan India.

Reference Books

1. Advanced Organic Chemistry by Jerry March, Wiley Eastern.
2. Chemistry of Natural Products by K.W. Bentley (Ed.).

7T3/ PAPER-III: PHYSICAL CHEMISTRY

Adsorption: Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro-kinetic phenomenon), catalytic activity at surfaces.

Micelles: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization

Liquid Crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic-nematic transition and clearing temperature - homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases,

Electrophoresis: Migration of an Ion in an Electric field - Factors affecting electrophoretic Mobility – Types of Electrophoresis – Free Electrophoresis, Zone Electrophoresis - General Techniques - Paper Electrophoresis, Cellulose Acetate, Gel Electrophoresis, Specialized Electrophoresis Technique - Discontinuous (Disc) Gel Electrophoresis, Gradient Electrophoresis, High Voltage Electrophoresis (HVE), Electrophoresis in Genetic Analysis - Restriction mapping, Southern Transfer, Gel Retardation or Band Shift Assay, DNA Sequencing, DNA Foot Printing.

Recommended Books :

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Chemical Kinetics, K. J. Laidler, Mcgraw-Hill.
3. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
4. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenun
5. A text book of Engineering Chemistry .S.S.Dara –S.Chand&Co.New Delhi
6. Thermotropic Liquid Crystals, Ed., G.W. Gray, John Wiley.
7. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.
8. Bio-Physical Chemistry- Principles and Techniques by Avinash Upadhyay, K.Upadhyay and Nirmal Nadh

7T4/ PAPER-IV: QUANTUM CHEMISTRY

Quantum Mechanics: Introduction, Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

Approximate Methods: The variation theorem, linear variation principle. Perturbation theory (first order and non degenerate). Applications of variation method and perturbation theory to the Helium atom.

Angular Momentum: Ordinary angular momentum, generalized angular momentum, eigenfunctions for angular momentum, eigenvalues of angular momentum, operator using ladder operators, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

Electronic Structure of Atoms: Electronic configuration, Russell-Saunders terms and coupling schemes, Slater-Condon parameters, term separation energies of the pn configuration, term separation energies for the dn configurations, magnetic effects: spin-orbit coupling and Zeeman splitting, introduction to the methods of self-consistent field, the virial theorem.

Born-Oppenheimer Approximation: Hydrogen molecule ion. LCAO-MO and VB treatments of the hydrogen molecule; electron density, forces and their role in chemical binding. Hybridization and valence MOs of H₂O, NH₃ and CH₄. Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical and cyclobutadiene.

Recommended Books :

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, AK Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, A. McWeeny, ELBS.

7T5/ PAPER-V: MINERAL BASED INDUSTRIES AND CORROSION

Ferrous and non-ferrous industries: Quality-control methods-General principles applied in studying an industry-Manufacture of iron ,steel and special steels Metallurgy of gold and silver.

Explosives: Classification, characteristics-special explosives- nitrocellulose-T.N.T Picric acid Dynamite-cordite and Gunpowder.

Ceramics: Classification of Ceramics –Basic raw material- Application of colours to pottery porcelain and Chinaware - manufacture. Glass: Raw materials, Manufacture of special glass-Optical , Borosilicate, Flint and Coloured glasses.

Industrial Poisons: Industrial poisons and their classification - solid liquid and gaseous poisons-their identification- physiological activity and control. Solids: Pb, As, Hg, asbestos, textile fibres. Liquids: organic solvents, Gases: Oxides of S, N and H₂S, Cyanides, Aldehydes, Ketones and Hydrocarbons.

Corrosion: Basic concepts of Corrosion- Dry or Chemical Corrosion - Mechanism - Pilling-Bedworth Rule - Wet or Electrochemical Corrosion - Mechanism - Types of Corrosion- Factors influencing corrosion - Thermodynamics and Kinetics of Corrosion Reactions - Some important corrosion control methods - Cathodic Protection - Anodic Inhibitors

Protective Coatings: Metallic coatings Galvanising and Tinning Metal cladding Electro plating – Metallised Coatings Chemical Conversion or Inorganic Coatings- Phosphate, Chromate, Chemical Oxide or Anodized Coatings.

Recommended Books:

1. Chemical process industries by R.N. Shreeve.
2. Applied chemistry for Engineer by Diamont.
3. Industrial poisons and solvents by Jacobs.
4. Chemistry of Engineering materials by Jain & Jain.
5. Engineering Chemistry by B.K.Sharma.
6. Environmental Chemistry by B.K.Sharma.
7. Corrosion, Volume-I, Metal Environment Reactions by L. L. Shreir, Newnes Butterworths, London.
8. Corrosion Engineering by Fontana and Greene, McGraw Hill Publication.

7P1/ PRACTICAL-I: INORGANIC CHEMISTRY PRACTICAL

Synthesis Inorganic Complex Compounds

Preparation of inorganic complex compounds and their characterisation

Some suggested complex compounds

- (1) $\text{VO}(\text{acac})_2$
- (2) $\text{TiO}(\text{C}_9\text{H}_8\text{NO})_2 \cdot 2\text{H}_2\text{O}$
- (3) $\text{cis-K}[\text{Cr}(\text{C}_2\text{O}_4)_2(\text{H}_2\text{O})_2]$
- (4) $\text{Na}[\text{Cr}(\text{NH}_3)_2(\text{SCN})_4]$
- (5) $\text{Mn}(\text{acac})_3$
- (6) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
- (7) $[\text{Co}(\text{NH}_3)_6][\text{Co}(\text{NO}_2)_6]$
- (8) $\text{cis-}[\text{Co}(\text{trien})(\text{NO}_2)_2]\text{Cl} \cdot \text{H}_2\text{O}$
- (9) $\text{Hg}[\text{Co}(\text{SCN})_4]$
- (10) $[\text{Co}(\text{Py})_2\text{Cl}_2]$
- (11) $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$
- (12) $\text{Ni}(\text{dmg})_2$
- (13) $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$

Recommended Books :

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS
2. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly, Prentice Hall

7P2/ PRACTICAL-II: ORGANIC CHEMISTRY PRACTICAL

Synthesis of Organic Compounds

Multistage synthesis of organic compounds involving three or more stages stages.

Purification and characterization of the synthesised compounds.

List of some suggested compounds.

1. p-Bromophenol
2. o-Chlorobenzoic acid
3. Paracetamol
4. p-Nitrophenylhydrazine
5. p-Nitrophenylazo β -naphthol
6. 2,4,5-Trimethoxybenzaldehyde

Recommended Books :

1. A Textbook of Practical Organic Chemistry by A. I. Vogel, ELBS and Longman group.
2. Practical Organic Chemistry by Mann and Saunders, ELBS and Longman group

MODEL QUESTION PAPER

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VII SEMESTER

Paper I: INORGANIC CHEMISTRY

Time: 3 Hours

Max. Marks: 70

*Answer any FIVE questions.
All questions carry equal marks*

- 1 (a) Explain ligand substitution reactions in octahedral complexes
(b) Write a note on Electrophilic and Nucleophilic reagents
- 2 (a) Explain Metal Substitution and Displacement Reactions
(b) Explain Acid and Base hydrolysis reactions of Cobalt (II) complexes
- 3 (a) Explain the Trans effect and its uses
(b) Briefly explain various theories of trans effect
- 4 (a) Write the mechanism of trans effect
(b) Explain the factors involved in the substitution reactions in square planar complexes
- 5 (a) Write the mechanism for one electron transfer reaction
(b) Explain the inner sphere mechanism
- 6 (a) Explain the structure and bonding in binuclear complexes with suitable examples
(b) Explain outer sphere mechanism
- 7 (a) Explain the separation of Lanthanides and Actinides
(b) Write the uses of Lanthanides and their compounds

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VII SEMESTER

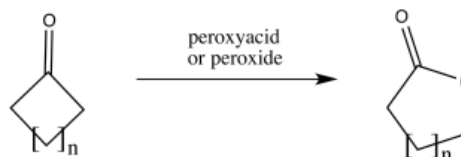
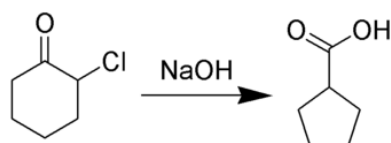
Paper II: ORGANIC CHEMISTRY

Time: 3 Hours

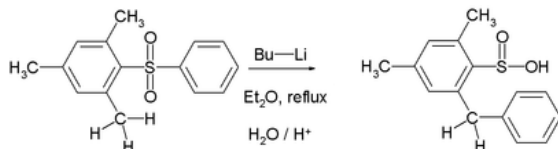
Max. Marks: 70

*Answer any FIVE questions.
All questions carry equal marks*

- Briefly explain bimolecular mechanism in aliphatic electrophilic substitution
 - Explain the mechanism of Haller-Bauer Reaction
- Write reaction, mechanism for the following with suitable examples
 - Wagner-Meerwein reaction
 - Pinacol-Pinacolone rearrangement
 - Wittig reaction
- Write the mechanism for the following
 -
 -



iii)



- Explain the formation and stability of free radicals
 - Write any two reactions and their mechanism involving free radicals
- Explain the Jablonski diagram in relation to absorption, fluorescence and phosphorescence
 - Explain Paterno-Buchi Reaction with mechanism
- Explain the selection rules and stereochemistry of electrocyclic reactions
 - Explain Cope and Claisen rearrangements with mechanisms
- Briefly explain the structural elucidation of Morphine
 - Explain the isolation and synthesis of Caffeine

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VII SEMESTER

Paper III: PHYSICAL CHEMISTRY

Time: 3 Hours

Max. Marks: 70

*Answer any FIVE questions.
All questions carry equal marks*

- 1 (a) Explain Surface Tension and pressure difference across curved surfaces
(b) Explain the Gibbs absorption isotherm
- 2 (a) Explain the determination of surface area by BET equation
(b) Explain catalytic activity at surfaces
- 3 (a) Write the classification of surface active agents
(b) Explain the factors affecting Critical Micellar Concentration
- 4 (a) Explain the concept of Micellization and hydrophic interactions
(b) Explain the thermodynamics of micellization
- 5 (a) Explain the mesomorphic of liquid crystals
(b) Explain molecular arrangement in smectic A and smectic C phases
- 6 (a) Explain factors affecting electrophoretic mobility
(b) Explain different types of electrophoresis
- 7 (a) Explain Disc Gel Electrophoresis and Gradient Electrophoresis
(b) Explain the application of electrophoresis in DNA sequencing and DNA footprinting

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VII SEMESTER

Paper IV: QUANTUM CHEMISTRY

Time: 3 Hours

Max. Marks: 70

*Answer any FIVE questions.
All questions carry equal marks*

- 1 (a) Derive Schrodinger equation to a particle in a box
(b) Explain harmonic oscillator and the rigid rotor
- 2 (a) Briefly explain the postulates of quantum mechanics
(b) Explain the application of variation method to the Helium atom
- 3 (a) Explain eigen functions and eigen values of angular momentum
(b) Explain the variation theorem and linear variation principle
- 4 (a) Explain Russell-Saunders terms and coupling schemes
(b) Explain term energies for pn and dn configurations
- 5 (a) Explain the methods of self consistent field
(b) Explain Spin-orbit coupling and Zeeman splitting
- 6 (a) Write the LCAO-MO approximation applied to Hydrogen
(b) Explain the Huckel theory of conjugated systems
- 7 (a) Explain the electron density forces and their role in chemical bonding
(b) Explain the Molecular Orbital diagram of water

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VII SEMESTER

Paper V: MINERAL BASED INDUSTRIES AND CORROSION

Time: 3 Hours

Max. Marks: 70

*Answer any FIVE questions.
All questions carry equal marks*

- 1 (a) Write about the quality control methods in Ferrous industries.
(b) Write the manufacture of steel.
- 2 (a) Explain the metallurgy of gold.
(b) Explain factors affecting corrosion
- 3 (a) Write the manufacture of gun powder and picric acid.
(b) Explain the manufacture of nitrocellulose and TNT
- 4 (a) Write the applications of colours to porcelain and Chinaware.
(b) Write the manufacture of flint glass and optical glass.
- 5 (a) Write the classification of industrial poisons with suitable examples.
(b) Explain the physiological activity and control of sulphur and hydrocarbons.
- 6 (a) Describe the theory and mechanism of wet corrosion with equation.
(b) Describe the kinetics of corrosion reactions.
- 7 (a) Explain the principle and applications of electroplating.
(b) Write the use metallic coatings as protective methods of corrosion.