Devrukh Shikshan Prasarak Mandal's

Nya. Tatyasaheb Athalye Arts, Ved. S.R. Sapre Commerce and Vid. Dadasaheb Pitre Science College

(Autonomous)

Late Kakasaheb Pandit Educational Campus,

Devrukh, Dist: Ratnagiri- 415 804, Maharashtra

NAAC Accredited 'A' Grade (Third Cycle), Mumbai University Best College Award 2009-10

Syllabus

Programme: T. Y. B. Sc.

Course- Inorganic Chemistry

w.e.f. Academic Year 2021-22

Choice Based Credit System
T. Y. B. Sc.
Chemistry Syllabus
To be implemented from the Academic year 2021-22

Course Content

Semester VI

Course Code	Unit	Topics	Credits	L/Week
USCHT61	I	Chemical Thermodynamics & Chemical Kinetics		
	II	Polymers & Renewable Sources		
	III	Quantum Chemistry & Applied Electrochemistry		
	IV	NMR & ESR Spectroscopy		
USCHT62	I	Coordination Chemistry		
	II	Properties of Coordination Compounds		
	III	Organometallic Chemistry		
	IV	Some Selected Topics		
USCHT63	I	Stereochemistry & Biomolecules		
	II	Molecular Rearrangements & Carbohydrates		
	III	Spectroscopy-II		
	IV	Polymers; Catalysts & Reagents		
USCHT64	I	Electro Analytical Techniques		
	II	Methods of Separation-II & Introduction to Quality		
	III	Food and Cosmetics Analysis		
	IV	Thermal Methods and Analytical Method Validation		
USCHP61		Chemistry Practicals I		
USCHP62		Chemistry Practicals II		
USCHP63		Chemistry Practicals III		
USCHP64		Chemistry Practicals IV		

T.Y.B.Sc. Syllabus Chemistry Paper-II
Inorganic Chemistry

Semester VI

Unit I: COORDINATION CHEMISTRY (15L)

1.1 Theories of metal-ligand bond (11L)

1.1.1 Recapitulation of VBT and its limitations.
1.1.2 Crystal Field Theory and effect of crystal field on central metal valence orbitals in various geometries from linear to Octahedral (from coordination number 2 to coordination number 6)
1.1.3 Splitting of d orbitals in octahedral, square planar and tetrahedral crystal fields.
1.1.4 Distortions from the octahedral geometry:
(i) effect of ligand field (ii) Jahn-Teller distortions.
1.1.5 Crystal field splitting parameters Δ; its calculation and factors affecting it in octahedral complexes, Spectrochemical series.
1.1.6 Crystal field stabilization energy (CFSE), calculation of CFSE for octahedral complexes with d^0 to d^{10} metal ion configurations.
1.1.7 Consequences of crystal field splitting on various properties such as ionic radii, hydration energy and enthalpies of formation of metal complexes of the first transition series.
1.1.8 Limitations of CFT
1.1.9 Evidences for covalence in metal complexes
(i) intensities of d-d transitions (ii) ESR spectrum of $[IrCl_6]^{2-}$ (iii) Nephelauxetic effect.

1.2 Molecular orbital Theory for coordination compounds (4L)

2.1.1 Identification of the central metal orbitals and their symmetry suitable for formation of σ bonds with ligand orbitals.
2.1.2 Construction of ligand group orbitals.
2.1.3 Construction of σ-molecular orbitals for an ML_6 complex.
2.1.4 Effect of π-bonding on complexes.
2.1.5 Examples like $[FeF_6]^{-4}$, $[Fe(CN)_6]^{-4}$, $[FeF_6]^{-3}$, $[Fe(CN)_6]^{-3}$, $[CoF_6]^{-3}$, $[Co(NH_3)_6]^{+3}$

Unit II: PROPERTIES OF COORDINATION COMPOUNDS (15L)

2.1 Stability of Metal-Complexes (4L)

2.1.1 Thermodynamic and kinetic stability of metal complexes with examples.
2.1.2 Stability constants: stepwise and overall stability constants and their interrelationship.
2.1.3 Factors affecting thermodynamic stability. (Factors related to nature of central metal atom, nature of ligand, chelate effect to be discussed).

2.2 Reactivity of metal complexes (4L)

2.2.1 Comparison between Inorganic and organic reactions.
2.2.2 Types of reactions in metal complexes.
2.2.3 Inert and labile complexes: correlation between electronic configurations and lability of complexes.
2.2.4 Ligand substitution reactions: Associative and Dissociative mechanisms.
2.2.5 Acid hydrolysis, base hydrolysis and Anation reactions.

2.3 Electronic Spectra (7L)

2.3.1 Origin of electronic spectra
2.3.2 Types of electronic transitions in coordination compounds: Intra-ligand, Charge transfer and

Intra-metal transitions.
2.3.3 Selection rules for electronic transitions.

2.3.4 Electronic configuration and electronic micro states, coupling of spin momenta (M_s), orbital momenta (M_l) and Spin-Orbit coupling or Russell-Saunders coupling.
2.3.5 Terms and Term symbols, Determination of Terms for p^2 and d^2 electronic configuration
2.3.6 Terms and micro-states for transition metal atoms/ions.

Unit III: ORGANOMETALLIC CHEMISTRY (15L)

3.1 Organometallic Compounds of main group metal (6L)
3.1.1 General characteristics of various types of organometallic compounds, viz. ionic, σ-bonded and electron deficient compounds.
3.1.2 General synthetic methods of organometallic compounds:
(i) Oxidative-addition (ii) Metal-metal exchange(transmetallation) (iii) Carbanion-halide exchange (iv) Metal-hydrogen exchange (Metallation) (v) Methylene insertion reactions.
3.1.3 Some chemical reactions of organometallic compounds:
(i) Reactions with oxygen and halogens (ii) Alkylation and arylation reactions (iii) Reactions with protic reagents (iv) Redistribution reactions (v) Complex formation reactions.

3.2 Metallocenes (5L)
Introduction, Ferrocene: Synthesis, properties, structure and bonding on the basis of VBT.

3.3 Catalysis (4L)
3.3.1 Comparison between homogeneous and heterogeneous catalysis
3.3.2 Basic steps involved in homogeneous catalysis
3.3.3 Mechanism of Wilkinson's catalyst in hydrogenation of alkenes.

Unit IV: SOME SELECTED TOPICS (15L)

4.1 Metallurgy (7L)
4.1.1 Types of metallurgies.
4.1.2 General steps of metallurgy; Concentration of ore, calcinations, roasting, reduction and refining.
4.1.3 Metallurgy of copper: occurrence, physicochemical principles, Extraction of copper from pyrites & refining by electrolysis.

4.2 Chemistry of Group 18 (5L)
4.2.1 Historical perspectives
4.2.2 General characteristics and trends in physical and chemical properties
4.2.3 Isolation of noble gases
4.2.4 Compounds of Xenon (oxides and fluorides) with respect to preparation and structure (VSEPR)
4.2.5 Uses of noble gases

4.3 Introduction to Bioinorganic Chemistry (3L)
4.3.1 Essential and non-essential elements in biological systems.
4.3.2 Biological importance of metal ions such as Na^+, K^+, Fe^{+2}/Fe^{+3} and Cu^{+2} (Role of Na^+ and K^+ w.r.t ion pump

Reference Books:

Inorganic Chemistry

1. D. Banerjea, Coordination chemistry, Tata McGraw Hill, New Delhi, (1993).
2. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd Ed., Oxford University Press, (1999).
3. N. N. Greenwood and E. Earnshaw, Chemistry of elements,Pergamon Press, Singapore, (1989).
4. W. L. Jolly, Modern inorganic chemistry, 2nd Ed. McGraw Hill Book Co., (1991).
5. B. E. Douglas and H. McDaniel, Concepts and models in inorganic chemistry, 3rd Ed., John Wiley & Sons, Inc., New York, (1994).
6. G. N. Mukherjee and A. Das, Elements of bioinorganic chemistry, Dhuri and Sons, Calcutta, (1988).
7. R. W. Hay, Bioinorganic chemistry, Ellis Harwood, England, (1984).
8. R. C. Mehrotra and A. Singh, Organometallic chemistry: A unified approach, Wiley Eastern, New Delhi, (1991)