M G Science Institute, Ahmedabad

(Autonomous college affiliated to Gujarat University)

B. Sc. in Chemistry

(Faculty of Science)

New Syllabus of

S. Y. B. Sc. Chemistry

(As Per National Education Policy- 2020)

To be implemented from Academic Year 2025-26

Board of Studies (Chemistry)

M G Science Institute, Ahmedabad

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B. Sc. SEMESTER – III

CHM 231(T): Inorganic Chemistry

Credit – 4, Hours – 60, Marks - 100

Course Outcomes:

After the completion of this course, student will be able to-

CO-1. Gain the fundamental knowledge of valence bond and molecular orbital theory, MO diagram of different types of molecules, Hybridization in complexes, Crystal field theory and splitting, Quantum mechanics, Operators, Different types d-block elements.

CO-2. Understand the basic concepts of valence bond and molecular orbital theory**,** mixing of orbitals, Particle in one dimensional box and ring, Crystal field theory and crystal field stabilization energy, Electronic configuration and properties of d- block elements.

CO-3. Solve the problems regarding bond order, stability of the molecules, CFSE of the complexes, wave mechanics, different types of compounds d- block elements and their preparations, occurrence and uses.

CO-4. Analyse and correlate the facts regarding bonding in the molecules, complexes, different equations of quantum mechanics, colour and magnetic properties of d- block elements.

CO-5. Evaluate and criticize the principles of chemical bonding, shape of the molecules and crystal field splitting in different complexes, solutions of different wave equations and formation of different compounds of d- block elements.

CO-6. Create, modify and synthesise the facts of molecular orbital diagram of different molecules, formation of different complexes, wave mechanics and comparison between transition and non-transition elements.

CO-PSO mapping (connecting COs with PSOs)

The mapping is a matrix with rows and columns as PSOs

Each element/cell of the matrix has a value in {--, 1,2,3}

The meaning associated with the values are as follows:

-- this CO (row) has nil/insignificant contribution to the PSO (column)

1 Relevant and small significant

2 Medium and moderate significant

3 Strong and high level of significant

These values have to be justified in the T-L-A of the course, particularly in terms of the BLOOM level of the question/problems

CO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	2	2	2	3
CO-2	3	3	2	2	2	3
CO-3	2	2	3	2	3	2
CO-4	3	2	3	3	2	3
CO-5	3	2	3	2	3	3
CO-6	3	3	2	2	3	3

Unit – I: Chemical Bonding **[25 Marks]**
[15 Hours]

Introduction, Valence bond theory of bond formation and its limitations (Heitler and London approach), Formation of H_2 molecule by valence bond theory, Molecular orbital Theory, LCAO Method, conditions for the combination of atomic orbitals to form molecular orbitals, bonding and antibonding, σ and π molecular orbitals, mixing of orbitals and formation of molecular orbitals, energy level diagram for molecular orbitals, rules for filling up of electrons to molecular orbitals, Bond order and its calculation, relation between the stability of molecules and bond order, bond strength and bond energy, Molecular orbital diagrams of heteronuclear diatomic molecules (CO, NO, NO^+, CN^-, HF, HCl), Molecular orbital diagrams of heteronuclear polyatomic molecules (BeH_2, NH_3), Molecular orbital diagrams of $[CoF_6]^{-3}$ and $[Co(NH3)_6]^{+3}$, Band Theory for metals.

Unit – II: Coordination Chemistry **[25 Marks]**
[15 Hours]

Introduction, Valence bond theory of complexes, examples of ML_4 and ML_6 type complexes, Limitations of Valence bond theory, Crystal Field Theory, Crystal Field Splitting in octahedral, tetrahedral, and square Planar complexes, Crystal Field Stabilization Energy (CFSE) with examples, Examples of calculation of CFSE in octahedral and tetrahedral complexes in weak ligand field (high spin) and strong ligand field (low spin), factors affecting the magnitude of crystal field Splitting (Δ),

Application of crystal field theory (colour of transition metal complexes, magnetic property of complexes), Jahn- Teller Effect.

Unit – III: Wave Mechanics **[25 Marks]**
[15 Hours]

Introduction, Derivation of time independent Schrodinger's Wave Equation, Conditions for acceptable wave function, Physical interpretation of ψ , ψ^2 and $\psi\ \psi^*$, Condition of normalisation of wave function, condition of orthogonality, Degeneracy, Orthonormal set of wave function, Operators, Operator algebra, Addition, Subtraction and multiplication of operators, commuting operators, Commutators, Linear operator, Vector operator, Laplacian operator, Eigenvalue, Eigenvalue function and Eigen value equation, Postulates of quantum mechanics, time dependent Schrodinger's Wave Equation, Particle in one dimensional box, Zero point energy.

Unit – IV: d - Block Elements **[25 Marks]**
[15 Hours]

Position, Electronic configuration and classification d-block element in the periodic table.

Characteristics of d-block Elements : metallic Character, Atomic Volume and densities, Melting point and Boiling point, Atomic Radii, Ionic Radii, Ionization Potentials, Oxidation states, Standard reduction potentials and reducing properties, Formation of colored compounds, Magnetic properties, Tendency to form complexes, Formation of non-stoichiometric compounds, catalytic properties, formation of alloy, Comparison between transition and non-transition elements.

Extraction, properties and use of some d-block elements: Copper, Platinum, gold, silver, Titanium, Iron.

Some compound of d-block elements (Preparation, properties and use):

Compound of Copper: Cuprous Oxide, Cuprous Chloride, Cupric Sulphate

Compound of Zinc: Zinc Oxide, Zinc Chloride.

REFERENCE BOOKS

1. '**Concise Inorganic Chemistry**' by J. D. Lee, 5th Ed., 2013, Wiley India.
2. '**Inorganic Chemistry'** by Shriver & Atkins, 5th Ed., 2013, Oxford University Press.
3. **'Modern Inorganic Chemistry'** by Dr. R. D. Madan, 1987, S. Chand, New Delhi.
4. '**Basic Inorganic Chemistry'** by F. A. Cotton, Geoffrey Wilkinson, Carlos A Murilloand Manfred Bochmann, 6th Ed., Wiley publication.

5.‘**Quantum chemistry’** by R. K. Prasad, 2nd Ed.,1996, New Age International publishers.
6.‘**Elements of Quantum Mechanics**’ by Michael D. Fayer, Indian Ed., 2001, Oxford University Press.
7. **‘Principles of Inorganic Chemistry’** by Puri, Sharma and Kalia, 2018, Vishal Publishing Co., Jallandhar – Delhi.
8.‘**Introductory Quantum Chemistry’** by A. K. Chandra, 4th Ed., 2017, Tata Mc Graw Hill PublishingCompany Limited, New Delhi.