Inorganic Chemistry II – 24732
Syllabus

Prof. Jhon Fredy Pérez Torres

1 Prerequisites

- Inorganic Chemistry I

2 Learning outcomes

At the end of this assignature students should be able to:

- Apply the point group theory to chemistry problems
- Recognize electronic configuration of symmetrical molecules
- Name coordination compounds from the chemical formulas and vice versa
- Apply the ligand field theory to chemistry problems
- Explain in detail the UV-Vis-NIR absorption/emission spectra of transition metal compounds
- Determine molecular spectroscopy terms from electronic configuration

3 Topics

1. Point Group Theory (15h)
   - 1.1. Introduction to group theory (week 1, 3h)
     - 1.1.1. Definitions
     - 1.1.2. Cayley tables
     - 1.1.3. Matrix representation of symmetry operations
     - 1.1.4. Conjugacy classes of a group
     - 1.1.5. Exercises
   - 1.2. Character tables (week 2, 3h)
     - 1.2.1. Irreducible representations and characters
     - 1.2.2. The orthogonality theorem
     - 1.2.3. High symmetry point groups
     - 1.2.4. Exercises
   - 1.3. Projection operators I (week 3, 3h)

1.3.1. Definitions
1.3.2. Vibrational normal modes
1.3.3. Selection rules in Raman and IR spectroscopy
1.3.4. Exercises

1.4. Projection operators II (week 4, 3h)
1.4.1. Symmetry adapted atomic orbitals
1.4.2. Symmetry adapted molecular orbitals
1.4.3. Electronic configuration of symmetrical molecules
1.4.4. Exercises

1.5. Examination (week 5, 3h)

2. Introduction to Coordination Chemistry (15h)

2.1. Coordination compounds (week 6, 3h)
2.1.1. The Lewis acids-bases concept: coordination complexes
2.1.2. Nomenclature of coordination compounds
2.1.3. Isomerism in coordination compounds
2.1.4. Exercises

2.2. Ligand field theory I (week 7, 3h)
2.2.1. Multipole expansion of the O_h ligand field
2.2.2. Perturbative treatment of d atomic orbitals in O_h ligand field
2.2.3. Exercises

2.3. Ligand field theory II (week 8, 3h)
2.3.1. The ligand field parameters Dq, Ds and Dt
2.3.2. Splitting of d atomic orbitals in different simmetries
2.3.3. Exercises

2.4. Transition metal complexes (week 9, 3h)
2.4.1. The stabilization energy
2.4.2. The spectrochemical series
2.4.3. Magnetic properties of transition metal complexes
2.4.4. Exercises

2.5. Examination (week 10, 3h)

3. UV-Vis-NIR Spectroscopy of Coordination Compounds (18 h)

3.1. Atomic term symbols of transition metals (week 11, 3h)
3.1.1. The Russell-Saunders coupling scheme
3.1.2. The Racah parameters B and C
3.1.3. Exercises

3.2. Molecular term symbols of coordination compounds (week 12, 3h)
3.2.1. Permutation group theory
3.2.2. Irreducible representations and characters of permutation groups

3.2.3. The Young tableaux
3.2.4. The $t_{2g}^n e_g^m$ electronic configurations
3.2.5. Exercises

3.3. Determination of the ligand field (Dq) and Racah (B, C) parameters (week 13, 3h)
3.3.1. The Tanabe-Sugano and Auxiliary Tanabe-Sugano diagrams
3.3.2. The nephelauxetic series
3.3.3. The Ruby laser
3.3.4. Exercises

3.4. Molecular orbital theory of transition metal complexes (week 14, 3h)
3.4.1. Symmetry adapted ligand molecular orbitals
3.4.2. Hückel description of acetylacetonato based transition metal complexes
3.4.3. Exercises

3.5. Ligand-metal and metal-ligand charge transfer (week 15, 3h)
3.5.1. UV-Vis absorption spectrum of the permanganate molecular ion
3.5.2. Photochemical processes initiated by charge transfers
3.5.3. Exercises

3.6. Examination (week 16, 3h)

4 Grading

- 3 exams (25%, 25%, 25%)
- Self–study work (25%)