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# COMPLEMENTS OF INORGANIC CHEMISTRY

CHIM/03 - 6 CFU - 1° Semester

## Teaching Staff

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## LEARNING OBJECTIVES

Acquire knowledge about metallic and ionic solids, polyelectronic atom, electronic states, crystal field and MO theories, inorganic and organometallic materials.

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## DETAILED COURSE CONTENT

### 1. SOLID STATE (12-hour module)

Crystal structures: chemical and crystallographic repeat unit, connection and coordination numbers, coordination polyhedra; octahedral and tetrahedral structures. Crystallographic parameters. Classification of solids; metallic solids, symmetry elements, packing of spheres, compact structures: hexagonal (hcp) and cubic compact (ccp) structures, body centered cubic structure. Not compact structures. Overview of the band theory; insulators, semiconductors and metals. Ionic radii and binary and ternary ionic solids. Important crystal structures: sodium chloride, cesium chloride, fluorite, rutile, zinc blende and wurtzite. Interstitial systems in compact structures: perovskites and spinels. Lattice energy, Madelung constant, Born-Haber cycle. Covalent solids; molecular solids. Outline of defects in solids.

### 2. TRANSITION ELEMENTS (10-hour module)

Particles and waves, the structure of the hydrogen atom, electronic configurations of atoms and ions; ionic radii. Polyelectronic atom, Russell-Saunders coupling, spin-orbit coupling. Magnetic properties. General characteristics of transition elements.

### 3. CFT-LFT-MO THEORIES (14 hour module)

Outline of element and symmetry operations. Classification of ligands: as donor atom; mono- and polydentate; sigma and pi ligands. Crystal field and ligand field theories. MO theory. Octahedral tetrahedral and square planar complexes. Spectrochemical series of ligands. 18 electron rule. High-spin and low spin complexes. Jahn-Teller effect. Notes on the electronic spectra. Coordination complexes and

formation constants of complexes. Stability of complex ions in aqueous solution. Chelation and macrocycle effects.

#### 4. SYSTEMATIC for Classes of compounds (16-hour form)

Chemistry of the elements of the first transition series: general characteristics; preparation, properties and use of the elements. Common compounds: synthesis and reactivity. Organometallic complexes of industrial use. Metal alkyls, alkylidenes, carbenes, carbonyl compounds, cyclopentadienyl compounds. Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu.

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### **TEXTBOOK INFORMATION**

- 1) F. ALBERT COTTON, GEOFFREY WILKINSON, CARLOS A. MURILLO, MANFRED BOCHMANN, Advanced Inorganic Chemistry, 6th Edition - Wiley
  - 2) N. N. GREENWOOD, A. EARNSMAW, Chimica degli Elementi - Piccin
  - 3) W. W. PORTERFIELD, Chimica Inorganica - Zanichelli
  - 4) SHRIVER, ATLINS, LANGFORD, Chimica Inorganica - Zanichelli
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