COURSE DETAIL

STRUCTURAL INORGANIC CHEMISTRY
Country Italy
Host Institution University of Bologna
Program(s) University of Bologna
UCEAP Course Level Upper Division
UCEAP Subject Area(s) Chemistry
UCEAP Course Number 158
UCEAP Course Suffix
UCEAP Official Title STRUCTURAL INORGANIC CHEMISTRY
UCEAP Transcript Title STRUCT INORG CHEM
UCEAP Quarter Units 6.00
UCEAP Semester Units 4.00

Course Description

This course is part of the Laurea Magistrale degree program and is intended for advanced level students. Enrollment is by permission of the instructor. Students acquire knowledge of Coordination Chemistry and are familiar with common theories concerning metal ligand bond, the synthesis and properties of coordination compounds, including most simple organometallic compounds. At the end of the course, students are able to relate the nature of the different metal-ligand combinations with the properties of the complexes and their possible use in different application fields including: catalysis, functional materials, bioinorganic and supramolecular chemistry.

Course contents:

I. The inorganic elements in the periodic table (6 hours)

Non-metals, metalloids and metals in the periodic table: electron configuration, characteristics, bonding, reactivity.

II. Coordination complexes and the metal-ligand bonding (8 hours)

a) General aspects. Metal ions: electron configuration, the d sub-shell in transition metals, the f sub-shell in lanthanides. Ligands: definition, the Lewis acid/base model. Multidentate ligands and chelates. Geometry. Nomenclature.

b) The metal-ligand bonding. The molecular orbital model: octahedral and tetrahedral complexes. Sigma/pi-donor, pi-acceptor ligands. Link with the crystal field theory: high spin/low spin complexes.

III. Spectroscopic investigation of transition metal complexes (12 hours)

a) UV-visible spectroscopy: spectral terms, Orgel diagrams, Tanabe-Sugano diagrams, intervalence charge transfer.

b) Mid-infrared and near infrared spectroscopies: application to carbonyl and cyano complexes, and to organic ligands.

c) Emission spectroscopy: basics, the Jablonski diagram, definition of quantum yield and emission lifetime. Luminescence from organic compounds and heavy-metal complexes and lanthanides.

IV. Reactivity of metal complexes: (18 hours)

a) Contributions to the stabilization energy of complexes: electrostatic interaction, crystal field stabilization energy, the HSAB model. Influence of the size and charge of the metal ion. S-p metals vs. transition metals : comparison.

b) Ligands substitution: inert/labile complexes, link with the crystal field theory, the trans effect.

c) Reactivity in organometallic chemistry: the 18-electron rule, oxidative addition, reductive elimination. Application to homogeneous catalysis

d) Excited states as new chemical species: different energy, lifetime, geometry, dipole moment. The case of [Ru(bpy)3]2+.Application to artificial photosynthesis and solar light harvesting

e).Luminescent metal complexes and lanthanide-based compounds: fundamentals and application to materials (light emitting devices) and life science (bioimaging and biosensing).

f) Photocatalytic processes mediated by transition metal complexes.

Language(s) of Instruction
English

Host Institution Course Number
93770

Host Institution Course Title
STRUCTURAL INORGANIC CHEMISTRY

Host Institution Course Details
https://www.unibo.it/en/study/course-units-transferable-skills-moocs/course-uni...

Host Institution Campus BOLOGNA
Host Institution Faculty
Host Institution Degree LM in ADVANCED SPECTROSCOPY IN CHEMISTRY
Host Institution Department Industrial Chemistry "Toso Montanari"
Course Last Reviewed 2025-2026

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