UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze e Tecnologie Biologiche, Chimiche e Farmaceutiche		
ACADEMIC YEAR	2022/2023		
BACHELOR'S DEGREE (BSC)	CHEMISTRY		
INTEGRATED COURSE	INORGANIC CHEMISTRY WITH LABORATORY		
CODE	13742		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	CHIM/03		
HEAD PROFESSOR(S)	BARONE GIAMPAOLO	Professore Ordinario	Univ. di PALERMO
OTHER PROFESSOR(S)	BARONE GIAMPAOLO BONSIGNORE RICCARDO	Professore Ordinario Ricercatore a tempo determinato	Univ. di PALERMO Univ. di PALERMO
CREDITS	10		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	2		
TERM (SEMESTER)	1° semester		
ATTENDANCE	Mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**BARONE GIAMPAOLO** Tuesday 15:00 17:00 Sede del Consorzio Universitario, corso Vittorio Emanuele, 92, 93100 Caltanissetta Wednesday 15:00 17:00 Studio del docente, viale delle Scienze, Edificio 17, 90128 Palermo **BONSIGNORE RICCARDO** Friday 11:00 12:30 Studio Docente, Viale Delle Scienze Ed.17,Primo piano, P1029		

DOCENTE: Prof. GIAMPAOLO BARONE

PREREQUISITES	Formal prerequisites
LEARNING OUTCOMES	Knowledge and understanding: At the end of the course, the student knows the main properties of transition elements and of their inorganic compounds, as well as the properties, structure and nature of the chemical bond and reactivity of their coordination compounds. The student is able to perform practical exercises concerning the synthesis and characterization of inorganic compounds through the use of instrumental methods. Applying knowledge and understanding: Ability to relate the structure and properties of inorganic compounds to the theoretical models of atomic and molecular properties. Making judgments: The knowledge of the properties of elements and of their inorganic compounds will allow the student to evaluate critically and independently simple problems in the field of inorganic chemistry. Communication: Ability to communicate effectively, in written and oral form, using scientific language. Lifelong learning skills: Ability to analyze, catalog and critically re-elaborate the acquired notions.
ASSESSMENT METHODS	Students' knowledge will be assessed through an oral interview of about 45 minutes, which includes also the evaluation of weekly reports on laboratory activities. The examination will evaluate the following knowledge and skills: - explain the basic concepts of transition metal coordination chemistry; - identify symmetry elements and the point group of molecules; - explain the nature of the chemical bond in coordination compounds through crystal field and molecular orbital theories; - correlate physical and spectroscopic properties and reactivity of transition metal complexes with their geometric and electronic structure; - formulate reaction mechanisms involving metal and organometallic compounds. The final assessment, properly graded, will be made on the basis of the following conditions: a) sufficient knowledge of subjects and theories addressed in the course and sufficient explanation ability; sufficient degree of awareness and autonomy in the application of theories to solve chemical problems (rating 18-21); b) Good knowledge of subjects and theories addressed in the course and discrete explanation ability; fair degree of awareness and autonomy in the application of theories to solve chemical problems (rating 22-25); c) Good knowledge of subjects and theories addressed in the course and good explanation ability; good degree of awareness and autonomy in the application of theories to solve chemical problems (rating 26-28); d) Excellent knowledge of subjects and theories addressed in the course and excellent explanation ability; excellent level of awareness and autonomy in the application of theories to solve chemical problems (rating 29-30L).
TEACHING METHODS	Teaching takes place in the first half of the second year and consists of frontal lectures and practical laboratory exercises. Frontal lectures outline the aims of the course and highlight the basic concepts for the interpretation and prediction of structure, properties and reactivity of metals and of metal compounds. The laboratory activities focus on the synthesis, isolation, purification and analysis of the synthesized compounds.

MODULE
INORGANIC CHEMISTRY

Prof. GIAMPAOLO BARONE

SUGGESTED BIBLIOGRAPHY

- G.L. Miessler, D.A. Tarr, “Chimica Inorganica” IV ed., PICCIN, 2012, ISBN: 88-299-2096-7
- J.E. Huheey, E.A. Keiter, R.L. Keiter, “Chimica inorganica. Principi, strutture, reattivita”, PICCIN, 1999, ISBN: 88-299-1470-3
- Z. Szafran, R.M. Pike, M.M. Singh, “Microscale Inorganic Chemistry: A Comprehensive Laboratory Experience” J. Wiley, Inc., New York, N. Y. 1991, ISBN: 0-471-61996-5

AMBIT	50135-Discipline chimiche inorganiche e chimico-fisiche
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48

EDUCATIONAL OBJECTIVES OF THE MODULE

To provide students with the tools necessary to understand the structure and properties of inorganic and coordination compounds, and to relate them to the theoretical models of atomic and molecular properties. By applying the molecular orbitals and crystal field theories, the student will be able to interpret structure, magnetic properties and electronic spectra of metal complexes, with particular reference to the elements of the d block.

SYLLABUS

Hrs	Frontal teaching
15	Chemistry of coordination compounds. Periodic properties of transition metals. Werner's theory. Lewis acid-base interaction. Structure and symmetry of metal complexes, coordination number, isomerism, ligand types, nomenclature. Crystal field theory; molecular orbitals theory; sigma, pi and delta bonds; inorganic ligands, donation and backdonation. Ligand field stabilization energy (LFSE). Lattice energy and hydration energy of metal cations. Spectrochemical series. Low and high spin complexes, magnetic properties. Octahedral and lower symmetry complexes, Jahn-Teller effect.
12	Electronic spectra of metal complexes. Light absorption, electronic spectra of atoms, spectroscopic terms, spin-orbit coupling and Russell-Saunders rules, microstates and their classification, Racah parameters. Electronic spectra of metal complexes, spectral terms, d-d transitions in the free ion and in the ligand field, selection rules and intensity, Orgel and Tanabe-Sugano diagrams, examples of application of the Tanabe-Sugano diagrams: determination of the octahedral Delta and of the Racah B parameter from the spectra.
5	Reactions and mechanisms of coordination compounds: ligand substitution and oxidation-reduction reactions. Substitutions in square planar complexes: trans effect.
10	Organometallic chemistry, reactions and catalysis. The 18-electron rule and electron counting. Organic ligands and nomenclature. Carbonyl complexes and metal carbonylates. Hydride and dihydrogen complexes. Single and multiple M-C bonds. Linear and cyclic pi-bonds, metallocenes. Metal-metal bonds. Reactions of organometallic complexes: substitution, cone angle of the ligands, oxidative addition and reductive elimination, insertion and elimination. Organometallic catalysts and catalytic cycles: hydrogenation with the Wilkinson catalyst, Ziegler-Natta polymerization.
6	General rules and safety provisions in a chemical laboratory. Description of the experiments to be carried out in the laboratory and of the techniques of isolation, purification and identification of the products obtained. The micro scale laboratory equipment. Micro scale laboratory techniques: use of IR spectroscopy for the identification of the synthesized compounds, preparation of KBr pellets, thermal analysis, crystallization techniques and washing of precipitates, drying, determination of the melting point.

MODULE
INORGANIC CHEMISTRY LABORATORY

Prof. RICCARDO BONSIGNORE

SUGGESTED BIBLIOGRAPHY	
Z. Szafran, R.M. Pike, M.M. Singh, “Microscale Inorganic Chemistry: A Comprehensive Laboratory Experience” J. Wiley, Inc., New York, N. Y. 1991, ISBN: 0-471-61996-5	
AMBIT	10693-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	40
COURSE ACTIVITY (Hrs)	60
EDUCATIONAL OBJECTIVES OF THE MODULE	
The laboratory activities aim at experimentally verifying salient topics of inorganic chemistry through the synthesis and characterization of compounds on a semi-micro scale.	

SYLLABUS

Hrs	Workshops
8	Synthesis and thermal analysis of group 2 (IIA) metal oxalates
8	Tin oxidation states. Synthesis of tin(II) and tin(IV) iodide complexes.
8	Cobalt(II) nitrate hexahydrate thione complexes: IR spectra for the identification of the synthesized compounds
8	Synthesis of copper glycine complexes: cis-bis(glycinato) and trans-bis(glycinato). Characterization of the compounds synthesized by IR spectroscopy.
12	Determination of octahedral Delta in Cr (III) (or Co, Ni) complexes by UV-Vis absorption spectroscopy. Investigation of the chemical equilibria of Cu(II)-ethylenediamine complexes by UV-Vis absorption spectroscopy.
8	Trans effect in platinum(II) complexes: preparation of cis and trans-(dichloro) (dipyridine)platinum(II) and registration of IR spectra.
8	Synthesis of the Wilkinson catalyst, [RhCl(PPh3)3], reaction with aldehydes and recording of IR spectra.