Inorganic Chemistry-2 (Chemistry of 1st Row Transition Metals and of Coordination Compounds)

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA323**	**SEMESTER**	**3rd**
COURSE TITLE	INORGANIC CHEMISTRY-2 (CHEMISTRY OF TRANSITION METALS)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	10
Seminars	1	
Laboratory work	3	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Inorganic Chemistry of Transition Metals-Coordination Chemistry) and Skills Development (Synthetic Inorganic Chemistry).
PREREQUISITE COURSES:	Typically, there are no prerequisite courses. It is recommended that the students should have passed the previous courses "Introduction to Inorganic Chemistry" and "Inorganic Chemistry 1".
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CHEM2062/ https://eclass.upatras.gr/courses/CHEM2061/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

At the end of this course the student should be able to:

1. Recognize d-block elements and write their ground-state electronic configurations.
2. Discuss the oxidation states of d-block elements.
3. Explain the variation of radii, ionization energies and other physical properties of d-block elements both horizontally and vertically within the Periodic Table.
4. Describe occurrence, metallurgy, chemical properties and uses of representative first row d-block metals.

5. Know the basic features of coordination chemistry (definition of the coordination complex, terminology, ligands, coordination numbers, stereochemistry, colours, magnetic properties, stability, isomerism, and applications of the metal complexes).
6. Discuss and analyse the bonding in coordination complexes (valence-bond theory, crystal field theory, molecular orbital theory).
7. Prepare, purify, crystallize and characterize coordination complexes of first-row d-block metal ions.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*Others*
Production of new research ideas	

At the end of the course the student will have further developed the following skills/competences:

1. Ability to demonstrate knowledge and understanding of concepts and principles related to the chemistry of the d-block elements.
2. Ability to demonstrate knowledge and understanding of concepts and principles related to coordination chemistry.
3. Ability to apply such knowledge and in-depth understanding to solve exercises of unfamiliar nature.
4. Ability to interact with others on interdisciplinary problems.
5. Skills enabling the student to synthesize and study coordination complexes.

3. SYLLABUS

1. The first-row d-block metals

a) Definitions.
b) Occurrence, metallurgy and uses.
c) Electronic configurations of atoms and ions.
d) Physical properties.
e) The reactivity of the metals.
f) Characteristic properties (colour of their compounds, paramagnetism, complex formation).

2. Descriptive chemistry of titanium, iron and copper

For each metal:

a) Occurrence, extraction and uses.
b) Physical properties.
c) Reactions.

3. Basic coordination chemistry

a) Historical background.
b) The coordination complex: Definitions and the Werner era.
c) Ligands (monodentate, bidentate, polydentate, terminal, bridging).
d) Coordination numbers and geometries.
e) Nomenclature
f) Isomerism in d-block metal complexes (ionization isomers, hydration isomers, coordination isomers, linkage isomers, polymerization isomers, geometrical isomers, optical isomers).
g) Applications of coordination complexes in technology, biology and medicine.

h) Stability constants of coordination complexes.

4. Bonding in d-block metal complexes

a) Valence Bond Theory (hybridization schemes, applying VBT).

b) Crystal Field Theory (the octahedral crystal field, crystal field stabilization energy, high- and low-spin octahedral complexes, the tetrahedral crystal field, the square planar crystal field, spectrochemical series of ligands, colours of metal complexes).

c) Molecular Orbital Theory (octahedral complexes, complexes with no metal-ligand π bonding, complexes with metal-ligand π bonding).

5. Laboratory exercises

a) Synthesis, purification and crystallization of d-block metal compounds and complexes, such as the double nickel(II)/ammonium/sulfate salt, potassium dichromate, potassium/chromium(III) alum, hexaamminonickel(II) chloride and bromide, bis(dimethylglyoximato) nickel(II), catena-tetra(μ-thiocyanato) cobalt(II) mercury(II), catena-tetrakis(aspirinato)dicopper(II), copper(I)chloride, bis(aquo)tetrakis (acetato) dichromium(II), octahedral cobalt(III) ammino complexes, etc.

b) Characterization of the above-mentioned compounds by means of conductivity measurements, room-temperature magnetochemistry, IR and UV/VIS/ligand field spectroscopies.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, seminars and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. Use of ICTs in the seminars providing information on the theory and practice of the laboratory experiments and the methodology for multi-step syntheses.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks)-solving of representative problems	13
Laboratory work (3 contact hours per week x 13 weeks)	39
Final examination (3 contact hours for the Theory and 3 contact hours for the Laboratory Exercises)	6
Hours for private study of the student and preparation of home-works	153
Course total	***250***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1) Written examination of the Theory after the end of the semester. The mark consists 50% of the final grade. Minimum passing grade:5. 2) Written examination in the concepts of the Laboratory exercises. The mark consists the other 50% of the final grade. Minimum passing grade: 5.

5. ATTACHED BIBLIOGRAPHY

1. D. Kessissoglou, P. Akrivos, "Biocoordination Chemistry", Vol. I: Theory, Ziti Publishing Company, 2006.

2. D. Kessisoglou, P. Akrivos, P. Aslanidis, P. Karafiloglou, A. Dendrinou-Samara, "Biocoordination Chemistry", Vol. II: Synthesis and Study of Coordination Compounds, Ziti Publishing Company, 2006.