Course Outline

1) General

SCHOOL	SCIENCE		
DEPARTMENT	CHEMISTRY		
DEGREE	MASTER		
COURSE CODE	**18B7**	**SEMESTER**	**Spring**
COURSE TITLE	Inorganic Complexes and Nanomaterials. Applications as Medicines, Cosmetics and Diagnostic Material		

INDEPENDENT TEACHING ACTIVITIES in the case that the credits are awarded to separate parts of the course e.g. Lectures, Laboratory Exercises, etc. If the credits are awarded uniformly for the entire course, enter the weekly teaching hours and total credits	**TEACHING HOURS PER WEEK**	**CREDITS**
	7	10
Add lines if necessary. The teaching organization and methods used are described in detail in (d).		

COURSE TYPE *general background, special background, general knowledge specialization, skill development*	general background, general knowledge specialization
PREREQUISITE COURSES:	Spring Semester Courses
COURSE AND EXAM LANGUAGE:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS?	It is offered if requested
COURSE WEBSITE (URL)	**https://eclass.uoa.gr/courses/CHEM259/**

(1) LEARNING OUTCOMES

LEARNING OUTCOMES

The learning outcomes, specific knowledge, skills and abilities of an appropriate level that the students will acquire after the successful completion of the course are described.

Consult Appendix A

- *Description of the Level of Learning Outcomes for each course of study according to the Qualifications Framework of the European Higher Education Area*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Annex B*
- *Comprehensive Guide to writing Learning Outcomes*

The aim of this course is to extend the basic principles of metal complexes and nanomaterials chemistry about the synthesis, properties and applications in the fields of health, pharmaceuticals and theranostics, based on specialized knowledge in Inorganic Chemistry. Discussion about the use of inorganic materials in cosmetics will be also performed. The expected learning outcomes are:
to be acquired through a combination of (i) reinforcement of knowledge and their development methodology through lectures, (ii) practice by analyzing examples of synthesis, analysis and expected properties interactively (iii) study of modern literature with an emphasis on both synthesis and analysis of properties.

Upon successful completion of the course, the student is expected to be able to:

1. Understand and explain the formation of metal complexes and factors affecting their stability and applications
2. Will be able to design and select appropriate substitutes for the desired application
3. Will be able to select appropriate oxidation states of metal ions as well as metal ions depending on the desired applications
4. Will be able to select appropriate experiments to study drug-target interaction at the molecular level.
5. Will be able to evaluate the above results.
6. Will be able to consolidate the categorization of nanomaterials (composition, size, shape, surface modification).
7. Will be able to understand and explain the role of nanoparticle characteristics in interactions with biological systems (pathways, toxicity, protein expression)
8. Will be able to plan and organize the development of nanoparticles according to the desired applications.
9. Will be able to organize the biological experiments which will examine materials interaction in biological systems
10. Will be able to explain and analyse metal ion-dependent properties of nanoparticles in the treatment of biological tissues (plasmonic resonance, hyperthermia and phototherapy)
11. Will be able to search the current literature on the domain and to improve their knowledge about the data that occurred.

Knowledge

1. Knowledge and understanding the role of metal ions in biological systems
2. Applications of metal complexes or nanoparticles as theranostic agents
3. Knowledge and understanding of improving cosmetic properties (sunscreens, creams)
4. Knowledge and understanding of spectroscopic and physiometric experiments aimed at evaluating the interactions of complex-target interactions at the molecular level
5. Knowledge and understanding of specific biological experiments in order to evaluate properties

Skills
1. Skill in the design of complexes/nanoparticles in bioapplications
2. Skill in the organization of appropriate synthetic methods for the regulation of nanoparticle characteristics
3. Skill in the processing of results and analysis of various techniques in order to determine the characteristics of nanoparticles
4. Skill in selecting and organizing appropriate spectroscopic experiments to determine the 'drug'-target interaction at the molecular level.
- 5. Skill in selecting and organizing appropriate biological experiments to determine toxicity, biocompatibility and stability in biological fluids

General Skills

Taking into account the general skills that the graduate must have acquired (as stated in the Diploma Appendix and listed below) which of the following is/are the course aimed at?.

Reearch, analysis and synthesis of data and information, using the necessary technologies
Adaptation to new situations
Decision making
Independent work
Teamwork
Working in an international environment
Generating new research ideas
Demonstrating social, professional and ethical responsibility
Promotion of free, creative and inductive thinking

1. Promotion of free, creative and inductive thinking
2. Search, analysis and synthesis of data
3. Adaptation to new situations
4. Group work
5. Autonomous work
6. Generation of new research ideas
7. Work in an international environment

(2) COURSE CONTENT

The following points are discussed in the lesson:
1. Basic principles of Inorganic Biological Chemistry.
2. Synthesis methodology of metal complexes and nanomaterials with biological interest

3. Design of ligands for the development of metal complexes with medicinal interest and multiple targets (e.g. anticancer and antimalarial)
4. Study of drug-target interaction (DNA, proteins) at the molecular level using UV-vis, cyclic voltammetry, viscometry.
5. Study of inorganic complexes and properties that developed according to the metal ion and the ligands (anticancer, hypertensive, antimicrobial, photodynamic therapy, oxidative stress, etc.)
6. Study of inorganic nanoparticles and their properties according to the metal ion(s) (hyperthermia, phototherapy, oxidative stress)
7. Classification of biological evaluation of the properties of the nanoparticles/complexes formed
8. Description of the internalization pathways of nanoparticles and the methodology of their experimental investigation.
9. Use of nanoparticles in cosmetology. Advantages-Risks

(3) TEACHING AND LEARNING METHODS – EVALUATION

<table>
<tr><td>LECTURES' DELIVERY
In person, distance, etc..</td><td>• Face to face (lectures)

• Modern distance education (guided study)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGIES
Use of I.C. T. in Lectures, Laboratory Exercises, Communication with students</td><td>In teaching:
▪ Additional education material (slides) in electronic platform e-class.
▪ Collaboration/lectures through Webex platform
In communication with students:
▪ Support of teaching procedure through the electronic platform e-class (announcements, information, messages, documents, user groups, etc.)
▪ Email</td></tr>
<tr><td>TEACHING ORGANIZATION
The teaching style and methods are described in detail.
Lectures, Seminars, Laboratory Exercises, Field Exercises, Literature Study & Analysis, Tutorial, Internship (Placement), Clinical Exercises, Art Workshop, Interactive Teaching, Educational Visits, Study Preparation (Project), Paper Writing Assignments, Artistic Creation, etc. etc.

The student's study hours for each learning activity as well as unguided study hours according to ECTS principles are listed</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>65</td></tr>
<tr><td>Guided study in relation to research task</td><td>26</td></tr>
<tr><td>Non guided study</td><td>40</td></tr>
<tr><td>Study and analysis of literature-Elaboration of study (project),
Writing a paper and presentation</td><td>99</td></tr>
<tr><td>Assessment preparation</td><td>20</td></tr>
<tr><td>Total course</td><td>250</td></tr>
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<tr><td>STUDENT EVALUATION
Description of the evaluation process

Assessment Language, Assessment Methods, Formative or Deductive, Multiple Choice Test, Short Answer Questions, Essay Development</td><td>The evaluation of students is done in Greek and includes:
• written final exam that includes:
i. questions answers</td></tr>
</table>

Questions, Problem Solving, Written Assignment, Report / Report, Oral Examination, Public Presentation, Laboratory Work, Clinical Patient Examination, Artistic Interpretation, Other / Others *Explicitly defined evaluation criteria are mentioned, and if and where they are accessible by students.*	ii. problem solving iii. multiple choice questions • evaluation of bibliographic work (project) and presentation, Course Grade Calculation: 60% exam grade and 40% assignment grade

(4) RECOMMENDED BIBLIOGRAPHY

- "Introduction to Nanoscale Science and Technology" J. Helfin Springer (2004)
- R. Ferrando, J. Jellinek, R. L. Hohnston, “Nanoalloys: from theory to applications of alloy clusters and nanoparticles”, Chemical Reviews, (2008), 108 (3), 845-910
- R. A. Sperling, W. J. Parak, “Surface modification, functionalization and bioconjugation of colloidal inorganic nanoparticles”, Philosophical Transactions of the Royal Society A, (2010), 368, 1333–1383
- K. M. Krishnan "Biomedical Nanomagnetics: A spin through possibilities in imaging diagnostics and therapy" IEEE Transactions on Magnetics 2010; 46:2523-2558
- A. Zaleska-Medynska, M. Marchelek, M. Diak, E. Grabowska, “Noble metal-based bimetallic nanoparticles: the effect of the structure on the optical, catalytic and photocatalytic properties”, Advances in Colloid and Interface Science, (2016), 229, 80–10
- Hanley C, Thurber A, Hanna C, Punnoose A, Zhang J, Wingett DG, Thurber, Hanna, Punnoose, Zhang, Wingett. "The Influences of Cell Type and ZnO Nanoparticle Size on Immune Cell Cytotoxicity and Cytokine Induction". Nanoscale Res Lett 2009; 4(12):1409–1420
- Biological Inorganic Chemistry, Structure and Reactivity, H. B. Gray, E. I. Stiefel, J. S. Valentine and I. Bertini, University Science Books, 2007.
- Bioinorganic Chemistry, D. Kesisiglou, G. Psomas, 2011
- Biological Inorganic Chemistry. A new Introduction to Molecular Structure and Function. R. Crichton, Elsevier Science, 2018 ISBN: 9780128117415.