COURSE OUTLINE

1. GENERAL

SCHOOL	SCHOOL OF SCIENCES		
DEPARTMENT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	ISCED level 6 - Bachelor's or equivalent level		
COURSE CODE	EN1	**SEMESTER**	7th
COURSE TITLE	Bioinorganic Chemistry		
TEACHING ACTIVITIES *If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.*		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	THEORY	3	3
Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.			
COURSE TYPE *Background, General Knowledge, Scientific Area, Skill Development*	Specialization & Skills Development		
PREREQUISITES:	According to the Undergraduate study program, there are no prerequisite courses. However, it is recommended that students have successfully completed the courses principles of Biology, Biochemistry and Inorganic Chemistry.		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE URL:			

2. LEARNING OUTCOMES

Learning Outcomes

Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

After successfully completing the course, students will be able to:

- Identify metal ions in biological systems.
- Have acquired knowledge about the major roles of metal ions in biological systems.
- Understand the possible reasons why nature has selected specific metal ions.
- Understand how metal ions enter cells.
- Describe the arrangement and coordination of metal ions with biopolymers, as well as how they are positioned in active sites.
- Explain the role of metal ions as electron carriers or as centers for substrate activation, among other functions.
- Understand the mode of action and function of key metalloproteins.
- Understand the mechanism of action of major enzymes, such as zinc enzymes.
- Describe the interactions of metal ions with DNA.
- Know the applications of metals and their compounds in therapy and diagnostics.
- Have acquired knowledge about the methods used to study metals in biological systems.
- Develop the ability to study and interpret contemporary scientific literature.

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,	*Project design and management*
ICT Use	*Equity and Inclusion*
Adaptation to new situations	*Respect for the natural environment*

Decision making	*Sustainability*
Autonomous work	*Demonstration of social, professional and moral responsibility and sensitivity to gender issues*
Teamwork	*Critical thinking*
Working in an international environment	*Promoting free, creative and inductive reasoning*
Working in an interdisciplinary environment	
Production of new research ideas	

By the end of this course, students will have developed the following general competencies:

1. Ability to understand the concepts and principles related to Bioinorganic Chemistry.
2. Ability to comprehend the concepts and properties of metal ions and the biological molecules in which they occur.
3. Ability to apply this knowledge to synthesize, analyze, and solve problems.
4. Ability to search for and evaluate information in order to answer questions regarding current and future applications of metal ions in biological systems.
5. Ability to interact and collaborate with others on chemical or interdisciplinary problems.
6. Ability to adopt and apply appropriate methodologies for solving unfamiliar problems.
7. Study skills necessary for ongoing professional development.

More generally, upon completion of the course, students will have developed the following transferable skills:

• Adaptation to new situations
• Decision-making
• Independent work
• Critical thinking and self-assessment
• Creative and inductive reasoning

3. COURSE CONTENT

1. The presence and role of metal ions in biological systems.
2. Selective binding and competitive behavior of metal ions.
3. Metal elements in vivo.
4. The metal ions of sodium, potassium, magnesium, calcium, cobalt, and nickel.
5. Manganese in catalytic enzymes.
6. Electron transfer in metalloenzymes.
7. Iron proteins involved in electron and oxygen transport.
8. Iron transport and storage proteins.
9. Copper biochemistry and types of copper active sites.
10. Zinc enzymes: Carbonic anhydrase, Carboxypeptidase, Alcohol dehydrogenase, alpha-Amylase, Cu–Zn superoxide dismutase.
11. The biological role of molybdenum.
12. Interaction of metal ions with DNA.
13. Metals and their compounds in therapy: Pt, Ru, Au, Ti, V, Fe, Cu, Li, Bi, As, Sb, Zn.
14. Metals used in diagnostics.
15. Methods for studying metals in biological systems: Spectroscopic methods, X-ray–based techniques, magnetic measurements, electrochemistry.

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD *Face to face, Distance learning, etc.*	In-person lectures
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) *Use of ICT in Teaching, in Laboratory Education, in Communication with students*	Use of ICT (PowerPoint) and electronic notes for teaching the Theory. The lectures include illustrative examples in each chapter to support better understanding of the theoretical material. Communication with students is carried out via email and the e-class platform.
TEACHING ORGANIZATION *The ways and methods of teaching are described in detail.*	**Activity** | **Workload/semester**

Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc. *The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.*	Lectures (3 hours of in-person teaching × 13 weeks)	39
	Study hours for preparing for the final theory examinations	55
	Assignment–Presentation	23
	Final theory examination (3 hours, in person)	3
	Course Total (40 hours of workload per credit unit)	120 hours (total student workload)
STUDENT EVALUATION *Description of the evaluation process* *Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others* *Please indicate all relevant information about the course assessment and how students are informed*	The grading distribution for the course Bioinorganic Chemistry (EN1) is: • Written Examination: 50% of the final grade. • Written and Oral Presentation of a Literature Assignment: 50% of the final grade. 1. The written examinations include short-answer questions, extended-response questions, multiple-choice questions, and problem-solving exercises. 2. The above assessment criteria are communicated to students during the first academic week of classes. They are also posted on e-class and accessible to all students. 3. The final examination is conducted in the Greek language.	

5. SUGGESTED BIBLIOGRAPHY

1. Βιοανόργανη Χημεία, Κεσίσογλου Δημήτρης, Ψωμάς Γεώργιος, Εκδόσεις Ζήτη, 2011, ISBN: 978-960-456-264-0.
2. Βιοανόργανη χημεία, Hay, Robert W., Εκδόσεις Παπαζήση, 1992, ISBN:9789600209631, Μετάφραση-Επιμέλεια: Μάνεση - Ζούπα, Έβη Ράπτης, Δ. Μάνεση - Ζούπα, Έβη Ράπτης, Δ.
3. Bioinorganic Chemistry: A Short Course, 3rd Edition, Rosette M. Roat-Malone, Wiley, 2020, ISBN: 978-111-953-526-3.
4. Principles of Bioinorganic Chemistry, Stephen J. Lippard, Jeremy M. Berg, University Science Books, 1994, ISBN: 978-093-570-273-6.
5. Bioinorganic Chemistry, Ivano Bertini, Harry B. Gray, Stephen J. Lippard, and Joan Selverstone Valentine, University Science Books, 1994, ISBN: 978-093-570-257-6.
6. Metals in Biological Systems. Von M. J. Kendrick, M. T. May, M. J. Plishka und K. D. Robinson, Ellis Horwood, New York, 1992, ISBN 013-577-727–5.
7. Inorganic Biochemistry: An Introduction, 2nd Edition, J. A. Cowan, Wiley, 1997, ISBN: 978-047-118-895-7.
8. Bioinorganic Chemistry, R. C. Maurya, De Gruyter, 2021, ISBN: 311-072-729-3.

Relevant scientific journals:

- Inorganic Chemistry
- Journal of Biological Inorganic Chemistry
- Bioinorganic Chemistry & Applications
- Journal of Inorganic Biochemistry
- Dalton Transactions