COURSE OUTLINE "ORGANIC CHEMISTRY OF BIOLOGICAL PROCESSES"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT	CHEMISTRY AND MEDICINE		
LEVEL OF STUDIES	POSTGRADUATE (MSc)		
COURSE CODE	OCB 113	**SEMESTER**	FIRST
COURSE TITLE	ORGANIC CHEMISTRY OF BIOLOGICAL PROCESSES		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	4	5

COURSE TYPE	Special Background (Semi Optional course)
PREREQUISITE COURSES:	There are not prerequisite courses. It is, however, recommended that students should at least have basic knowledge of Organic Chemistry and Biochemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The powerpoint material of the course is however in English. Teaching may be performed in English in case of foreign students participate in the postgraduate program.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	-

2. LEARNING OUTCOMES

Learning outcomes

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

- Recognize the functional groups of organic compounds encountered in the biological systems and the factors which determine the acidity and the basicity and the electrophilicity and nucloephilicity, respectively, of the various molecules invlolved in the reactions occurring in the biological systems.
- Describe with the aid of curly arrows the main mechanisms of the organic reactions of the biological systems and understand the differences within the same types of reactions in the way they are usually performed in the laboratory and the way taking place in Nature.
- Comprehend the concepts of chirality and pro-chirality and their consequences on (a) the three-dimentional structure of organic compounds and (b) the stereochemical outcome of reactions involving chiral or prochiral molecules.
- Recognize the main classes and the structural characteristics of biomolecules (lipids, carbohydrates, amino acids, peptides and proteins, nucleic acids, enzymes and coenzymes and comprehend the role of conjugated reactions and of high-energy compounds in biosynthesis.
- Comprehend mechanistically the various steps involved in the biosynthesis of biologically avtive biomolecules/natural products, such as penicillins and cephalosporins as well as prostaglandins.
- Comprehend and describe mechanistically the most important biological processes, such as hydrolyses, esterifications, thioesterifications, amidations, carbonyl condensations, carboxylations and decarboxylations, aminations and deaminations, single carbon transfers, rearrangements, isomerizations and epimerizations, oxidations and reductions of carbonyl compounds, hydroxylations and other oxidations through metal complexes.

- Comprehend and describe basic concepts and the design of metabolism in living organisms
- Comprehend and describe the interconnection of major metabolic pathways, including photosynthesis (light and dark reactions), glycolysis/gluconeogenesis/citric acid cycle, fatty acid metabolism, amino acid biosynthesis and protein turnover, taking place in living organisms that result in extraction of energy from their environment to perform their functions and synthesize the building blocks of biomolecules.
- Comprehend the basic principles of metabolic control in biological systems.
- Comprehend the recurring motifs in metabolic regulation.
- Comprehend and describe common metabolic diseases (i.e. diabetes mellitus).

General Competences

By the end of this course the student will, furthermore, have developed the following skills (abilities):

- Ability to demonstrate knowledge and understanding of the essential facts, concepts, theories and applications related to the Organic Chemistry of the biological processes
- Ability to apply this knowledge and understanding to solve problems related to the Organic Chemistry of the biological processes of non-familiar nature
- Ability to apply this knowledge for understanding other biological processes
- Ability to adopt and apply methodology for solving non-familiar problems
- Study skill needed for continuous professional development
- Ability to interact with others in solving problems of chemical/biochemical or multidisciplinary nature

Generally, by the end of this course the student will have developed the following general abilities:

- *Search for, analysis and synthesis of data and information, with the use of the necessary technology*
- *Adapting to new situations*
- *Decision-making*
- *Working independently*
- *Team work*
- *Criticism and self-criticism*
- *Production of free, creative and inductive thinking*
- *Working in an interdisciplinary environment*

3. SYLLABUS

- *Common Mechanisms in Biological Pathways* (functional groups, acids and bases – electrophiles and nucleophiles, mechanisms of electrophilic addition reactions, nucleophilic substitution reactions, nucleophilic carbonyl addition reactions, nucleophilic acyl substitution reactions, carbonyl condensation reactions, elimination reactions, oxidations and reductions)
- *Biomolecules* (chirality and pro-chirality, lipids, carbohydrates, amino acids, peptides and proteins, nucleic acids, enzymes, coenzymes, coupled reactions and high-energy compounds)
- *Biological Pathways with emphasis to Metabolism* [Basic concepts and design of metabolism in living organisms; interconnection of major metabolic pathways, including photosynthesis (light and dark reactions), glycolysis/gluconeogenesis/citric acid cycle, fatty acid metabolism, amino acid biosynthesis and protein turnover, taking place in living organisms; basic principles of metabolic control in biological systems; recurring motifs in metabolic regulation; common metabolic diseases]

- *Biosynthesis of selected Natural Products* (penicillins and cephalosporins, prostaglandins and other eicosanoids)
- *Summary of Biological Transformations* (hydrolyses, esterifications, thioesterifications and amidations, carbonyl condensations, carboxylations and decarboxylations, aminations and deaminations, 1-carbon transfers, rearrangements, isomerizations and epimerizations, oxidations and reductions of carbonyl compounds, hydroxylations and other oxidations via metal complexes)

4. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of ICT (powerpoint) in teaching and in the communication with the students.
TEACHING METHODS	

Activity	***Semester workload***
Lectures	28
Final examination	3
Private study of the course material throughout the lecturing period. Collaborative problem-solving work by the students working in teams of two, following the end of lecturing period. Preparation for the final examination.	94
Course total ***(25 work load for each ECTS credit)***	**125**

STUDENT PERFORMANCE EVALUATION	**1.** Following the end of the lecture period, a collaborative problem-solving work is assigned to each pair of students. This work includes three problems based on the taught material. This work is returned to the instructors before the final examination and is marked. This mark forms the 40% of the final mark. **2.** Oral examination on the material of the work of each student individually (60% of the final mark) Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades ≤ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades, the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and ≥ 9 = A **3.** Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course.

5. ATTACHED BIBLIOGRAPHY

1. J. McMurry, T. Begley, "The Organic Chemistry of Biological Pathways", Robert and Company Publishers, Englewood, Colorado, 2005.
2. G.M. Cooper, R.E. Hausman. *Το Κύτταρο: Μια Μοριακή Προσέγγιση,* 1η Έκδοση στα

Ελληνικά, Ακαδημαϊκές Εκδόσεις Ι. Μπάσδρα και ΣΙΑ ΟΕ, 2011
3. J.M. Berg, J.L. Tymoczko, L. Stryer. *Βιοχημεία,* 1η Έκδοση στα Ελληνικά, Πανεπιστημιακές Εκδόσεις Κρήτης, 2014