COURSE LAYOUT

1. GENERAL

SCHOOL	APPLIED BIOLOGY & BIOTECHNOLOGY		
DEPARTMENT	BIOTECHNOLOGY		
STUDY LEVEL	*Undergraduate*		
COURSE CODE	**1405**	**SEMESTER**	5th
COURSE TITLE	Molecular Recognition		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	3	1.56
Laboratory exercises	2	0.56
Group and/or individual assignments		0.56
Independent study		1.82
TOTAL		4.5

COURSE TYPE	Background
PREREQUISITES	No, but knowledge of Biochemistry and basic principles of Molecular Biology are highly recommended
LANGUAGE	Greek with English support in terminology
IS THE COURSE OFFERED for ERASMUS STUDENTS?	YES (in Greek)
COURSE WEB PAGE	https://mediasrv.aua.gr/eclass/courses/BIOTECH144

2. LEARNING OUTCOMES

Learning Outcomes

Upon successful completion of the course, the student will:

• Has knowledge of the basic structural units that make up biomolecules.
• Can perceive and quantify interactions between biomolecules (protein-protein and protein-DNA) at the molecular level.
• Has knowledge of the methods and techniques used to quantify the interactions between biomolecules on a molecular scale.
• Has knowledge of the basic principles governing the methods of determining the structure of biomolecules.
• Has knowledge of protein folding mechanisms.
• Has knowledge of the mechanisms that govern protein translocation.
• Has knowledge of the molecular scale processes and actors for signal transduction.
• Has knowledge of the mechanisms of recognition of elements of the immune system at the molecular level.
• Has knowledge of processes and methods for drug design.
• Be able to operate molecular graphics programs on the PC and construct and analyze biomolecules.
• Be able to compose papers and analyze results obtained from the study of structural elements of biomolecules and develop the ability for on-line access to libraries and scientific journals.

General Competences

1. Search and analysis of data and information using the necessary technologies.
2. Adaptation to new situations.

3. Decision making.
4. Autonomous work.
5. Group work.
6. Generation of new research ideas.
7. Project planning and management.
8. Promotion of free, creative and inductive thinking.

3. COURSE CONTENT

I. GENERAL PRINCIPLES.

1. Structural elements of biomolecules (amino acids, nucleotides, cofactors, proteins, nucleic acids).
2. Types of interactions involved in recognition (qualitative and quantitative analysis). Degrees of recognition.
 a. Atomic interactions (H-bonds, electrostatic interactions, Van der Waals, hydrophobicity, π-π, cation-π, halogen bonds, steric hindrance, stabilization of internal charges).
 b. Interactions of building blocks of molecules.
3. Energy analysis of interactions.
 a. Molecular Engineering
 b. Molecular Dynamics.
4. Protein recognition regions.
 a. Structural elements
 b. The location of the substrate.
5. Size and complexity of identification areas.
6. Basic principles of high-resolution structure determination methods (X-ray crystallography, NMR, cryo-electron microscopy)

II. PROTEIN FOLDING AND PROTEIN TRANSLOCATION

7. The thermodynamics of protein folding
8. Folding mechanisms in the cell (cytoplasm, endoplasmic reticulum)
9. Mechanisms of protein translocation to their final destination (nucleus, endoplasmic reticulum, mitochondrion, lysosome, secretion)

III. CHEMICAL SIGNAL TRANSDUCTION, INTRACELLULAR AND BETWEEN CELLS

10. Hormones, neurotransmitters.
11. Common molecular mechanisms for signal transduction.
 a. Slow-fast signaling.
 b. Signal initiation and termination.
12. GPCRs, G-proteins, kinase cascade. Structural view of signaling.
13. Recognition between immune molecules (molecular/structural view)
 a. Antibody-antigen recognition
 b. Antigen presentation by MHC-I and MHC-II molecules.

IV. STRUCTURE-BASED DRUG DESIGN

14. Libraries of small molecules (fragments, lead-compounds, drug-like molecules).
15. Docking of small molecules in protein cavities.
16. Evaluation of results.
17. Application of structural data for the development of new, effective and selective drugs.

V. LABORATORY

1. Amino acids and protein structure.
2. Molecular identification of proteins (transcription factors)-DNA.
3. Membrane proteins.
4. Hemoglobin – structural changes and synergistic effect, allosteric modifiers
5. Proteolytic enzymes - molecular action.

6. Design of enzyme inhibitors 7. The molecular action of insecticides.

4. TEACHING and LEARNING METHODS - Evaluation

TEACHING METHOD	In suitably equipped teaching rooms
USE OF INFORMATICS and COMMUNICATION TECHNOLOGIES	Use of powerpoint presentations in lectures, use of e-class website and videos to inform, distribution of educational material, delivery & grading of laboratory exercises, molecular graphics software
TEACHING ORGANISATION	*Activity* / *Work Load* Lectures: 39 Laboratory exercises: 12 Group and/or individual assignments: 21 Independent study: 40.5 *Course total (25 hours of student work load per ECTS)*: ***112.5***
STUDENTS EVALUATION	I. Written final exam, which includes: • Multiple choice questions. • Questions of short and/or detailed development. • Problems/exercises based on theoretical knowledge developed in the lectures. II. Laboratory Exercises III. Individual Assignments IV. Group assignment (compulsory oral presentation by all team members, awarding up to 2.5 credits) The overall grade is obtained as a sum of the above individual evaluations

5. BIBILIOGRAPHY

1. Introduction to protein structure (Branden & Tooze) (1999). Garland Publishing Inc, ISBN 0-8153-0270-3
2. Biochemistry (Stryer) (2015) Broken Hill Publishers.
3. The cell, a molecular approach G.M. Cooper and R.E. Hausman, Eds, 2009, Sinauer Assosciates, Inc. Publishing, USA
4. Communication within Animal Cells Greg J.Baritt , Oxford Science Pubs.1992 ISBN 0-19-854726-9
5. Plant Biochemistry and Molecular Biology Hans-Walter Heldt, Oxford Pubs. 1997 ISBN 0-19-850179-X
6. Proteins: Form and Function (Bradshaw & Purton Eds.) (1990). Elsevier Trends Books ISBN 1 85166 512 9

Chemical Communication: The Language of Pheromones (Agosta) (1992)