COURSE CONTENT

(1) GENERAL INFO

SCHOOL	ENGINEERING			
DEPARTMENT	BIOMEDICAL ENGINEERING			
MSc PROGRAM	BIOMEDICAL ENGINEERING AND TECHNOLOGY			
STUDY LEVEL	POSTGRADUATE, MSc			
COURSE CODE	**BMET103**	**SEMESTER**	**A**	
COURSE TITLE	**Biology-Biotechnology**			
TEACHING			**HOURS**	**ECTS**
		LECTURES	39	5
COURSE TYPE	SPECIALIZATION			
COURSE REUIREMENTS:	-			
TEACHING AND EXAMINATION LANGUAGE:	ENGLISH			
IS THIS COURSE OFFER TO ERASMUS STUDENTS	YES (IN ENGLISH)			
COURSE WEBPAGE (URL)	https://eclass.uniwa.gr/courses/300/			

(2) LEARNING OUTCOMES

Learning outcomes

Course Objectives:
The purpose of the course is the study of basic knowledge in biology and its applications in the developing field biotechnology. In particular, basic biological principles and concepts will be analyzed such as the structure and function of biomolecules, biological membranes, the flow of information and energy in the cell as well as basic knowledge about the function of genes and viruses. Presentation of basic biotechnologies such as molecular cloning, PCR transgenic and knock out models. Additionally, presentation of cutting-edge biotechnologies such as multiphoton imaging, stem cell biology and molecular proteomic analysis and the application of the above in the diagnosis and possible therapy of various diseases.

Learning Outcomes:
1. Knowledge of the basic concepts of biology and introduction to the scientific field of biotechnology.
2. Understanding the possibility of exploiting and connecting biological knowledge with biotechnological applications.
3. Understanding the utility of the application of various biotechnologies for the clinical study, treatment and therapy of various human diseases.
4. Ability to evaluate the results of biotechnological applications for the analysis, diagnosis and treatment of various diseases.

Achievement of Course Objectives and Learning Outcomes:
The achievement of the above objectives and learning outcomes will be realized through lectures during which students actively participate with questions that lead to discussions resulting in the understanding and familiarization with basic biological knowledge as well as their understanding of the possibility that this knowledge can and is utilized and applied in the field of biotechnology. So as the students develop critical skills, as well as the ability to evaluate the important achievements of biotechnology, they undertake the organization and preparation as well as the oral presentation of individual projects on cutting-edge biotechnology issues. Finally, in order for the students to gain a first experience and insight regarding the complexity and intricacy of acquiring knowledge in the field of biology as well as the application of this knowledge in the field of biotechnology, a visit takes place to a research institute where the students have the opportunity to see a state-of-the-art bioimaging unit up close. The unit is equipped with three Confocal Microscopes, one of which functions as a multiphoton microscope, and a high-tech wide-field "Time lapse" microscope, capable of live cell

imaging. Also, during the visit there is a presentation of a cell and tissue culture room with the instruments it includes such as laminar flow hood, light microscope, mini cell centrifuge, etc.

General abilities

- Adaptation to new situations
- Autonomous work
- Teamwork
- Work in an interdisciplinary environment
  Respect for diversity and multiculturalism

(3) COURSE CONTENT

"Basic principles of biology, biomolecules"
Definitions, basic concepts and principles concerning the living matter, structure and functional properties of carbohydrates, lipids, proteins and nucleic acids.

"Energy flow in the cell"
Definitions, basic concepts, laws of thermodynamics, redox, energy currency of the cell (ATP), activation energy, enzymatic function.

"Cell membrane and transport mechanisms through the cell membrane"
Definitions, basic concepts, structure and functional properties of cell membrane, transport of small molecules, diffusion, facilitated diffusion, active transport, osmosis, transport of macromolecules, pinocytosis, phagocytosis.

"Genes"
Definitions, basic concepts, genetic code, basic mechanisms of gene control in prokaryotic and eukaryotic organisms, mutations.

"Viruses"
Definitions, basic concepts, structure and categorization, lytic and lysogenic cycles.

"Biotechnology"
Definitions, basic concepts, recombinant DNA, molecular cloning, DNA libraries, PCR, animal cloning, transgenic and knock out models of organisms, fluorescent in situ hybridization (FISH), immunoenzymatic diagnostic techniques.

"Stem cells and applications in biomedicine"
Definitions and basic concepts, embryonic stem and adult pluripotent stem cells, clinical applications, gene modification of neural stem cells, somatic cell reprogramming technologies to pluripotent stem cells, induced pluripotent stem cell models.

"Live cell brain imaging systems and technologies"
Definitions, basic concepts, stimulated emission depletion microscopy, multiphoton confocal microscopy, in vivo imaging, in vivo study of brain cell dynamics, 3D whole brain imaging, optogenetics.

"Proteomics"
Definitions and basic concepts, high pressure liquid chromatography (HPLC), mass spectrophotometer, determination of proteins and post-translational modifications by mass spectrophotometer, mass trajectory analyzer, applications of proteomics in clinical diagnosis and identification of therapeutic target molecules in various diseases.

(4) TEACHING AND LEARNING METHODS - EXAMINATIONS

<table>
<tr><td>COURSE DELIVERY</td><td>Physical presence, face to face at the auditorium</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES</td><td>The theoretical part of the course involves the use of a projector for presenting fundamental concepts and is supplemented by the use of the blackboard at the auditorium.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Teaching / lectures</td><td>39</td></tr>
<tr><td>Lecture material study</td><td>30</td></tr>
<tr><td>Unsupervised literature review and preparation of the final project</td><td>56</td></tr>
<tr><td>Total</td><td>125</td></tr>
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<tr><td>STUNDET EVALUATION</td><td>50% Final exam paper with multiple-choice questions
50% written (powerpoint) personal assignment and oral presentation</td></tr>
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(5) SUGGESTED LITERATURE

Books, scientific articles and related scientific resources:

[1] Raven, Johnson, Mason and Duncan, Biology published by McGraw Hill.
[2] Priyamvada Rajasethupathy, Emily Ferenczi and Karl Deisserothourna:Targeting circuits,Cell 2016, 165(3) 524-534.
[3] Martin Barak Veronika Fedorova Veronika Pospisilova Jan Raska Simona Vochyanova Jiri Sedmik Hana Hribkova, Hana Klimova ,Tereza Vanova, Dasa Bohaciakova : Human iPSC-Derived Neural Models for Studying Alzheimer's Disease: from Neural Stem Cells to Cerebral Organoids Stem Cells Reviews and Reports 2022, 18, 792-820.
[4] Ustione and Piston: A simple introduction to multiphoton microscopy, J. of Microscopy, 2011, 243, 221-226.
[5] Ziyi Zhao, Chenxi Li, Fei Tong, Jingkuang Deng, Guofu Huang and Yi Sang : Review of applications of CRISPR-Cas9 gene-editing technology in cancer research , Biological Procedures Online 2021, https://doi.org/10.1186/s12575-021-00151-x.
[6] Xuyu Qian, Hongjun Song and Guo-li Ming: Brain organoids: advances, applications and challenges Development, 2019, 146, dev166074. doi:10.1242/dev.166074.