COURSE OUTLINE

1. GENERAL

SCHOOL	APPLIED BIOLOGY AND BIOTECHNOLOGY		
ACADEMIC UNIT	BIOTECHNOLOGY		
LEVEL OF STUDIES	BACHELOR OF SCIENCE		
COURSE CODE	**3600**	**SEMESTER**	7th (fall semester)
COURSE TITLE	NANOBIOTECHNOLOGY AND BIOSENSORS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	0,12
Laboratory Courses	2	0,08
Tutorials/essays/practice actions	1,5	0,06
TOTAL ECTS (Table 4)		**5,00**
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Advanced (Level 7)
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES (in English)
COURSE WEBSITE (URL)	https://oeclass.aua.gr/eclass/courses/4814/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course is the basic introduction to the scientific field of biosensors and nanotechnology and their applications in life sciences, as well as all affiliated techniques and methods used for the development, study and application of biosensors and nanotechnologies in modern analytical and diagnostic science, food safety and environmental monitoring.

The educational context aims to introducing students to the principles of nanotechnology, Biosensors, Electrochemistry and Microengineering, covering wide area of supplementary knowledge, including in-depth elements of microfluidics, photonics, biomolecular processes, molecular recognition, analytical chemistry and quality control.

It also refers to introductory principles and methodologies for designing and standardizing mircoelectromechanical systems (MEMS) and biosensors, carrying out analyses with high throughput systems, the use of expert systems, knowledge of materials used in MEMS and basic microengineering techniques (lithography, etching etc).

Finally, the course aims to provide to students a comprehensive review of the importance of biosensors and nanotechnology on modern analytical and diagnostic science and their contribution to the industry and service sectors. In parallel, it fosters the perspective career opportunities with specialization in analytical science with advanced methods.

Following the completion of the course, students will be able to:

- **Understand the principles of biosensors and nanotechnology, their affiliated**

technologies and fields of application.

- Know the tools and techniques of microengineering and analysis based on different biosensor systems.
- Design basic MEMS.
- Carry out laboratory analyses using at least two different biosensor types.
- Apply skills and knowledge for seeking new technologies and utilize research results for designing novel biosensor-based analytical systems.
- Collaborate with other students in order to prepare and publicly present a plan of nanotechnological and biosensor-based approaches to a real application/analytical need, having in parallel acquired oral and written presentation skills.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
Others ….

- Autonomous work
- Team work
- Work in a multidisciplinary environment
- Production of new research ideas
- Promotion of free, creative and inductive thought

3. SYLLABUS

1. Biosensors: A historical review.
2. Principles of nanotechnology
3. Elements of electrochemistry
4. Cyclic voltammetry, voltammetry and chronoampeormetry
5. Electrochemical impedance spectrometry
6. Optical biosensors
7. Cell-based biosensors
8. Methods for immobilizing/entrapping biomolecules
9. Microelectromechanic Systems (MEMS) – Introduction to Microenginnering. Commercial applications
10. Basic Microengineering technologies: lithography, imprinting, surface microenginnering, volume microengineering
11. Microfludics for biological applications, protein separation and direct screening for disease agents
12. Artificial intelligence systems in biosensors
13. Application of MEMs in life sciences. DNA analysis. Application of microelectrode arrays
14. Application of biosensors in food safety and environmental monitoring
15. Application of biosensors in medicine and life sciences
16. Other applications of biosensors

4. TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Class courses (amphitheater/lab courses room)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Power point presentations
Distant educational support through the e-class electronic platform.
Communication of assessment of student tests and group studies through e-mail</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography,
tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Δραστηριότητα</th><th>Φόρτος Εργασίας Εξαμήνου</th></tr>
<tr><td>Lectures courses</td><td>39 h</td></tr>
<tr><td>Laboratory courses in small student groups</td><td>10 h</td></tr>
<tr><td>Group and/or individual work: Preparation of plan of natotechnological and biosensor-based approaches to a real application/analytical need</td><td>20 h</td></tr>
<tr><td>Autonomous study</td><td>56 h</td></tr>
<tr><td>Total
(25hours of working input per credit unit)</td><td>125 h
(5 ECTS)</td></tr>
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</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>I. Written Examination in theory (50%) including:
- Multiple choice tests
- Critical assessment tests referring to the available biosensor and microengineering technologies and their application opportunities
- Comparative review of educational material.

II. Examination in laboratory courses (50%) including:
1. Group and/or individual assignments or/and
2. Written examination in laboratory courses including:
- Multiple choice questions
- Critical analysis questions

The final grade for the course is determined by the total results for the different parts of the examination.</td></tr>
</table>

5. ATTACHED BIBLIOGRAPHY

-Suggested textbooks:

- Σ. Κίντζιος, Νανοβιοτεχνολογία και Βιοαισθητήρες,2015
- *Μ. Προδρομίδης,* Ηλεκτροχημικοί Αισθητήρες &Βιοαισθητήρες,2010
- *F.S. Ligler,* Optical Biosensors: Present & Future, Elsevier 2002
- *J.Y.Yoon*, Introduction to Biosensors: From Electric Circuits to Immunosensors, Springer 2012
- *J. Li, N. Wu,*Biosensors Based on Nanomaterials and Nanodevices (Nanomaterials and their Applications), CRC 2013

-Related scientific journals:

- Biosensors and Bioelectronics
- Sensors & Actuators