COURSE OUTLINE

1. GENERAL

SCHOOL	APPLIED BIOLOGY AND BIOTECHNOLOGY		
ACADEMIC UNIT	BIOTECHNOLOGY		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	**175**	**SEMESTER**	7th
COURSE TITLE	ANIMAL BIOTECHNOLOGY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS**
LECTURES	3	0,12
PRACTICAL EXERCISES	2	0,08
ESSAYS	1,5	0,06
TOTAL ECTS (Table 4)		**5,00**

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge, Skills development
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/modules/auth/courses.php?fc=37

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 a basic introductory course on concepts of animal biotechnology, genetic engineering technologies in animal organisms and the applications arising in the agricultural and biomedical field.

This course aims to introduce students to the basic technologies of animal biotechnology for the understanding and application of genetic engineering technologies related to the creation of transgenic animals, gene targeting for gene inactivation, modification and conditional gene expression, as well as to the identification of mutations by genetic analysis. It also refers to basic concepts and methodologies for the generation of biotechnological products such as monoclonal antibodies, recombinant proteins, vaccines and latest technologies related to animal cloning, stem cell biology, regenerative medicine, gene therapy, animal cell culturing, cryopreservation, assisted reproduction, genotypic analysis and diagnosis of diseases in order for the student to obtain a comprehensive insight into the applications of Biotechnology in Animal husbandry and biomedicine.

Finally, the aim of the course is the understanding of the importance of biotechnological technologies based on the use of animal organisms for the identification of gene function and the development of innovative approaches and biotechnological products with applications in diagnosis and treatment.

Upon successful completion of this course the student will be able to:

- Understand the basic approaches of animal biotechnology and its applications in the agricultural and biomedical field.
- Acquire knowledge of the tools and techniques of genetic engineering in animal organisms and their application for the understanding of gene function and the production of innovative biotechnological processes and products.
- Assess the applications of animal biotechnology technologies and to propose them in specific projects / programs.
- Be trained in biotechnological approaches for the production of pharmaceutical proteins, and in modern techniques used for the production of transgenic animals.
- Learn in detail about the process of creating transgenic animals through the method of microinjection of DNA in pronuclei of fertilized oocytes but also with lentiviruses, having acquired knowledge about the applications of transgenic animals.
- Understand the stages of gene targeting to create knockout mice and its applications.
- Understand the mechanism of action and usefulness of the nucleases ZFNs in genome modifications.
- Understand why the CRISPR / CAS9 system is superior as a genetic tool for modifying animal organisms compared to other techniques such as genetic targeting, ZNFs and TALENs nucleases.
- Distinguish and select genetic tools for the application of gene modifications in mammals either in specific cell types or at specific time intervals.
- Understand the principle and the usefulness of Forward Genetics in the identification of genes involved in the pathogenesis of genetic diseases.
- Acquire knowledge of mammalian cloning methods with an emphasis on nuclear transfer.
- Become familiar with technologies for the production of monoclonal antibodies and with their application in the diagnosis and treatment of human diseases.
- Understand the methods for the production of vaccines and the importance of vaccination to protect population health.
- Understand the importance of the stem cells in combination with gene therapy for the treatment of human diseases.
- Gain full knowledge of cutting-edge technologies based on the use of animal organisms and their cells in order to indulge further by applying them within postgraduate and professional level.
- In the laboratory, the student is trained in tools and cutting-edge techniques of Animal Biotechnology, and collaborates with his fellow students to evaluate the experimental results and adequately present the results and conclusions of the experimental process.

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	*Production of new research ideas*
Adapting to new situations	*Project planning and management*
Decision-making	*Respect for differences and multiculturalism*
Working independently	*Respect for the natural environment*
Team work	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Working in an international environment	*Criticism and self-criticism*
Working in an interdisciplinary environment	*Production of free, creative and inductive thinking*

- Working independently
- Team work

- Decision-making
- Working in an interdisciplinary environment
- Production of new research ideas
- Project planning and management
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Production of free, creative and inductive thinking

3. SYLLABUS

1. **Introduction to Animal Biotechnology**: Production of pharmaceutical proteins with biotechnological methods. Transgenic technologies in animal organisms. The laboratory mouse as a model organism. Biology, genetics and genome features of the laboratory mouse. Oogenesis, spermatogenesis and fertilization in mammals. Critical embryo stages in Animal Biotechnology. Bioethical issues.
2. **Technologies for the generation of transgenic animals:** Functional Genomics Technologies. Forward and Reverse Genetics. Creation of transgenic animals through DNA microinjection into the pronuclei of fertilized oocytes. Creating transgenic animals with lentiviruses. Advantages, Disadvantages. Transgenic animal applications.
3. **Gene targeting technology**: Embryonic stem cells. Design of gene construct. Positive and negative selection markers. Gene targeting stages for the generation of knockout mice. Applications.
4. **Genome modifications of animals with zinc-finger nucleases (ZFNs)**: ZFNs features and mechanism of action. Target Recognition by ZFNs. Design and construction of ZFNs. Mechanisms of genomic modifications with ZFNs. Use in animal organisms and applications.
5. **Genome modifications of animals with the system CRISPR/CAS9**: The CRISPR/CAS gene locus in the streptococcus. Description of the CRISPR/CAS9 system. Biotechnological use of the CRISPR/CAS9 system in animal organisms. Strategies to minimize off-target modifications. Comparison with ZNFs and TALENs nucleases.
6. **Spatial and temporal control of inducible gene expression and modifications in animals**: Recombination with the Cre/loxP system. Applications of the Cre/loxP system to animal organisms. Tissue-specific gene activation and inactivation. Inducible temporal gene modifications at the transcriptional and post-transcriptional level.
7. **Forward Genetics: from the phenotype to the identification of the causal gene**: Chemical mutagenesis with N-ethyl-N-nitrosourea. Phenotypic analysis. Detection of the mutated gene by mapping. Stages of mapping. Polymorphic genetic markers.
8. **Animal cloning**: Animal cloning methods. Nuclear transfer. Cloning stages. Re-programming in cloning. Applications of animal cloning in agriculture and biotechnology. Bioethical issues.
9. **Stem cells**: Types of mammalian stem cells and their topology. Embryonic stem cells. Adult stem cells. Induced pluripotent stem cells. Stem cell applications.
10. **Gene therapy**: History of gene therapy. Disease targets. Prerequisites and tools in gene therapy. *Ex vivo, in vivo* gene therapy applications. Vectors in gene therapy. Stages of gene therapy. Problems in gene therapy. Latest achievements.
11. **Monoclonal antibodies – Vaccines**: Review of the immune system. Monoclonal, polyclonal antibodies. Techniques for the production of monoclonal antibodies. Applications of monoclonal antibodies in the diagnosis and treatment of human diseases. Types of vaccines. Vaccination mechanisms. Examples, HPV vaccines.

Laboratory: Generation of transgenic mice - Design of transgene construct - Isolation of genomic DNA from mouse tissue - Genotyping of transgenic mice - Animal cell culture - Overproduction of proteins in mammalian cell lines - Cryopreservation - *In vitro* fertilization

(IVF), and intracytoplasmic sperm injection (ICSI)

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face in suitably equipped teaching rooms.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	The course is completely computerised in the form of Powerpoint, Web linking, etc. Computer programmes and applications are taught and distributed to students. Course material also made available to the students via the e-class platform.
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*	***Activity*** — ***Semester Workload*** Lectures — 39 h Laboratory work — 20 h Group and/or individual works — 15 h Independent study — 51 h Course total (Total contact hours and training) — ***125 h***
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.*	**I.** Written final examination in Theory (50%) of different difficulty, based on the lectures offered, containing: - Questions of multiple choice. - Questions of theoretical knowledge. - Problems based on lecture material. **II.** Laboratory exercises/practicals: Written Examination (35%) of different difficulty, based on the lectures offered, containing: - Questions of multiple choice. - Questions of theoretical knowledge. - Problems based on lecture material. **III.** Group and small autonomous works (15%).

5. ATTACHED BIBLIOGRAPHY

-Suggested bibliography :
-Relevant scientific journals:

- Molecular Biotechnology: Principles and Applications of Recombinant DNA. Glick BR, Pasternak JJ, Patten CL. 4th edition, published by ASM Press. 2009.
- Principles of Gene Manipulation and Genomics. Twyman R, Primrose SB. 8th edition, Wiley-Blackwell , 2013.
- Professor's booknotes