# COURSE OUTLINE

## 1. GENERAL

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| **SCHOOL** | APPLIED BIOLOGY AND BIOTECHNOLOGY | | |
| **ACADEMIC UNIT** | BIOTECHNOLOGY | | |
| **LEVEL OF STUDIES** | *Undergraduate* | | |
| **COURSE CODE** | | **SEMESTER** | 9th |
| **COURSE TITLE** | HEREDITY AND EPIGENETIC MODULATIONS | | |

| **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 and Practicals | 5 | 5 |
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| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).* | | |

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| **COURSE TYPE** *general background, special background, specialised general knowledge, skills development* | Special background |
| **PREREQUISITE COURSES:** | No |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS :** | Greek |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | Yes (in Greek) |
| **COURSE WEBSITE (URL)** | |

## 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 supplement of the course on Special Issues in Genetics.

The course aims to introduce students to concepts, molecular mechanisms and methodologies of epigenetic theory & analysis for the interpretation of the phenotypic variability of animals, humans and other organisms.

The aim of the course is to help students to understand phenomena of epigenetic interpretation and to differentiate them from the concepts of classical genetics, but also to recognize the cooperation of epigenetic mechanisms with classical genetics.

More importantly, emphasis will be placed on understanding the nature of genetic and epigenetic (genetic x environmental) interactions, health and disease, and their possible pharmacological modulation. The latter is a major challenge in many areas of research and can help develop preventive strategies, drug design or new disease treatments. Finally, it will include the introduction of new elements & basic principles/concepts in methods of analysis with interest on epigenetics.

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

• Understand and appreciate the importance and contribution of Epigenetics in addressing modern challenges and questions in the field of modern Genetics and related disciplines.

• Explain the basic and critical characteristics of Epigenetic science in relation to the classical view of the genetic code in the manifestation of the phenotype.
• Understand the interpretation of biological phenomena and the sign of phenotypic alterations as a result of inheriting non-DNA changes.
• Recognize the cooperation of genetic and epigenetic interactions, in each individual due to the polymorphisms and their different response to a chemical or drug.
• Understand the contribution of epigenetics to homeostasis mechanisms during hematopoiesis and myogenesis.
• Interpret the complex regulation of epigenetic mechanisms in the development of diseases such as Beckwith & Weidemann, Prader-Willi and Angelman syndromes.
• Understand that any environmental impact (eg diet, tobacco use, alcohol, etc.) has a significant epigenetic effect on human cells and health.
• Understand the importance of triggered epigenetic modifications by infectious agents, especially in populations of reared organisms (eg farm animals, fish, etc.) for the health benefit of both animals as well as humans.
• Understand the importance of epigenetic marks/indicators in the pathogenesis of diseases such as, Alzheimer's, post-traumatic stress disorder, pathogen infections, aging and their contribution to innovative diagnostic and therapeutic approaches.
• Understand the need to apply innovative therapies that target epigenetic processes, especially in incurable diseases (eg cancer). Specifically for the cancer cell it will be discussed in detail, the epigenetic changes and stages mediated in cellular processes that lead to the manifestation of an altered/transformed phenotype, from the onset of oncogenesis to the stage of cancer.
• Extend knowledge of the pathological processes of the cells that cause protein misfolding (prions), as in the transmission of the Bovine Spongiform Encephalopathy (BSE) and Kuru (TSE) in humans
• Collaborate with his / her classmates to identify and interpret and / or solve complex problems and questions in Genetics / Epigenetics addressed in the literature.
• Expand his/her horizons in relation to the latest developments in epigenetic research to improve the quality of life and the environment.
• Be trained in writing scientific manuscripts and in searching, reporting and managing bibliography.
• Be introduced, as part of the Laboratory exercise, in modern tools and techniques of Epigenetic analysis.

**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?*

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| *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
- Working in an interdisciplinary environment
- Production of new research ideas
- Decision-making
- Search for, analysis and synthesis of data and information, with the use of the necessary technology

## 3. SYLLABUS

1. Review of the concepts of Genetics and Epigenetics. Historical review of Epigenetics. Enzymes of epigenetic action. Epigenetic mechanisms in animal cells.
2. Heredity in Epigenetics. Transfer of epigenetic modifications to gametes and genetic improvement of animals. Examples of epigenetic differentiation on monozygotic twins.
3. Inheritance and epigenetic mechanisms of polymorphic locations and gene haplotypes. Inheritance of genetic alterations in the functionality of epigenetic enzymes and their consequences.
4. Transgenerational epigenetic inheritance. The role of lifestyle, diet and metabolism in epigenetic inheritance. Interactions of the metabolomic and epigenomic profile in mammalian cells.
5. Epigenetic modulations in maintaining homeostasis in hematopoiesis and myogenesis.
6. Epigenetic toxicology in agrobiotechnology.
7. Inheritance of epigenetic mechanisms of imprinting in Beckwith & Weidemann, Prader-Willi and Angelman syndromes.
8. Epigenetic pathophysiology of diseases and new therapeutic approaches in diseases such as, eating disorders, metabolism, immunological diseases, Alzheimer's, asthma, heart disease, aging.
9. Epigenetics of cancer.
10. Abnormality of epigenetic programming and epigenetic changes in cloned animals and assisted reproductive technologies (ART) in humans. Epigenetic signature of the induced pluripotent stem cells, iPSCs.
11. Prions and epigenetics. Protein misfolding.
12. Recent developments in epigenetic research. Methods and experimental approaches in Epigenetic analysis.

## 4. TEACHING and LEARNING METHODS - EVALUATION

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| **DELIVERY**<br>*Face-to-face, Distance learning, etc.* | Face to face, synchronous and asynchronous learning |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY**<br>*Use of ICT in teaching, laboratory education, communication with students* | Power point presentations. Course material also made available to the students via the e-class platform. |
| **TEACHING METHODS**<br>*The manner and methods of teaching are described in detail.*<br>*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.*<br><br>*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 |
| Laboratory work (tutorials) focused on Genetics problem-solving in smaller groups | 26 |
| Essay preparation | 13 |
| Independent study | 47 |
| Course total (Total contact hours and training) | ***125*** |

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| **STUDENT PERFORMANCE EVALUATION**<br>*Description of the evaluation procedure*<br><br>*Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions,* | I. Theory: Written final exam (50%) which includes:<br>- Multiple selection or development questions.<br>- Problem solving |

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| *open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other*<br><br>*Specifically-defined evaluation criteria are given, and if and where they are accessible to students.* | II. Individual or Group Work (10%)<br>III. Laboratory (40%)<br>- Multiple Choice or short-answer Questions.<br>-Problem solving |

## 5. ATTACHED BIBLIOGRAPHY

*-Suggested bibliography :*
*-Relevant scientific journals:*

Recommended Bibliography:


- Benjamin Lewin Genes IX. Chapters 19, 20, 23. Basra Publications, Alexandroupolis
- Epigenetics. Allis, Jenuwein, Reinberg and Caparros. Cold Spring Harbor Laboratory Press. ISBN-13: 978-0879697242, Edition: 1
- Concepts of Genetics, Special Chapter #1, Klug, Cummings, Spencer, Palladino 2019, Academic Publications of I. Basra Publications, Alexandroupolis
- Tutor's notes, In each lecture the teaching material will be available as a power-point presentation supported by Video.