# Principles of Cellular and Molecular Biology [3635]

COURSE OUTLINE

## (1) GENERAL

| | | | |
|---|---|---|---|
| **SCHOOL** | ANIMAL BIOSCIENCES | | |
| **ACADEMIC UNIT** | DEPARTMENT OF ANIMAL SCIENCE | | |
| **LEVEL OF STUDIES** | Undergraduate [Required] | | |
| **COURSE CODE** | 3635 | **SEMESTER** | 1st |
| **COURSE TITLE** | PRINCIPLES OF CELLULAR AND MOLECULAR BIOLOGY | | |

| **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 (ECTS)** |
|---|---|---|
| Lectures | 3 | 2.5 |
| Laboratory training | 3 | 2.5 |
| **Total** | **6** | **5** |
| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).* | | |

| | |
|---|---|
| **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:** | - |
| **COURSE WEBSITE (URL):** | https://oeclass.aua.gr/eclass/courses/768/ |
| **TEACHING STAFF:** | Theory: Arsenakis I., Zoidis E., Theodorou G., Politis I.<br>Laboratoty practice: Balaskas C., Zoidis E., Theodorou G., Politis I., Stefos G. |

## (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*

This is an introductory course aiming to educate students in the relation between cell organization, structure, and function with the underlying molecular mechanisms. It comprises detailed description of cellular structure and function, with emphasis on eukaryotic cells. The basic properties and functions of biomolecules (carbohydrates, lipids, proteins, and nucleic acids) will also be presented. Cells will be presented as systems able to assimilate and transform energy and to process molecular input. Gene expression, cell cycle, protein synthesis, intracellular protein transport and metabolism will be presented. Moreover, applications and methods in contemporary cellular and molecular biology will be also discussed to introduce students to the basic concept of scientific experimentation to exploring cellular and molecular phenomena. Laboratory training will facilitate students comprehending the basic principles underlying lectures.

Upon successful completion of the course, students will be able (according to Bloom) to:

- Know the properties and functions of major groups of biomolecules (**Knowledge / Understanding**).
- Understand the origin of life from abiotic molecules to multicellular organisms (**Understanding**).
- Describe the structure and function of the cell membrane and cellular organelles of eukaryotes (**Knowledge / Understanding**).
- Explain the mechanisms of storing, transporting, and expressing gene coding (**Understanding / Application**).
- Understand the inter- and intra-cellular mechanisms of communication (**Understanding / Analysis**).
- Describe the mechanisms of inherited and acquired immunity (**Knowledge / Understanding**).

**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*<br>*Adapting to new situations*<br>*Decision-making*<br>*Working independently*<br>*Team work*<br>*Working in an international environment*<br>*Working in an interdisciplinary environment*<br>*Production of new research ideas* | *Project planning and management*<br>*Respect for difference and multiculturalism*<br>*Respect for the natural environment*<br>*Showing social, professional and ethical responsibility and sensitivity to gender issues*<br>*Criticism and self-criticism*<br>*Production of free, creative and inductive thinking*<br>*.....*<br>*Others...*<br>*.....* |
| • Autonomous work<br>• Teamwork<br>• Work in a multidisciplinary environment<br>• Production of new research ideas<br>• Decision making<br>• Search, analysis and synthesis of data and information and the use of the required technologies | |

## (3) SYLLABUS

**Theory**

• Introduction and history of cellular and molecular biology.

• Prokaryotic and eukaryotic cell. Intracellular space. Cell membrane. Cytoplasm. Subcellular organelles: endoplasmic reticulum, Golgi apparatus, mitochondria, lysosomes, peroxisomes, cellular inclusions, and storage products. Cytoskeleton: structure and organization, centrioles. Nucleus: nuclear membrane, nucleoplasm, nucleolus. Interstitial environment.

• Cellular senescence, apoptosis, necrosis. Mechanisms of cell homeostasis and protein turnover.

• Cellular autophagy, autophagosome biogenesis, lysosome. Cell recognition and communication. • Cell cycle and mitosis. Meiosis. • Cell synthesis. Cell energy and thermodynamics.

• Structure and function of proteins. Cell membrane transport systems.

• Macromolecules, biomolecules, and coded information. Biochemistry of nucleic acids, DNA and RNA structures.

• Introduction to the molecular biology of the cell. Chromosome organization in the nucleus and chromatin structure. Reproduction of genetic information, replication, and DNA repair mechanisms.

• Principles of gene expression. Transcription and its mechanism. Regulation of gene transcription. Gene editing, RNA processing. Genetic code, regulation of protein translation, posttranslational modifications.

• Other control mechanisms in gene expression, epigenetic modification in the cell, methylation, and histone modifications. The "Epigenetic code". Methods for nucleic acid isolation and analysis.

• Cellular and molecular organization of the immune system.

• Techniques for chicken embryo growth, enzymatic tissue degradation, embryonic fibroblast isolation, cell culture, cell counting and viability.

**Laboratory training**

• Cell preparations and microscopy.

• DNA isolation, analysis, insertion into plasmids.

• Protein properties.

• Enzyme kinetics.

## (4) TEACHING and LEARNING METHODS - EVALUATION

| | |
|---|---|
| **TEACHING METHOD**<br>*Face-to-face, Distance learning, etc.* | In class, face to face. |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY**<br>*Use of ICT in teaching, laboratory education, communication with students* | PowerPoint and video presentations. 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.*

| ***Activity*** | ***Semester workload*** |
|---|---|
| Lectures | 39 |
| Laboratory practice | 39 |
| Literature search and analysis | 47 |
| | |
| | |
| | |
| **Course total (25 h of workload per ECTS)** | ***125*** |

| | |
|---|---|
| *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* | |
| **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, 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.* | Evaluation language: Greek<br>Evaluation method: Written final examination.<br><br>I. Theory (T): 60% of the final exam with short-answer questions.<br><br>II. Laboratory (L): 40% of the final exam with multiple choice questions (50%) and microscopy histology slide description (50%).<br><br>Final score: (T)+(L) = 60+40=100% of the total final score. |

## (5) ATTACHED BIBLIOGRAPHY

**-Proposed Literature:**

B. Marmaras. 2013. Cell Biology. A molecular approach. Typorama publishers. 5th edition. Patras.
Benjamin Lewin Genes IX. Κεφάλαια 1-11, 24, 26, 29. Jones and Bartlett Publishers. London
H. Lodish, A. Berk, SL. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell. 2000. Molecular cell Biology. W. H. Freeman editiors, 4th edition, New York.

**- Related Scientific journals (non-exhaustive list):**

Cell
Nature (all reviews)
Science
Gene PLoS ONE, PLoS Genetics
Trends in Genetics
Journal of Cell Biology
Nature Biotechnology