COURSE OUTLINE

1. GENERAL

SCHOOL	APPLIED BIOLOGY AND BIOTECHNOLOGY		
ACADEMIC UNIT	BIOTECHNOLOGY		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	**380**	**SEMESTER**	3rd
COURSE TITLE	GENETICS		

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	3
Practicals	2	2
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		5

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS :	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	e-class https://mediasrv.aua.gr/eclass/modules/auth/opencourses.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*

This is a basic course that presents the fundamentals of the science of Genetics.

Its aim is to introduce students to the basic principles of Genetics, while also reporting to the theory and techniques of genetic analysis.

Lastly, the course's aim is the understanding of the methodology of solving Genetics problems.

After successfully completing this course, students will:

- Have acquired knowledge on the functions and interactions of genes
- Have acquired competencies in the techniques of Mendelian analysis
- Be able to interpret the outcomes of crosses between monohybrids, dihybrids and multihybrids and define in detail the genotypes and phenotypes of all individuals.
- Be able to calculate χ^2 to decide whether observations of progenies ratios in particular crosses deviate from expectations purely on the basis of chance.
- Be able to explain the results of dihybrid crosses and define in full detail the genotype

and phenotype of all individuals intergenerational and intragenerational.

- Be able to test experimental results in dihybrids crosses under different regimes of dominance and epistasis and use the χ^2 test to reject or not a precise null hypothesis.
- Have become familiar with the ways in which the environment affects the manifestation of the phenotype, the norm of reaction of a genotype, genotype-environment interactions, twin studies, and their applications.
- Be able to calculate the estimated distance between linked genes based on outcomes for crosses involving these genes.
- Be able to explain the outcomes of crosses between dihybrids for linked genes and define in detail the genotypic and phenotypic ratios of progenies in all generations.
- Be able to perform a three – point testcross and draw a linkage map of the linked – genes, showing the order and the distance in map units.
- Have familiarized themselves with the cell cycle, mitosis, meiosis.
- Understand the mechanisms of sex determination in animals.
- Learn about the structure of Y chromosome and understand the importance of the SRY gene in the development of testis in mammals, while also interpret what causes sex reversal.
- Learn about the structure of X chromosome and understand the importance of X-inactivation for the dose compensation through epigenetic mechanisms.
- Understand the sex-linked inheritance and distinguish it from sex-influenced and sex-limited inheritance.
- Learn about the types of gene mutations, how they are caused, and interpret their effects in protein structure and function as well as in diseases.
- Know the types of chromosome mutations, such as deletions, duplications, inversions, translocations, and understand how they develop and their effect in individuals and their gametes.
- Have understood how to use plant monosomic lines for a gene and, through appropriate crosses, identify the chromosome that carries the gene.
- Have gained knowledge about extra-nuclear inheritance, the theory of endosymbiosis, the molecular genetics of mitochondria and chloroplasts, and human diseases associated with mutations in mitochondrial DNA
- Have developed their ability to collaborate with other students to solve complex Genetics problems.

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*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Working in an interdisciplinary environment
- Production of new research ideas

3. SYLLABUS

1. **Introduction in Genetics - Mendelian analysis:** Mendel's analysis. Monohybrids, dihybrids and multihybrids crosses. Variations on dominance. Mendelian genetics in agriculture and humans. Pedigree analysis. Mendelian analysis and definition of probability. Product and sum rules. The χ^2 test.
2. **Extension of Mendelian analysis**: Multiple alleles. ABO blood group in humans. Incompatibility alleles in plants. Operational test of allelism. Lethal alleles. Gene interaction. Epistasis. Complementation test. Three or more gene interaction. Pleiotropism - Penetrance – Expressivity. Modifier genes. Genetic suppression. Position effect. Genetic anticipation. Epigenetic inheritance. Paramutation. Parental imprinting
3. **Genotype and Environment**: The norm of reaction. Genotype-environment interactions. Developmental noise. Twin studies.
4. **Linkage and chromosome mapping**: Chromosome recombination from independent assortment. Intrachromosomal recombination. Genetic and cytological events correlation of intrachromosomal recombination. Tetrads analysis and stage of meiosis during which crossing - over occurs. Linkage of two genes. Genes in coupling or repulsion phase. Meiotic crossover and recombination is absent in *Drosophila* males. Linkage of genes on the X chromosome. Estimation of recombination frequency from dihybrid crosses. Genetic distance between two genes. Maximum recombinant frequency between linked genes. Linkage map of three or more genes. Three – point testcross. Coefficient of coincidence. Coefficient of interference. Estimation of progenies proportion from linkage map. Mapping function. Sister chromatid exchanges. Intralocus recombination.
5. **Cell cycle. Mitosis. Meiosis. Spermatogenesis. Oogenesis:** Cellular structure and genetic function. Diploid organisms and homologous chromosomes. Mitosis. Meiosis. Gamete formation, spermatogenesis and oogenesis. Sexual reproduction in diploid organisms. Chromosome structure in mitosis and meiosis.
6. **Sex chromosomes, Sex determination, and sex-linked inheritance**: Sex chromosomes. Sex determination (*C elegans, Drosophila*, mammals). Mechanism of gene dose compensation. Syndrome Turner and Klinefelter. Y chromosome, SRY gene in the development of testis, Sex reversal, holandric genes. X chromosome, X inactivation, Epigenetic mechanisms. Sex-linked inheritance, recessive and dominant X-linked. Sex-influenced inheritance. Sex-limited inheritance.
7. **Gene and chromosomal mutations**: Molecular basis of mutations. Types of mutations. Mutagenesis agents. Changes in chromosome structure. Deletions. Duplications. Inversions. Translocations.
8. **Changes in chromosome number**: Euploidy. Monoploids. Triploids. Autotetraploids. Allopolyploids. Aneuploidy. Monosomics. Trisomics.
9. **Extranuclear inheritance**. Mitochondrial DNA. Mitochondrial diseases. Chloroplast DNA. Origin of mitochondria and chloroplasts.

Laboratory exercises: genetic problems on Mendelian genetics for the study of one or multiple genes, epistasis, genetic linkage and genetic maps, estimation of recombination frequency from genetic crosses, X-linked genes, gender-affected and gender-restricted heredity. Predicting the heredity of a trait by studying the results of experimental crosses. Support predictions with the chi-square (x^2) statistical test. Predicting the offspring of a cross, for a trait with a given type of heredity. Applications in probability calculations. Experimental design to confirm the results and predictions mentioned above.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face, in class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *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 *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*	See table below
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. **II.** Laboratory exercises: Written Examination (50%) of different difficulty, based on the lectures offered, containing: - Problem solving

Activity	***Semester workload***
Lectures	39
Laboratory work (tutorials) focused on Genetics problem-solving in smaller groups	26
Independent study	60
Course total (Total contact hours and training)	***125***

5. ATTACHED BIBLIOGRAPHY

-Suggested bibliography :
-Relevant scientific journals:

Concepts of Genetics (11th Edition) ISBN 0321948912, Klug, Cumminngs, Spencer, Palladino 2015 Pearson Education Inc.