COURSE OUTLINE

1. GENERAL INFORMATION

FACULTY/SCHOOL	SCHOOL OF PLANT SCIENCES		
DEPARTMENT	CROP SCIENCE		
LEVEL OF STUDY	*Pregraduate*		
COURSE UNIT CODE	55	**Semester:**	3rd
COURSE TITLE	PLANT PHYSIOLOGY		
INDEPENDENT TEACHING ACTIVITIES *in case credits are awarded for separate components/parts of the course, e.g. in lectures, laboratory exercises, etc. If credits are awarded for the entire course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHNG HOURS**	**ECTS**
	Lectures	3	5
	Laboratory Exersices	2	
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail under section 4			
COURSE TYPE *Background knowledge, Scientific expertise, General Knowledge, Skills Development*	Background & Skill Development		
PREREQUISITE COURSES:	Functional Anatomy of Plants, Chemistry, Physics, Mathematics		
LANGUAGE OF INSTRUCTION:	Greek		
LANGUAGE OF EXAMINATION/ASSESSMENT:			
THE COURSE IS OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	Openeclass AUA – Plant Physiology (aua.gr)		

2. LEARNING OUTCOMES

Learning Outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate (certain) level, which students will acquire upon successful completion of the course, are described in detail. It is necessary to consult:

APPENDIX A

- *Description of the level of learning outcomes for each level of study, in accordance with the European Higher Education Qualifications' Framework.*
- *Descriptive indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and*

APPENDIX B

- *Guidelines for writing Learning Outcomes*

At the end of the course students will be able to know and understand:

• what are the physiological processes and what is their importance for the life of the plant,

• what are the biological systems, what biological components do they include and how do they contribute to the realization of physiological processes,

• how the physiological systems and processes are connected to each other and how they contribute to the functionality of each plant organ and the plant as a whole,

• what are the developmental processes, what physiological processes do they include and how do they differ with age,

• what natural resources the plant manages,

• how plant physiology is useful in digital agriculture,

• how plant physiology is used in biofortification of a crop.

During the laboratory exercises, students gain insight into:
• how they will perform a laboratory experiment to collect physiologically relevant data, concerning key molecules (sugars, starch, chlorophylls, carotenoids) and physiological functions (photosynthesis, transpiration) of the plant, and
• how experimental results will be processed.

General Competences

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and are mentioned below), at which of the following does the course attendance aim?

Search for, analysis and synthesis of data and information by the use of appropriate technologies,	*Project planning and management*
Adapting to new situations	*Respect for diversity and multiculturalism*
Decision-making	*Environmental awareness*
Individual/Independent work	*Social, professional and ethical responsibility and sensitivity to gender issues*
Group/Team work	*Critical thinking*
Working in an international environment	*Development of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Introduction of innovative research	*(Other…….citizenship, spiritual freedom, social awareness, altruism etc.)*
	…….

• Analysis of the contribution, synthesis & integration of physiological processes at the level of the cell, tissue, organ, and whole plant.
• Recognition of the physiological processes that contribute to the realization of each developmental stage of the plant's biological cycle.
• Understanding the plasticity of plant response to environmental conditions and agronomic processes and interventions.
• Understanding the spatial arrangement, synergy or competition of individual biological systems.
• Ability to base approach and document questions of the type, which system does what, where, how, when, and why, at each stage of the plant's biological cycle.
• Understanding the behavior and productivity of the cultivated plant, depending on its genetic background, the environment in which it will be found and the production system that will be applied.

3. COURSE CONTENT

THEORY OUTLINE

I. Basic physiological mechanisms & processes - Analysis of plant functionality in space (5 weeks)

• Capture and conversion of solar energy: Photosystems, photosynthetic electron transport chain, proton ATPase, photophosphorylation.
• Carbon sequestration and management: Calvin system, phosphoropentose pathway, photosynthesis, C3 & C4 plants, photorespiration, sucrose production & degradation, starch production & degradation, triose-3P management, Krebs system, respiratory electron transport chain, respiration, metabolite production. Introduction to metabolic networks.
• Energy management: Energy molecules & systems, energy transport, energy metabolism: day in photosynthetic tissue, day in non-photosynthetic tissue, night.
• Movement & management of materials: Short & long distance movement, material movement systems, motive forces, apoplasmic space, symplasmic space, woody vascular system, hematous vascular system. Tissue injury, healing mechanism. Water potential and factors that modify it, osmotic potential, sparging, soil water, absorption of soil

water, entry of water into the vessels of wood, water transport within the vascular system, atmospheric water potential, transpiration, structure and functionality of stomata & substomatal space. Nutrients and the function of nutrition.

II. Basic developmental mechanisms & processes - Analysis of plant functionality over time (8 weeks)

• Regulatory molecules: Cytokinin, gibberellin, indole acetate, abscisate, ethylene, phytochrome, cryptochrome. Management of information, communication of cells, tissues, organs. Introduction to regulatory networks.

• Meristem function & growth of young tissue: Meristem activation, cell division, mechanism of cell growth, establishment of polarity, role of IAA, apex dominance, bud dormancy.

• The formation of the young plant: Mechanisms & processes of seed germination, geotropism, perception of the direction of gravity, statolith, statocell, statenchyma, root cap, emergence of the young plant from the soil, perception of the direction of light, phototropism.

• Formation of new body: Differentiation, morphogenesis, new root, root functionality, root systems, new shoot, shoot functionality, new leaf, leaf functionality, foliage. Periodic functions.

• The physiology of flower and fruit development: The perception of the season. The function of flowering, the functionality of the flower, gametogenesis, pollination. Post-fertilization processes, developmental phases, fruit respiration, fruit ripening, regulation of fruit development, parthenocarpy. Sperm development. The dormancy of sperm.

• The physiology of plant tissue senescence: Processes of plant tissue degradation and collapse, material recycling systems, programmed cell death, programmed senescence and apoptosis of the plant organ.

• Introduction to the optical properties of the leaf: The fate of the radiation falling on a leaf, response of the leaf, optical biomarkers, usefulness of these indicators in agriculture.

• Introduction to the biofortification of crops: Need for biofortification of a crop, active substances, categories of biofortification, ways of biofortification, response of metabolic and regulatory elements to exogenous application.

LABORATORY PART

Exercises in a laboratory class with the aim of obtaining experimental data, interpreting them and presenting them in a laboratory report.

Exercises include:
(1) extraction and determination of sugars;
(2) study of starch hydrolysis;
(3) determining the water status of plant tissue and
(4) extraction and determination of chlorophylls and carotenoids.

4. TEACHING METHODS--ASSESSMENT

MODES OF DELIVERY *Face-to-face, in-class lecturing, distance teaching and distance learning etc.*	In-class lecturing
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY *Use of ICT in teaching, Laboratory Education, Communication with students*	Use of slide presentation and blackboard. Communication with students. Learning process support by access to e-class asynchronous distance learning platform.
COURSE DESIGN *Description of teaching techniques, practices and methods:* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, Internship, Art Workshop, Interactive teaching, Educational visits, projects, Essay writing, Artistic creativity, etc.* *The study hours for each learning activity as well as the hours of self-directed study are given following the principles of the ECTS.*	

Activity/ Method	Semester workload
Lectures	33
Skill development	8
Laboratory practice	22
Individual laboratory project (data processing and commenting)	26
Personal study	36
Total of Course (25 hours of workload per ECTS)	***125***

STUDENT PERFORMANCE EVALUATION/ASSESSMENT METHODS *Detailed description of the evaluation procedures:* *Language of evaluation, assessment methods, formative or summative (conclusive), multiple choice tests, short- answer questions, open-ended questions, problem solving, written work, essay/report, oral exam, presentation, laboratory work, other……etc.* *Specifically defined evaluation criteria are stated, as well as if and where they are accessible by the students.*	Oral final exam (100%) including: - Open-ended judgment & documentation questions (the ability to apply the principles and mechanisms and the way of approaching and documenting the subject is evaluated)

5. SUGGESTED BIBLIOGRAPHY:

Taiz & Zeiger, Plant Physiology & Development, 6th American - 2nd Greek Edition 2017, Utopia Publishing.

6. TEACHERS:

-Theory:
Dimitris Bouranis, Professor
Styliani Chorianopoulou, Assistant Professor

-Laboratory:
Dimitris Bouranis, Professor
Styliani Chorianopoulou, Assistant Professor
Georgios Liakopoulos, Associate Professor
Panagiota Bresta, Assistant Professor

Dimosthenis Nikolopoulos Assistant Professor
Emilia-Eleni Nikolopoulou, EDIP