COURSE OUTLINE

1. GENERAL INFORMATION

FACULTY/SCHOOL	APPLIED ECONOMICS AND SOCIAL SCIENCES / ENVIRONMENT AND AGRICULTURAL ENGINEERING		
DEPARTMENT	AGRICULTURAL ECONOMICS AND DEVELOPMENT / NATURAL RESOURCES DEVELOPMENT AND AGRICULTURAL ENGINEERING		
LEVEL OF STUDY	*Pregraduate*		
COURSE UNIT CODE	**9**	**Semester:**	6th / 3rd
COURSE TITLE	PHYSIOLOGY OF PLANTS		
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*	Scientific expertise		
PREREQUISITE COURSES:	BOTANY (SYSTEMATICS-PLANT ANATOMY)		
LANGUAGE OF INSTRUCTION:	Greek		
LANGUAGE OF EXAMINATION/ASSESSMENT:			
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://oeclass.aua.gr/eclass/courses/AFPGM129/		

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*

The first section of the course is dedicated to the understanding of the functions of plants, which is also the subject of the course. It examines the functions as a whole at the level of the organization and how they coordinate with each other. The second section examines the basic functions, i.e. photosynthesis, transpiration, respiration and nutrition. The knowledge of these functions represents background knowledge for the student, necessary in a series of courses with more agronomic oriented content. The third section presents the transport mechanisms and the coordination of functions through hormones, as well as the coordination with the environment, through the perception of external stimuli. This section is also important because it refers to applications in agricultural practice. The fourth section examines

the effects of pathogens and enemies on the structure and function of plant organisms and the mechanisms through which plants defend themselves. Special mention is made of secondary metabolites, molecules which play an important role in defense. The knowledge of defense mechanisms is a prerequisite not only for understanding the courses of Phytopathology and Pharmacology, but also for a number of applications such as the production of biologically active substances.

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.)*
	…….

Individual/Independent work
Group/Team work
Environmental awareness
Development of free, creative and inductive thinking

3. COURSE CONTENT

THEORY

• Introduction: The main functions of plants. The effect of photosynthetic organisms on shaping the planet's physiognomy
The subject of Physiology is the study of the functions of plants: A summary of the main functions
The appearance of photosynthetic organisms dramatically changed the face of the planet
The colonization of land by plant organisms was based on new, improved structures and functions
Photosynthesis: The energy supplier of the Biosphere
The light reactions of photosynthesis
The photosynthetic electron flow
The conversion of photon energy into chemical energy in the form of ATP and NADPH
The phase of the biochemical reactions of photosynthesis
The chemical energy of the products of the light reactions (ATP and NADPH) is used for the assimilation of CO_2 and the synthesis of carbohydrates in the biochemical reactions of photosynthesis
• Transpiration: The inevitable consequence of land colonization
The function of transpiration
Adjustable and non-adjustable resistances limit water losses
The contribution of osmosis to stomatal movements
• Cellular Respiration: The regulator of energy and carbon balance
The metabolic fate of photosynthetic products depends on current carbon and energy needs
Cellular aerobic respiration: An efficient catabolic process that provides substrates and energy to all cells
The pathway of respiration
Glycolysis is the catabolic pathway of glucose breakdown that takes place in the cytoplasm and produces pyruvate
Through the link reaction pyruvate enters the Krebs cycle
Acetyl enters the Krebs cycle and is completely oxidized to CO_2 while ATP and NADH are produced
The final stage of aerobic respiration: The respiratory chain and ATP production
In conditions of insufficient or complete lack of oxygen, anaerobic respiration operates as an alternative
• Certain environmental factors affect the energy, carbon and water balances of plants
The vital role of energy, water and carbon balances in plants
Energy balance depends on energy supply

Carbon and water balances are affected by CO2 concentration
Extreme temperatures disrupt the carbon and water balances, but also the energy balance
Water stress disrupts carbon, water and energy balances
• The transport of water, inorganic nutrients and photosynthetic products: A necessary requirement for the development of a complex organism
The transport of water from the soil to the atmosphere through the plant body
The entry of water into the root from the soil requires a water potential difference
After entering the root, the water should be directed to the xylem vessels
The movement of water in xylem vessels occurs through mass flow due to either a negative pressure (tension) developed in the above-ground part or a positive pressure developed in the root (root pressure)
The uptake, transport and assimilation of nutrients
The root absorbs nutrients from the soil which are transferred to the above-ground part of the plant
Classification of essential nutrients based on plant requirements
The availability of soil nutrients to plants
The mechanisms of nutrient absorption by roots
Movement of nutrients from the root to the final destinations
Essential nutrients play vital roles
The lack of a single essential element causes deficiency
The phloem is the main transport tissue of the photosynthetic products from the sources to the sinks
Phloem loading mechanisms
Phloem unloading can be either symplasmic or apoplasmic
The distribution of photosynthetic products to sinks
• Internal coordination: Phytohormones coordinate functions to complete the complex developmental program
The internal coordination: The plant hormones (phytohormones)
The mechanisms of action of plant hormones
• External coordination: The perception of stimuli and the coordination of functions with the conditions prevailing in the external abiotic environment
The perception of stimuli from the external abiotic environment and the reactions of plants
The mechanisms of external coordination
The perception of light quality and quantity: Phytochrome and photomorphogenesis
The perception of the length of the day. Photoperiodism as a mechanism for measuring time
The mechanisms by which plants measure time
The perception of the photoperiodic stimulus and the induction of flowering: A complex mechanism of confirmation of the favorable period for reproduction
The mechanisms of plant movement
PhyA regulates gravitropic and phototropic perception
• The interactions between plants and other organisms
Defense: Care for survival
The fundamental preexisting defense mechanisms
Induced defense relies on the timely activation of certain defense mechanisms
The defense of plant tissues is not always effective
Symbiotic relationships confer benefits on both partners
Mycorrhizal symbiotic relationships dramatically improve nutrient absorption
The symbiotic relationships of the roots with nitrogen-fixing bacteria lead to the formation of nodules
Beneficial microorganisms: A new field of research

LABORATORY

Exercise 1: Production of starch during photosynthesis
Exercise 2: Study of the hydrolysis of starch by its hydrolytic enzymes in vitro
Exercise 3: The water state of the plant cell: turgor - plasmolysis
Exercise 4: Determining the water status of plant tissue: Water potential
Exercise 5: Transpiration and stem function
Exercise 6: Seed germination and its measurements. Scotomorphogenesis and photomorphogenesis.

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	39
Laboratory practice	10
Individual laboratory project (data processing and commenting)	30
Personal study	46
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.*	**I. Final written exam in the theory of the course** including a combination of 10 short-answer questions, open-ended questions and multiple choice questions. **II. The written examination in the laboratory part of the course** includes 5 short answer, open-ended, problem solving and documentation questions (the ability to apply the principles and mechanisms and the way of approaching and documenting the answer is evaluated).

5. SUGGESTED BIBLIOGRAPHY:

Plant Physiology. G. Aivalakis, G. Karabourniotis, G. Liakopoulos, EMBRYO Publications (in Greek)
Introdution to Plant Physiology, 4th edition. W.G. Hopkins, N.P.A. Hüner, Wiley Publications.

6. TEACHERS:

-Theory:
George Karabourniotis, Professor
Georgios Liakopoulos, Associate Professor
Dimosthenis Nikolopoulos, Assistant Professor
-Laboratory:
Georgios Liakopoulos, Associate Professor
Dimosthenis Nikolopoulos, Assistant Professor
Panagiota Bresta, Assistant Professor