**COURSE LAYOUT**

1. **GENERAL**

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| **SCHOOL** | OF APPLIED ECONOMICS AND SOCIAL SCIENCES |
| **DEPARTMENT** | AGRICULTURAL ECONOMICS AND RURAL DEVELOPMENT |
| **STUDY LEVEL** | *Undergraduate* |
| **COURSE CODE** | 9 | **SEMESTER** | 6th |
| **COURSE TITLE** | Plant Physiology |
| **INDEPENDENT TEACHING ACTIVITIES** | **WEEKLY TEACHING HOURS** | **ECTS** |
| LECTURES | 3 | 5 |
| LABORATORY CLASSES | 2 |  |
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| **COURSE TYPE** | GENERAL KNOWLEDGE |
| **PREREQUISITES** | BOTANY, PHYSICS, MATHEMATICS |
| **LANGUAGE** | Greek |
| **IS THE COURSE OFFERED forERASMUS STUDENTS?** | YES (in English) |
| **COURSE WEB PAGE** | https://mediasrv.aua.gr/eclass/courses/AFPGM129/ |

1. **LEARNING OUTCOMES**

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| **Learning Outcomes** |
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| Aim of the course is to introduce and explore the physiology of the vascular plants. In the first unit, are discussed the plant functions and their coordination in the plant organism. The second unit, aims to the understanding of the basic functions –photosynthesis, transpiration, cellular respiration, plant nutrition- which are the basic knowledge for upcoming courses. The next unit, deals with the transport mechanisms, the internal coordination via hormonal signals, and the coordination of the plant organism with the environment, via the perception of external stimuli. The last unit, refers to the interactions between plants and other organisms. Main goal, is to investigate and understand the defense mechanisms of the plant species against pathogens and/or other enemies, with special mention to the secondary metabolites, that play a crucial role. Along with the laboratory classes and assignments, the learning outcomes of the course, are the understanding of the basic plant organism’s functions, the way the plant coordinates with the environment, and the way it can survive and defense against the external threats. All the above mentioned subjects, are important and form the basic knowledge both for agronomical applications, the course of phytopathology, and for the development and production of bioactive products.  |
| **General Competences** |
| * Autonomous work and assignments
* Group work and assignments
* Environmental awareness
* Development of analytical and creative thinking skills
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1. **COURSE CONTENT**

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| **Theory*** Introduction: The main functions of plants. The influence of photosynthetic organisms on the formation of the physiognomy of the planet

The subject of Physiology is the study of plant functions: A summary of the main functionsThe advent of photosynthetic organisms has dramatically changed the face of the planetThe colonization of the land by plant organisms was based on new, improved structures and functionsPhotosynthesis: The energy feeder of the biosphereThe light reactions of photosynthesisThe photosynthetic electron flowThe conversion of photons into chemical energy in the form of ATP and NADPHThe biochemical reactions of photosynthesisThe chemical energy of the products of light reactions (ATP and NADPH) is used for the assimilation of CO2 and the synthesis of carbohydrates during the biochemical reactions of photosynthesis* Transpiration: The inevitable consequence of the colonization of the land by plants

The function of transpirationAdjustable and non-adjustable resistances reduce water lossesThe contribution of osmosis to stomatal movements* Cellular respiration: Managing energy and carbon skeletons

The metabolic fate of photosynthetic products depends on carbon and energy needsCellular aerobic respiration: An efficient catabolic process that provides substrates and energy to all cellsThe pathway of respirationGlycolysis is the catabolic process of glucose breakdown that takes place in the cytoplasm and produces pyruvateThrough the link reaction the pyruvate enters the Krebs cycleAcetyl enters the Krebs cycle and is completely oxidized to CO2 while producing ATP and NADHThe final stage of aerobic respiration: The respiratory chain and ATP productionAnaerobic respiration works in conditions of insufficiency or complete lack of oxygen* Certain environmental factors affect the energy, carbon and water balances of plants

The vital role of energy, water and carbon balancesThe energy balance depends on the energy supplyCarbon and water balances are affected by CO2 concentrationExtreme temperatures impede carbon and water balances, as well as energy balanceWater stress disturbs the balances of carbon, water and energy* The transport of water, minerals and photosynthetic products: A prerequisite for the development of a complex organism

The transfer of water from the soil to the atmosphere through the plantThe entry of water into the root from the ground requires a difference in water potential After entering the root, the water should be directed to the xylem vesselsThe movement of water in the xylem vessels occurs through mass flow that is due either to a negative pressure (tension) that develops in the aboveground part or to a positive pressure that develops in the root (root pressure)The uptake, transfer and assimilation of nutrientsThe root absorbs nutrients from the soil which are transferred to the aboveground partsClassification of the essential nutrients based on the requirements of the plantsThe availability of nutrients to plantsThe mechanisms of nutrient uptake by rootsMovement of nutrients from the root to the aboveground partsEssential nutrients play vital rolesLack of a single essential element causes nutrient deficiencyThe phloem is the main transport path for photosynthetic products from sources to sinksPhloem loading mechanismsUnloading of the phloem can take place viasymplasmic or apoplasmic mechanismsThe distribution of photosynthetic products to the sinks* Internal coordination: Phytohormones coordinate plant functions in order to complete the complex development program

Internal coordination: Plant hormones (phytohormones)The mechanisms of action of phytohormones* External coordination: The perception of stimuli and the coordination of functions with the conditions prevailing in the external abiotic environment

Perception of stimuli from the external abiotic environment and plant responsesThe mechanisms of external coordinationPerception of the quality and quantity of light: Phytochrome and photomorphogenesisThe perception of the length of the photoperiod. Photoperiodism as a mechanism of time measurementThe mechanisms by which plants measure timeThe perception of photoperiodic stimulus and the induction of flowering: A complex mechanism for confirming the favorable period for reproductionThe mechanisms of plant movementPhyA regulates gravitropic and phototropic sensing* Interactions between plants and other organisms

Defense: Caring for survivalThe mechanisms of fundamental pre-existing defenseInduced defense is based on the timely activation of certain defense mechanismsDealing with an invasion strengthens the plant organismPlant tissue defense is not always effectiveSymbiotic relationships bring benefits to both partnersThe symbiotic relationships of mycorrhizae dramatically improve nutrient absorptionThe symbiotic relationships of roots with nitrogen-fixing bacteria lead to the formation of nodulesBeneficial microorganisms: A new field of research**Laboratory exercises**Exercise 1: Synthesis of starch from photosynthesisExercise 2: Starch hydrolysis from its hydrolyzing enzymes in vitroExercise 3: Plant cell water status: turgor - plasmolysisExercise 4: Determination of plant tissue water status: Water potentialExercise 5: Transpiration and stem functionExercise 6: Seed germination and relevant measurements. Skotomorphogenesis and photomorphogenesis |

1. **TEACHING and LEARNING METHODS - Evaluation**

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| **TEACHING METHOD** | Live, face to face teaching in the classroom\*\*Due to the special circumstances (COVID-19), the method may differ. |
| **USE OF INFORMATICS and COMMUNICATION TECHNOLOGIES** | For the course are both used Power-point presentation and the class board. There is contact with the students via e-mail. The support of learning process and the necessary materials are facilitated by the electronic, web based e-class platform. |
| **TEACHING ORGANISATION** |

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| *Activity* | *Workload* |
| Lectures (direct) | 39 |
| Laboratory Classes | 10 |
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| Individual work (experimental results) | 30 |
| Autonomous study | 46 |
| *Total contact hours and training(25 hours per ECTS)* | ***125******(5 ECTS)*** |

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| **STUDENTS EVALUATION** | 1. Theory: Written final examination 10 short answer questions or multiple choice\*
2. Laboratory class: Written final examination with open type questions and questions that need critical thinking (the evaluation is based on the capability of the student to apply the taught principles and mechanisms)\*

\*Due to the special circumstances (COVID-19), the method of evaluation may differ. |

1. **BIBILIOGRAPHY**

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| Book: Aivalakis G., Karabourniotis G., Liakopoulos G. (2016), Plant Physiology, Embryo Publishers, Athens (in Greek) |