**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 | |

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 functions  The advent of photosynthetic organisms has dramatically changed the face of the planet  The colonization of the land by plant organisms was based on new, improved structures and functions  Photosynthesis: The energy feeder of the biosphere  The light reactions of photosynthesis  The photosynthetic electron flow  The conversion of photons into chemical energy in the form of ATP and NADPH  The biochemical reactions of photosynthesis  The 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 transpiration  Adjustable and non-adjustable resistances reduce water losses  The contribution of osmosis to stomatal movements   * Cellular respiration: Managing energy and carbon skeletons   The metabolic fate of photosynthetic products depends on 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 process of glucose breakdown that takes place in the cytoplasm and produces pyruvate  Through the link reaction the pyruvate enters the Krebs cycle  Acetyl enters the Krebs cycle and is completely oxidized to CO2 while producing ATP and NADH  The final stage of aerobic respiration: The respiratory chain and ATP production  Anaerobic 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 balances  The energy balance depends on the energy supply  Carbon and water balances are affected by CO2 concentration  Extreme temperatures impede carbon and water balances, as well as energy balance  Water 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 plant  The 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 vessels  The 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 nutrients  The root absorbs nutrients from the soil which are transferred to the aboveground parts  Classification of the essential nutrients based on the requirements of the plants  The availability of nutrients to plants  The mechanisms of nutrient uptake by roots  Movement of nutrients from the root to the aboveground parts  Essential nutrients play vital roles  Lack of a single essential element causes nutrient deficiency  The phloem is the main transport path for photosynthetic products from sources to sinks  Phloem loading mechanisms  Unloading of the phloem can take place viasymplasmic or apoplasmic mechanisms  The 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 responses  The mechanisms of external coordination  Perception of the quality and quantity of light: Phytochrome and photomorphogenesis  The perception of the length of the photoperiod. Photoperiodism as a mechanism of time measurement  The mechanisms by which plants measure time  The perception of photoperiodic stimulus and the induction of flowering: A complex mechanism for confirming the favorable period for reproduction  The mechanisms of plant movement  PhyA regulates gravitropic and phototropic sensing   * Interactions between plants and other organisms   Defense: Caring for survival  The mechanisms of fundamental pre-existing defense  Induced defense is based on the timely activation of certain defense mechanisms  Dealing with an invasion strengthens the plant organism  Plant tissue defense is not always effective  Symbiotic relationships bring benefits to both partners  The symbiotic relationships of mycorrhizae dramatically improve nutrient absorption  The symbiotic relationships of roots with nitrogen-fixing bacteria lead to the formation of nodules  Beneficial microorganisms: A new field of research  **Laboratory exercises**  Exercise 1: Synthesis of starch from photosynthesis  Exercise 2: Starch hydrolysis from its hydrolyzing enzymes in vitro  Exercise 3: Plant cell water status: turgor - plasmolysis  Exercise 4: Determination of plant tissue water status: Water potential  Exercise 5: Transpiration and stem function  Exercise 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** | |  |  | | --- | --- | | *Activity* | *Workload* | | Lectures (direct) | 39 | | Laboratory Classes | 10 | |  |  | | Individual work (experimental results) | 30 | | Autonomous study | 46 | | *Total contact hours and training(25 hours per ECTS)* | ***125***  ***(5 ECTS)*** | |
| **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) |