SZKOŁA GŁÓWNA GOSPODARSTWA WIEJSKIEGO

Physiomics

Educational subject description sheet

Basic information

Field of study Biotechnology	**Didactic cycle** 2024/25
Speciality -	**Subject code** BBTBTjS_D.310K.01606.24
Organizational unit Faculty of Biology and Biotechnology	**Lecture languages** english
Study level first cycle (engineering degree)	**Mandatory** Obligatory subjects
Study form full-time studies	**Block** Major subjects
Education profile General academic	**Disciplines** Biological sciences

Coordinator	Stanisław Karpiński
Teacher	Stanisław Karpiński

Period Semester 5	**Examination** Exam **Activities and hours** Lecture: 15	**Number of ECTS points** 1

Goals

Code	Goal
C1	The aim of the course is to provide students with a comprehensive (holistic) approach to the functioning of the plant organism, along with paying attention to the adaptation of plant life strategies to changing environmental conditions resulting from evolutionary processes. During the course, students will learn about specialist terminology used in plant physiomics.

Entry requirements

Basic knowledge of biochemistry, molecular biology and plant physiology
Before starting the course, the student should have knowledge of plant physiology and cell structure, basic molecular mechanisms

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	the structure of plant and animal cells and the physiological processes	BTj_K3_W04, BTj_K3_W05, BTj_K3_W06	Written exam
W2	the physiomic approach integrates the entire plant metabolism at all levels of its organization into one network of mutual dependencies	BTj_K3_W04, BTj_K3_W05, BTj_K3_W06, BTj_K3_W07_inz, BTj_K3_W08, BTj_K3_W10, BTj_K3_W12	Written exam
W3	the importance of a holistic and systemic approach to the functioning of plants, starting from the molecular level, through cells, tissues and organs, and ending with the entire plant organism	BTj_K3_W03, BTj_K3_W04, BTj_K3_W05, BTj_K3_W06, BTj_K3_W07_inz, BTj_K3_W08, BTj_K3_W09, BTj_K3_W10, BTj_K3_W12, BTj_K3_W13_inz	Written exam
W4	the mechanisms of gene expression	BTj_K3_W08, BTj_K3_W10	Written exam
Skills – Student can:			
U1	comprehensively assess the complexity of biochemical signals occurring in plants	BTj_K3_U01_inz, BTj_K3_U02_inz, BTj_K3_U03, BTj_K3_U04_inz, BTj_K3_U05_inz, BTj_K3_U06_inz, BTj_K3_U07, BTj_K3_U08_inz, BTj_K3_U09_inz, BTj_K3_U10_inz, BTj_K3_U11_inz, BTj_K3_U12_inz, BTj_K3_U13_inz, BTj_K3_U14_inz, BTj_K3_U15_inz, BTj_K3_U16, BTj_K3_U17, BTj_K3_U18, BTj_K3_U19, BTj_K3_U21, BTj_K3_U22	Written exam
Social competences – Student is ready to:			
K1	identify significant mechanisms influencing the physiology of plants, which should be analyzed in more detail in the systems studied	BTj_K3_K02, BTj_K3_K06, BTj_K3_K07	Written exam

K2	recognize the complexities of signal conduction mechanisms in plants	BTj_K3_K01	Written exam

Study content

No.	Course content	Subject's learning outcomes	Activities
1.	Developing a comprehensive (holistic) approach to the functioning of the plant organism in students, along with paying attention to the adaptation of plant life strategies to changing environmental conditions resulting from evolutionary processes. Specialist terminology used in plant physiomics. Issues such as: Differences in structure and function between plant and animal cells. Photosynthesis, structure and function of the photosynthetic apparatus, mechanism of action and regulation of the photosynthetic electron transport chain, extinction and dissipation of excess excitation energy (NPQ). Breathing and the respiratory electron transport chain. Interrelationship between respiration and photosynthesis. Regulation of plant temperature and NPQ, the role of NPQ in the mechanism of light cell memory and plant acclimatization, regulation of growth and yield. The role of chloroplast retrosignals in the coordination of plant responses to environmental stresses andthe regulation of gene expression, the role of cis and trans regulatory elements. Molecular physiology of biotic and abiotic stress in plants. Cellular automaton and intelligent signal network in plants, regulation of transpiration and water consumption efficiency. Electrical signals in plants and their role.	W1, W2, W3, W4, U1, K1, K2	Lecture

Course advanced

Activities	Methods of conducting classes
Lecture	Lecture, Problem lecture, E-learning - lecture part

Activities	Examination method	Percentage
Lecture	Written exam	100%

Activities	Credit conditions
Lecture	Collecting at least 51% of points

Literature

Obligatory

1. Baker, N.R. (2008). Chlorophyll fluorescence: a probe of photosynthesis in vivo. Annu. Rev. Plant Biol 59: 89-113.
2. Mullineaux, P.M., Karpinski, S. (2002). Signal transduction in response to excess light: getting out of the chloroplast. Curr. Opin. Plant Biol. 5: 43-48.
3. Peak, D., West, J.D., Messinger, S.M., and Mott, K.A. (2004). Evidence for complex, collective dynamics and emergent, distributed computation in plants. Proc. Natl. Acad. Sci. USA 101: 918-22.
4. Szechyńska-Hebda, M., Kruk, J., Górecka, M., Karpińska, B., Karpiński, S. (2010). Evidence for light wavelength-specific photoelectrophysiological signaling and memory of excess light episodes in Arabidopsis. Plant Cell 22: 2201-2218.
5. Taiz, L., Zeiger, E. (2002) Plant Physiology. Third edition. Sinauer Associates Inc., pp. 700.

Calculation of ECTS points

Activity form	**Activity hours***
Lecture	15
Preparation for the exam	10
Student workload	**Hours** 25
Number of ECTS points	**ECTS** 1

* hour means 45 minutes

Effects

Code	Content
BTj_K3_K01	The graduate is ready to proper storage of data, updating and extending knowledge on topics related to biotechnology and the related sciences;
BTj_K3_K02	The graduate is ready to development and application of one’s skills in practice (including communication, teamwork), which enable effective lifelong learning with respect to biological sciences;
BTj_K3_K06	The graduate is ready to presenting justified arguments supporting one’s standpoint regarding scientific, ethical and social topics influencing the progress in biological sciences;
BTj_K3_K07	The graduate is ready to recognising the scope and ethical nature of the effects of utilising biotechnology and its impact on the society; settling ethical dilemmas related to the work of a biotechnologist;
BTj_K3_U01_inz	The graduate can utilise proper techniques and knowledge related to biotechnology in practice, under the care of a supervisor;
BTj_K3_U02_inz	The graduate can perform and present an independent experiment (a final diploma thesis), which reflects features such as: e.g. competences associated with the ability of proper time management, solving a research problem as well as performing tasks and interpreting the quality of results;
BTj_K3_U03	The graduate can provide and explain specific examples and apply proper experimental methods associated with the explanation of principles related to gene expression;
BTj_K3_U04_inz	The graduate can present and discuss key principles of scientific interdisciplinary bases, as well as a multidisciplinary approach to the processes and mechanisms of life;
BTj_K3_U05_inz	The graduate can understand and explain chemical processes forming a basis for explaining biochemical reactions, and able to apply proper techniques for their investigation;
BTj_K3_U06_inz	The graduate can use laboratory equipment in order to gather observations and data
BTj_K3_U07	The graduate can follow proper principles of safety and work ethics during the execution of scientific research using various experimental methods under laboratory and field conditions
BTj_K3_U08_inz	The graduate can assess the social, economic and legal conditions of the activities of a biotechnologist;
BTj_K3_U09_inz	The graduate can preliminarily asses the economic effect of the proposed modifications of a biotechnological process;
BTj_K3_U10_inz	The graduate can critically assess the functionality and validity of technical and technological solutions used in a biotechnological process;
BTj_K3_U11_inz	The graduate can able to assess the usefulness of the available methods or devices and propose potentially the best solution when solving a practical problem related to the technological utilisation of biological material;
BTj_K3_U12_inz	The graduate can plan and perform experiments related to the preparation, creation and utilisation of biological material in a production process;
BTj_K3_U13_inz	The graduate can propose analytical methods and plan an experiment for solving engineering tasks related to various stages of creating a biotechnological product;
BTj_K3_U14_inz	The graduate can translate the results of experiments into practical solutions;
BTj_K3_U15_inz	The graduate can design modification of the features of a biological organism and the conditions of a process associated with the multiplication of biological material in accordance with the adopted assumptions, select devices and unit operations related to the extraction, purification and preservation of a bioproduct;
BTj_K3_U16	The graduate can choose and apply proper symbols, graphical signs and language forms for presenting scientific ideas, plans and experimental results (e.g. the utilisation of chemical formulas for biological molecules);
BTj_K3_U17	The graduate can analyse topics from genetics and molecular biology, provide and explain certain detailed examples;

Code	Content
BTj_K3_U18	The graduate can coherently communicate within the scope of the topics pertaining to biotechnology both with specialists and with outside receivers;
BTj_K3_U19	The graduate can use a foreign language in speech and in writing within the scope of fields of science and scientific disciplines proper for the field of biotechnology, according to the requirements defined for level B2 of the Common European Framework of Reference for Languages;
BTj_K3_U21	The graduate can coping with understanding, planning and analysing; being able to interpret and report biological data acquired while working individually and in a group;
BTj_K3_U22	The graduate can find and assess information from various sources, including from original research, and present in a well organised manner (e.g. essays, reports and laboratory reports);
BTj_K3_W03	The graduate knows and understands key aspects of biotechnology
BTj_K3_W04	The graduate knows and understands the necessity to use proper simple computational techniques (including statistical analysis, computational tools and computer software suites) for biological data
BTj_K3_W05	The graduate knows and understands the principles which define the three-dimensional structure of biological macromolecules, with the ability to explain and provide the examples of the relationship between structure and function
BTj_K3_W06	The graduate knows and understands the functions of various cells (prokaryotic and eukaryotic), being able to critically explain, how their properties are related to varying biological functions, knowing how they can be tested experimentally
BTj_K3_W07_inz	The graduate knows and understands experimental methods serving the examination of important areas in the field of biotechnology, chemistry, biochemistry, biophysics, molecular biology and the related sciences;
BTj_K3_W08	The graduate knows and understands the features of cellular metabolism and its control, including the knowledge of certain experimental techniques;
BTj_K3_W09	The graduate knows and understands living organisms and their place in the natural environment, and how they can be used for the good of humanity;
BTj_K3_W10	The graduate knows and understands terms, principles and theories related to processes and mechanisms which have shaped the world of nature, knowing how they can be used efficiently;
BTj_K3_W12	The graduate knows and understands the principles of mathematics and statistics for assessing and interpreting phenomena and processes occurring in the environment;
BTj_K3_W13_inz	The graduate knows and understands the importance of processes necessary to asses and initiate research in the field of biotechnology;