SZKOŁA GŁÓWNA GOSPODARSTWA WIEJSKIEGO

Sensors, Indices and Bioindicators for Agricultural and Biological Sciences

Educational subject description sheet

Basic information

Field of study Course Offer for exchange students - second cycle studies, including uniform master studies (MA programmes) **Speciality** - **Organizational unit** Course Offer for exchange students **Study level** second cycle studies, including uniform master studies (MA programmes) **Study form** full-time studies **Education profile** General academic	**Didactic cycle** 2024/25 **Subject code** PWMPWM2S_D.B100000P.06423.24 **Lecture languages** english **Mandatory** Elective subjects **Block** Basic subjects **Disciplines**

Coordinator	Mohamed Kalaji
Teacher	Mohamed Kalaji

Period Winter semester	**Examination** Pass with grade **Activities and hours** Lecture: 30 Laboratory exercises: 30 Field exercises: 15	**Number of ECTS points** 7

Goals

Code	Goal
C1	The aim of this course is to provide students with comprehensive knowledge related to the employment of very advanced sensors and instrumentations in the field of plant science including: agronomy, ecology, horticulture, biology, botany, crop sciences, forestry, food production, meteorology and plant physiology. The course includes hands-on training for the students.
C2	This course is based on Oxford and Cambridge's one-on-one teaching model (Tutorial System), which promotes liberal education and the development of critical thinking among students. The Oxford tutoring system is a face-to-face meeting between tutor and student. Essays are usually submitted weekly and form the basis of tutorial discussions. Grades are based on the essays, discussions, and presentations. The objective of this course is to provide students with a comprehensive knowledge of the use of state-of-the-art sensors and instruments in the field of plant science. This includes understanding the physiological state of plants, applying artificial neural networks and machine learning to develop future devices to predict coming changes before they are visible to the naked eye or other, usually destructive, methods. Students will also learn how we can communicate with plants to understand and inform them about their needs. Finally, the student will be open to developing a biological feedback system that allows plants to control their growing environment.

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	Main development trends in the field/discipline.		Project, Presentation, Assessment of speeches during classes, Assessment of work in the laboratory
W2	The methodology of scientific research in the field/discipline of research, including programs for data analysis.		Project, Presentation, Assessment of speeches during classes, Assessment of work in the laboratory
Skills – Student can:			
U1	Develop research methodology and creatively use research methods, techniques and tools, characteristic of the field/discipline.		Project, Presentation, Assessment of speeches during classes, Assessment of work in the laboratory
U2	Use didactic skills and professional qualifications related to the methodology and technique of conducting didactic classes, including modern methods and techniques of conducting classes.		Project, Presentation, Assessment of speeches during classes, Assessment of work in the laboratory
Social competences – Student is ready to:			
K1	Representing one's position during substantive discussions, also of an interdisciplinary nature.		Project, Presentation, Assessment of speeches during classes, Assessment of work in the laboratory

Code	Outcomes in terms of	Effects	Examination methods
K2	Recognition of knowledge in solving cognitive and practical problems specific to the research area (field/discipline) and in an interdisciplinary approach.		Project, Presentation, Assessment of speeches during classes, Assessment of work in the laboratory

Study content

No.	Course content	Subject's learning outcomes	Activities
1.	• Illumination intensity and spectral composition • Leaf Area Index (LAI) • Analysis of plant architecture • Normalised Difference Vegetation Index (NDVI) • Pigment concentration • Photosynthesis, respiration, transpiration, and stomatal conductance are biological processes. The photosynthetic efficiency of photosynthesizing organisms. • Study of the moisture content and water potential in plants and various plant organs • Comparison of Temperature Measurement • Remote Sensing • Modelling and Artificial Neural Networks (ANN) • Phenotyping systems and mobile phone applications for biological and agricultural research. • Artificial Indigence and machine learning	W1, W2, U1, U2, K1, K2	Lecture
2.	Equipping students with practical training and expertise in utilising sophisticated instruments to anticipate and identify the impact of stressors on plant growth. The purpose of this section is to equip students with extensive information regarding the use of cutting-edge instruments in the realm of plant science, encompassing disciplines such as agronomy, horticulture, biology, botany, crop sciences, forestry, ecology, soil science, meteorology, and plant physiology.	W1, W2, U1, U2, K1, K2	Laboratory exercises
3.	The field classes involve conducting experiments in controlled or semi-controlled environments such as growth chambers and greenhouses. Additionally, students may have the opportunity to visit various Polish scientific institutes, including the Greenhouse Experimental Station of SGGW, ITP, IHAR, IBL, IUNG, INHORT, and the Botanical Garden, where they can make use of field measurements.	W1, W2, U1, U2, K1, K2	Field exercises

Course advanced

Activities	Methods of conducting classes
Lecture	Lecture, Conversation lecture, Case study, Discussion, Brainstorm, Presentation, Problem solving, Analysis of source materials, Teamwork
Laboratory exercises	Laboratory (experiment), learning by experiment

Activities	Methods of conducting classes
Field exercises	Field measurements, Field observations, Measurement

Activities	Examination method	Percentage
Lecture	Presentation	50%
Lecture	Assessment of speeches during classes	20%
Laboratory exercises	Assessment of work in the laboratory	15%
Field exercises	Project	15%

Activities	Credit conditions
Lecture	Assessment of students' preparation (student lectures), students' reports and presentations (exercises) and their activity during classes.
Laboratory exercises	Students make measurements in the laboratory and analyze the results obtained.
Field exercises	Students perform measurements in field conditions and analyze the results obtained and be prepared to share in manuscript creation.

Literature

Obligatory

1. https://scholar.google.pl/scholar?hl=pl&as_sdt=0%2C5&as_ylo=2022&as_vis=1&q=non-invasive+methods+plant+physiology&btnG=
2. Kalaji M. H., Pietkiewicz S., 2004. Some physiological indices to be exploited as a crucial tool in plant breeding. Plant Breeding and Seeds Science. 49: 19-39. Review. Hunt S., 2003. Measurements of photosynthesis and respiration in plants. Physiologia Plantarum117: 314-325. Gloser J., Gloser V., 2001. Biophysical non-invasive methods for stress detection in Plants. JCEA 2: 1-2.
3. Kalaji M.H., Guo P. 2008. Chlorophyll fluorescence: A useful tool in barley plant breeding programs. In: Photochemistry Research Progress (Eds. A. Sanchez, S. J. Gutierrez). Nova Publishers, NY, USA, 439-463. Bussotti F., Desotgiu R., Pollastrini M., Kalaji M.H., Łoboda T., Bosa K., 2012. Misurare la vitalita delle piante per mezzo della fluorescenza della clorofilla. Universita di Firenze. I edizione italiana.
4. Kalaji M.H., Goltsev V., Bosa K., Allakverdiev S.I., Strasser R.J., Govindjee. Experimental in vivo measurements of light emission in plants: a perspective dedicated to David Walker. Photosynthesis Research, 114: 69-96
5. Goltsev V., Zaharieva I., Chernev P., Kouzmanova M., Kalaji M.H., Yordanov I., Krasteva V., Alexandrov V., Stefanov D., Allakverdiev S., Strasser R.J., 2012. Drought-induced modifications of photosynthetic electron transport in intact leaves: Analysis and use of neural networks as a tool for a rapid non-invasive estimation. Biochim. Biophys. Acta – Bioenergetics 1817: 1490-1498.
6. Kalaji M.H., Goltsev V., Bosa K., Allakverdiev S.I., Strasser R.J., Govindjee. Experimental in vivo measurements of light emission in plants: a perspective dedicated to David Walker. Photosynthesis Research 114:69–96.
7. Kalaji M.H., Gert Schansker, Richard J. Ladle, et al. 2014. Frequently Asked Questions about in vivo chlorophyll fluorescence: practical issues. Photosynthesis Research.DOI: 10.1007/s11120-014-0024-6

Optional

1. https://www.nature.com/subjects/climate-change/srep Instruments: http://www.hansatech-instruments.com/ http://ppsystems.com/ http://www.bbe-moldaenke.de/en/ http://psi.cz/

Calculation of ECTS points

Activity form	Activity hours*
Lecture	30

Laboratory exercises	30
Field exercises	15
Preparation for exercises	20
Preparing the project	20
Preparation of a paper	50
Preparation of a multimedia presentation	45
Student workload	**Hours** 210
Number of ECTS points	**ECTS** 7

* hour means 45 minutes