SZKOŁA GŁÓWNA GOSPODARSTWA WIEJSKIEGO

Climate Change Impacts on Plant Growth and Crop Yield: Non-Invasive Monitoring Methods

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.B100000.06439.24 **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** 10

Goals

Code	Goal
C1	The aim of this course is to equip students with the theoretical knowledge and practical tools necessary to understand the impact of climate change on crop growth and quality. The course will thoroughly emphasise the use of analytical tools to aid in making informed decisions regarding current and future changes in the complex global climate situation.
C2	Additional goals: The goals of providing a course related to climate change issues include: 1. Understanding Climate Change Science: - Provide a comprehensive understanding of the scientific principles behind climate change. - Explore the evidence and mechanisms of global climate change. 2. Analyzing Climate Impact on Agriculture: - Assess the impact of climate change on crop growth and quality. - Study the effects of changing weather patterns, temperature, and CO2 levels on agriculture. 3. Developing Analytical Skills: - Equip students with analytical tools and methods to evaluate climate data. - Teach students how to use modeling and simulation tools to predict climate impacts on agriculture. 4. Promoting Sustainable Practices: - Encourage the adoption of sustainable agricultural practices to mitigate climate change effects. - Explore strategies for reducing greenhouse gas emissions in agriculture. 5. Enhancing Decision-Making Abilities: - Train students to make informed decisions based on climate data analysis. - Foster critical thinking and problem-solving skills in the context of climate adaptation and mitigation. 6. Preparing for Future Challenges: - Equip students with the knowledge to anticipate and adapt to future climate-related challenges in agriculture. - Study potential future scenarios and their implications for food security and agricultural sustainability. 7. Encouraging Interdisciplinary Learning: - Integrate knowledge from various fields such as meteorology, soil science, plant physiology, and environmental science. - Promote a holistic understanding of how climate change intersects with different scientific disciplines. 8. Fostering Global Awareness: - Increase awareness of the global nature of climate change and its widespread impacts. - Encourage students to consider the global context of local agricultural practices. 9. Engaging in Policy and Advocacy: - Educate students on the role of policy in addressing climate change. - Encourage involvement in advocacy and policymaking to support sustainable agricultural practices. 10. Building Community Resilience: - Teach strategies for enhancing the resilience of farming communities to climate change. - Explore ways to support local and global food systems in the face of climate challenges.
C3	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 to study climate change. 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 (autonomous systems in agriculture).

Entry requirements

Basic understanding of agricultural or horticultural sciences and related fields.

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.		Oral credit, Project, Presentation
W2	The methodology of scientific research in the field/discipline of research, including programs for data analysis.		Oral credit, Project, Presentation
Skills – Student can:			

Code	Outcomes in terms of	Effects	Examination methods
U1	Develop research methodology and creatively use research methods, techniques and tools, characteristic of the field/discipline.		Oral credit, Project, Presentation
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.		Oral credit, Project, Presentation
Social competences – Student is ready to:			
K1	Representing one's position during substantive discussions, also of an interdisciplinary nature.		Oral credit, Project, Presentation
K2	Recognition of knowledge in solving cognitive and practical problems specific to the research area (field/discipline) and in an interdisciplinary approach.		Oral credit, Project, Presentation

Study content

No.	Course content	Subject's learning outcomes	Activities
1.	1. The climate change – challenge and facts 2. The effects of changes in the world hydrological cycle on availability of water resources 3. The effects of global change on soil conditions in relation to plant growth and food production 4. The CO2 fertilization effect: higher carbohydrate production and retention as biomass and seed yield 5. The effects of elevated CO2 and temperature change on transpiration and crop water use 6. Effects of higher day and night temperatures on growth and yields of some crop plants 7. Adverse effects of elevated levels of ultraviolet (UV)-B radiation and ozone (O3) on crop growth and productivity 8. Combined effects of changing CO2 temperature, UV-B radiation and O3 on crop growth 9. The potential effects of climate change on world food production and security 10. Climate change, global agriculture and regional vulnerability 11. Integrating land-use change and evaluating feedbacks in global change models 12. Global change impacts on agriculture, forestry and soils 13. Global climatic change and agricultural production: An assessment of current knowledge and critical gaps	W1, W2, U1, U2, K1, K2	Lecture

No.	Course content	Subject's learning outcomes	Activities
2.	Providing students with knowledge related to the employment of advanced instrumentations to predict and detect the effects of climate change on plant growth. The aim of this part is to provide students with comprehensive knowledge related to the employment of most advanced instrumentations in the field of plant science including: agronomy, horticulture, biology, botany, crop sciences, forestry, ecology, soil science, meteorology and plant physiology. Topics to be covered in lab: • Light intensity and quality • Morphological parameters of plant leaves • Leaf Area Index • Plant architecture analysis • Water content and potential in plants and different plant organs • Pigments content • Photosynthesis, respiration, transpiration, stomatal conductance • Photosynthetic efficiency of photosynthesizing organisms • Temperature Measurement Comparison • Normalized Difference Vegetation Index • Remote Sensing • Modelling and Artificial Neural Networks (ANN) • Mobile applications for biology and agricultural researches	W1, W2, U1, U2, K1, K2	Laboratory exercises
3.	The field classes include the use of some filed measurements in controlled and semi-controlled conditions (growth chambers, green house) and visiting some Polish scientific institutes such as Skierniewice Experimental Station (SGGW), ITP, IHAR, IBL, IUNG, INHORT and Botanical garden.	W1, W2, U1, U2, K1, K2	Field exercises

Course advanced

Activities	Methods of conducting classes
Lecture	Lecture, Problem lecture, Case study, Discussion, Design method, Teamwork
Laboratory exercises	Teamwork, Laboratory (experiment), learning by experiment, Measurement
Field exercises	Field measurements, Field observations

Activities	Examination method	Percentage
Lecture	Presentation	70%
Laboratory exercises	Oral credit	15%
Field exercises	Project	15%

Activities	Credit conditions
Lecture	Presentation/lecture by the student
Laboratory exercises	Knowledge of the available techniques

Activities	Credit conditions
Field exercises	Proper data interpretation and analysis

Literature

Obligatory

1. https://scholar.google.pl/scholar?as_ylo=2022&q=climate+changes&hl=pl&as_sdt=0,5&as_vis=1
2. PCC AR4 WG1 (2007). Solomon, S.; Qin, D.; Manning, M.; Chen, Z.; Marquis, M.; Averyt, K.B.; Tignor, M.; Miller, H.L., eds. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. ISBN 978-0-521-88009-1. (pb: 978-0-521-70596-7).
3. IPCC TAR WG1 (2001). Houghton, J.T.; Ding, Y.; Griggs, D.J.; Noguer, M.; van der Linden, P.J.; Dai, X.; Maskell, K.; Johnson, C.A., eds. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. ISBN 0-521-80767-0. Archived from the original on 30 March 2016. (pb: 0-521-01495-6).
4. https://www.google.com/search?q=climate+change&tbm=bks&sxsrf=ALeKk01kmW-6UdYekl4W7ZBQNUgu7nhPGg:1602534699539&source=lnt&tbs=sbd:1&sa=X&ved=0ahUKEwjJ7oX88q_sAhVUPcAKHV5uDzMQpwUIIg&biw=1920&bih=969&dpr=1 IPCC AR4 SYR (2007). Core Writing Team; Pachauri, R.K; Reisinger, A., eds. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC. ISBN 92-9169-122-4.
5. https://www.ipcc.ch/ https://research.un.org/en/climate-change/reports https://www.springer.com/journal/40641 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/

Optional

1. Climate Change at DMOZ • Climate Change Resources from SourceWatch • Climate Change from the UCB Libraries GovPubs • Climate Change from the Met Office (UK) • Global Climate Change Indicators from NOAA • Global Climate Change from NASA (US) • Global Carbon Dioxide Circulation (NASA; 13 December 2016) • Climate Change: Evidence & Causes, from the Royal Society and the U.S. National Academy of Sciences • Ocean Motion: Satellites Record Weakening North Atlantic Current
2. • Intergovernmental Panel on Climate Change (IPCC) • United Nations University's 'Our World 2' Climate Change Video Briefs • United Nations University's 'Our World 2' Indigenous voices on climate change films • Climate Change on In Our Time at the BBC. • Climate Change Performance Index 2010 • Climate Library at Center for Ocean Solutions, Stanford University
3. • Climate Change: Coral Reefs on the Edge An online video presentation by Prof. Ove Hoegh-Guldberg, University of Auckland • What We Know — The Reality, Risks and Response to Climate Change 2014 report, Am. Assn. for the Advancement of Science • Climate change and forest genetic resources. • HistoricalClimatology.com • Climate History Network • Confronting the Realities of Climate Change Union of Concerned Scientists

Calculation of ECTS points

Activity form	Activity hours*
Lecture	30
Laboratory exercises	30
Field exercises	15
Preparing the project	50
Preparation of a paper	50

Preparation of a multimedia presentation	100
Student workload	**Hours** 275
Number of ECTS points	**ECTS** 10

* hour means 45 minutes