SZKOŁA GŁÓWNA GOSPODARSTWA WIEJSKIEGO

Green Infrastructure in Climate Change Adaptation

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.06305.24 **Lecture languages** english **Mandatory** Elective subjects **Block** Basic subjects **Disciplines**

Coordinator	Daria Sikorska
Teacher	Daria Sikorska, Agnieszka Karczmarczyk, Agnieszka Bus, Piotr Sikorski, Anna Baryła

Period Winter semester	**Examination** Exam **Activities and hours** Lecture: 20 Laboratory exercises: 10 Field exercises: 15	**Number of ECTS points** 6

Goals

Code	Goal
C1	The course aims to present the problem of the functioning of green infrastructure as an element of the urban landscape and its potential to mitigate the negative effects of climate change.
C2	To present a broad context of urban ecosystem ecology and the role and ecosystem services of greenery in the city
C3	to present planning of green infrastructure for climate change adaptation (flood protection, microclimate mitigation, and protection against noise and dust pollution) using GIS tools
C4	To present practical aspects will be addressed, such as the design and construction of specific nature-based solutions (bioretention ponds, green tracks, rain gardens, green roofs and facades etc.).

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	Students know the difference between the natural and urban water cycle.		Written exam, Project, Report
W2	Students know the principles of the design and maintenance of different types of blue-green infrastructure.		Written exam, Project, Report
W3	Students know the elements of green infrastructure and the ecosystem services they provide		Written exam, Project, Report
Skills – Student can:			
U1	Students are able to choose proper NBS to solvethe specified environmental problem in the city.		Written exam, Project, Report
U2	Students are able to select construction materials for NBS solutions.		Written exam, Project, Report
U3	Students are able to use GIS tools for green infrastructure implementation		Written exam, Project, Report
U4	Students are able to assess the efficiency of different blue-green infrastructure measures.		Written exam, Project, Report
Social competences – Student is ready to:			
K1	Students are able to discuss the options of system upgrading.		Written exam, Project, Report
K2	Students are aware of the social role of green infrastructure implementation		Written exam, Project, Report

Study content

No.	Course content	Subject's learning outcomes	Activities

1.	The concept of green infrastructure (or blue-green infrastructure) has recently gained growing attention as a solution to improve people's health and well-being and a solution to progressing climate change. The course aims to present the problem of the functioning of green infrastructure as an element of the urban landscape and its potential to mitigate the negative effects of climate change. The broad context of urban ecosystem ecology and the role and ecosystem services of greenery in the city will be presented. Contemporary definitions, typology and design principles of urban green infrastructure will be discussed. Using practical examples, students will learn about contemporary trends and concepts related to greenery management in the city, taking into account strategic and planning documents. The practical aspects will be addressed, such as the design and construction of specific nature-based solutions (bioretention ponds, green tracks, rain gardens, green roofs and facades etc.). An important element of the course will also be learning about the planning of green infrastructure for climate change adaptation (flood protection, microclimate mitigation, and protection against noise and dust pollution) using GIS tools. The role of public participation in implementing green infrastructure will be presented.	W1, W2, W3, U1, U2, U3, U4, K1, K2	Lecture, Laboratory exercises, Field exercises
2.	Water balance in the city. UHI effect. Need for adaptation of the cities to the climate change. NBS, LID, SUDS – sets of measures for limitation of the negative impact of urbanization on water balance. Ecosystem services provided by green infrastructure. Green infrastructure as biodiversity hotspots. Technical solutions of rainwater harvesting, rainwater retention, delaying runoff. Constructions and functions of green roofs, green walls, rainwater gardens, stormwater ponds, constructed wetlands, etc. Selection of construction materials in terms of their functions and environmental impact. Green infrastructure in spatial planning and public participation in green infrastructure implementation.	W1, W2, W3, U1, U2, U3, U4, K1, K2	Lecture
3.	Students will design green roof and as an example of green infrastructure and a stormwater retention pond as an example of green infrastructure. Students will learn how to select construction materials based on their functions and potential impact on the environment (laboratory work on assessing the physical and chemical properties of different construction materials). During the field exercise, students will be able to see practical applications of blue-green infrastructure in the area of the University Campus. Part of the exercise will involve ecosystem services screening in the field (Vistula river valley or, optionally Masurian Lakes – only summer semester) and collecting field reference data for spatial analyses in GIS, performed during a desk study.	W1, W2, W3, U1, U2, U3, U4, K1, K2	Laboratory exercises, Field exercises

Course advanced

Activities	Methods of conducting classes
Lecture	Lecture, Conversation lecture, Problem solving, Analysis of source materials, Observation

Activities	Methods of conducting classes
Laboratory exercises	Problem solving, Individual work, Laboratory (experiment), learning by experiment, Measurement
Field exercises	Case study, Problem solving, Observation, Field observations

Activities	Examination method	Percentage
Lecture	Written exam	40%
Laboratory exercises	Project	30%
Field exercises	Report	30%

Activities	Credit conditions
Lecture	Lectures – written exam (test form);
Laboratory exercises	report from the laboratory classes; computer GIS project assessment, presentation of the project results
Field exercises	computer GIS project assessment, presentation of the project results

Literature

Obligatory

1. Kabish N., Korn H., Stadler J., Bonn A., 2017. Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice (Theory and Practice of Urban Sustainability Transitions). Springer; 1st ed.
2. Braeas R.C., 2020. Nature-Based Solutions to 21st Century Challenges. DOI: 10.4324/9780429294600
3. Braeas R.C., 2018. Blue and Green Cities: The Role of Blue-Green Infrastructure in Managing Urban Water Resources 1st ed. 2018 Edition

Optional

1. Liao K-H., Deng S., Tan P.Y., 2017. Blue-Green Infrastructure: New Frontier for Sustainable Urban Stormwater Management. In book: Greening Cities. DOI: 10.1007/978-981-10-4113-6_10
2. Sikorski, P., Wińska-Krysiak, M., Chormański, J., Krauze, K., Kubacka, K., & Sikorska, D. (2018). Low-maintenance green tram tracks as a socially acceptable solution to greening a city. Urban Forestry & Urban Greening, 35, 148-164.
3. Karczmarczyk, A., Bus, A., & Baryła, A. (2018). Phosphate leaching from green roof substrates—can green roofs pollute urban water bodies?. Water, 10(2), 199.
4. Sikorska, D., Sikorski, P., & Hopkins, R. (2017). High biodiversity of green infrastructure does not contribute to recreational ecosystem services. Sustainability, 9(3), 334.
5. Karczmarczyk, A., Bus, A., & Baryła, A. (2021). Assessment of the efficiency, environmental and economic effects of compact type on-site wastewater treatment plants—results from random testing. Sustainability, 13(2), 982.

Calculation of ECTS points

Activity form	Activity hours*
Lecture	20
Laboratory exercises	10
Field exercises	15
Conducting empirical research	20

Preparation for the test	20
Preparing a report	10
Preparation for exercises	20
Conducting literature research	10
Preparation for the exam	20
Preparation of the report	20
Student workload	**Hours** 165
Number of ECTS points	**ECTS** 6

* hour means 45 minutes