Physical Basis of Climate Change

Educational subject description sheet

Basic information

Field of study Joint Bachelor in Sustainability	**Education cycle** 2025/26
Speciality Sustainable Physics & Chemistry	**Subject code** UJ.WPAJBSSPCS.8100.16413.25
Organizational unit Faculty of Law and Administration	**Lecture languages** english
Study level first cycle (joint degree programme)	**Subject related to scientific research** Yes
Study form full-time degree programme	**Disciplines** Physical sciences, Earth sciences and the environment
Education profile General academic	**ISCED classification** 0532 Earth sciences
Mandatory obligatory	**USOS code**

Subject coordinator	Piotr Szwedo
Lecturer	Ditte Taipale, Blanca Ayarzaguena, Marta Abalos, Natalia Calvo

Period Semester 5	**Examination** exam **Activities and hours** Lecture: 26 Classes: 10	**Number of ECTS points** 5.0

Goals

C1	The course aims to give a picture of the natural greenhouse effect of the atmosphere, the intensification of the greenhouse effect and the expected climate changes as a result, the effects of the changes and the possibilities for adapting to and combating climate change. To achieve this, the course also covers climate change prediction models – what they include, how they work, what they predict, what are the uncertainties of their predictions and how well do their predictions compare with observations.

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	the natural greenhouse effect of the atmosphere, the intensification of the greenhouse effect, how climate on Earth has changed throughout time (both before and after industrialization), and how and why human activity affects the climate.	JBS_K1_W03, JBS_K1_W04, JBS_K1_W06	written exam, credit with grade
W2	how climate change models work, what they include, the changes they predict, and the uncertainties of their predictions.	JBS_K1_W04, JBS_K1_W06, JBS_K1_W07	written exam, credit with grade
W3	the scale and extent of environmental consequences of climate change.	JBS_K1_W04, JBS_K1_W06, JBS_K1_W07	written exam, credit with grade
Skills – Student can:			
U1	mathematically solve relevant questions related to climate change.	JBS_K1_U03	written exam, credit with grade
U2	analyse CMIP model simulations using jupyter notebooks	JBS_K1_U03	credit with grade
Social competences – Student is ready for:			
K1	to justify his or hers ideas related to climate change based on scientific information and critically follow the climate change debate in the media, including social media	JBS_K1_K03, JBS_K1_K05	written exam, credit with grade
K2	to evaluate the feasibility of climate change mitigation strategies.	JBS_K1_K03	written exam, credit with grade

Calculation of ECTS points

Activity form	Activity hours*
Lecture	26
Classes	10
preparation for classes	26
tasks solving	15
exercises performance	10
self-study regarding classes	5
preparation for the exam	43

Student workload	Hours	ECTS
	135	5.0

* hour means 45 minutes

Study content

No.	Course content	Subject's learning outcomes
1.	Interactive lecture: Introduction to the course, revising basic physics needed for the course, basics of meteorology, greenhouse effect (DT)	W1, K1
2.	Interactive lecture: Intensification of greenhouse effect, radiation forcing, sensitivity parameter, feedback phenomena, climate change until 1850 (DT)	W1, K1
3.	Exercise session: Support for the first calculation exercise set (DT)	W1, U1
4.	Interactive lecture: Carbon cycle. Climate change from 1850 till present (DT)	W1, K1
5.	Interactive lecture: Causes of radiative forcing (DT)	W1, K1
6.	Exercise session: Support for the second calculation exercise set (DT)	W1, U1
7.	Interactive lecture: Climate models (NC)	W2, K1
8.	Interactive lecture: Emission and concentration scenarios, climate models (NC)	W2, K1
9.	Exercise session connected to climate models (NC)	W2, U1
10.	Interactive lecture: Climate change projections (MA)	W2, W3, K1
11.	Interactive lecture: Climate change projections, comparison of model results with observed climate changes (MA)	W2, W3, K1
12.	Exercise session connected to climate change projections (MA)	W2, W3, U2
13.	Interactive lecture: Comparison of model results with observed climate changes. Uncertainties in climate projections (BA)	W2, W3, K1
14.	Interactive lecture: Sea level rise (BA)	W2, W3, K1
15.	Interactive lecture: Detection and attribution of climate change (BA)	W3, K1
16.	Exercise session: Support for the third calculation exercise set (BA)	W2, W3, U1
17.	Interactive lecture: climate change adaptation (DT)	W3, K1
18.	Interactive lecture: climate change mitigation in society and by individuals (DT)	W3, U2, K1, K2

Course advanced

Teaching methods :

conversation lecture, discussion, practicals

Activities	Examination methods	Credit conditions
Lecture	written exam	The final exam counts 40% towards the final grade. There is no minimum amount of exam points that a student needs to get in order to pass the course, instead more than 45% of course points are needed to pass the course.
Classes	credit with grade	Each of the calculation exercise sets and the exercise hand-ins count up to 10% of the final grade. Participating in the discussion session counts up to 10% of the total grade. If three decent messages have been written, students will receive points corresponding to 10% of the final grade. If only one or two decent replied have been written, students will get points corresponding to 3.3% and 6.6% of the final grade, respectively.

Entry requirements

None

Literature

Obligatory

1. Dessler, A. (2022) Introduction to Modern Climate Change, Cambridge University Press, and the latest IPCC report.

Effects

Code	Content
JBS_K1_K03	The graduate can consider different visions of the future and develop own evidence-based opinions in reference to the balance of values linked to economic development, social welfare, and environmental protection.
JBS_K1_K05	The graduate can defend the importance of scientific data and methods as a basis for decision-making.
JBS_K1_U03	The graduate can apply adequate methods and tools, including selected IT tools, to solve problems related to data collection, analysis, and management in the context of sustainability.
JBS_K1_W03	The graduate can give examples of sustainability-related dilemmas and hypothesize on the optimal course of action.
JBS_K1_W04	The graduate can identify sustainability-related problems specific to selected cultural, geographical, and political contexts.
JBS_K1_W06	The graduate can describe interconnections between various aspects of sustainability and identify their significance in the context of natural and social sciences, with a special focus on disciplines included in the selected specialisation track (law and politics; chemistry and physics; chemistry and biology; economics and geography; economics, management and engineering; humanities).
JBS_K1_W07	The graduate can apply the theory and methodology of disciplines included in the selected specialisation track to sustainability-related problems, taking into consideration practical limitations such as protection of intellectual property.