

Basics of Atmospheric Chemistry Educational subject description sheet

Basic information

Field of study	Education cycle
Joint Bachelor in Sustainability	2025/26
Speciality	Subject code
Sustainable Physics & Chemistry	UJ.WPAJBSSPCS.8100.16414.25
Organizational unit	Lecture languages
Faculty of Law and Administration	english
Study level	Subject related to scientific research
first cycle (joint degree programme)	Yes
Study form	Disciplines
full-time degree programme	Chemical sciences, Physical sciences, Earth sciences and
Education profile General academic	the environment ISCED classification
Mandatory obligatory	0532 Earth sciences USOS code

Subject coordinator	Piotr Szwedo	
Lecturer	Theo Kurtén, Matti Rissanen	

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

Goals

The course focuses on teaching the fundamentals of atmospheric chemistry. We will cover topics such as unifying and common concepts in atmospheric chemistry, atmospheric composition, and concentration unit conversions, thermodynamic and kinetic tools needed in atmospheric chemistry, elemental cycles of N, C, O, H and S, key features of stratospheric (ozone) chemistry, and key features of tropospheric (radical oxidation) chemistry, including air pollution.

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowled	lge - Student knows and understands:	1	1
W1	the basic concepts and unifying features of atmospheric chemistry, including the concept of oxidation and the relationship between altitude, chemical energy and chemical complexity, as well as the key chemical features of the atmospheric N, C, O, H and S cycles.	JBS_K1_W06, JBS_K1_W07	written credit, credit with grade, project
W2	the main features of stratospheric chemistry (Chapman mechanism, catalytic ozone-depleting cycles) and tropospheric chemistry (formation of oxidants, radical oxidation mechanisms, the role of NOx, and the characteristics of photochemical smog).	JBS_K1_W04, JBS_K1_W06, JBS_K1_W07	written credit, credit with grade, project
W3	the facilities, instrumentation and current relevant atmospheric chemistry research topics within the faculty.	JBS_K1_W06, JBS_K1_W07	written credit, credit with grade, project
Skills - S	Student can:		•
U1	apply kinetic and thermodynamic tools to solve simple atmospheric chemical problems, including concentration unit conversions, computing lifetimes using given rate coefficients, and using the pseudo- steady state approximation to simplify reaction rate expressions.	JBS_K1_U02, JBS_K1_U03	written credit, credit with grade, project

Calculation of ECTS points

Activity form	Activity hours*	Activity hours*	
Lecture	20	6	
Classes	1(10	
preparation of a project	2!	25	
exercises performance	4(40	
preparation for final test	34		
Student workload	Hours 135	ECTS 5.0	

* hour means 45 minutes

Study content

No.	Course content	Subject's learning outcomes
1.	Interactive lecture: Introduction to the course and introducing fundamental concepts in atmospheric chemistry	W1

No.	Course content	Subject's learning outcomes
2.	Interactive lecture: Introducing fundamental concepts in atmospheric chemistry	W1
3.	Exercise session: Help available for solving the first exercise set	W1
4.	Interactive lecture: Atmospheric composition, history of the atmosphere	W1
5.	Interactive lecture: History of the atmosphere and unit conversion	W1, U1
6.	Exercise session: Help available for solving the first exercise set	W1, U1
7.	Interactive lecture: Biogeochemical cycles	W1
8.	Exercise session: Feedback and answers to the first exercise set and help available for solving the second exercise set	W1, U1
9.	Interactive lecture: Thermodynamic and kinetic tools needed in atmospheric chemistry	W1, U1
10.	Interactive lecture: Thermodynamic and kinetic tools needed in atmospheric chemistry	W1, U1
11.	Exercise session: Help available for solving the second exercise set	W1, U1
12.	Interactive lecture: Stratospheric chemistry	W1, W2
13.	Exercise session: Help available for solving the advanced exercise set	W1, U1
14.	Interactive lecture: Tropospheric chemistry	W1, W2, U1
15.	Lab visit	W3
16.	Interactive lecture: Tropospheric chemistry	W1, W2, U1
17.	Exercise session: Feedback and answers to the second exercise set and help available for solving the advanced exercise set	W1, U1
18.	Interactive lecture: Chemistry of air pollution	W1, W2
19.	Poster presentations by students (2h)	W1, W2

Course advanced

Teaching methods :

project method, conversation lecture, laboratories, practicals

Activities	Examination methods	Credit conditions
Lecture	written credit	The final exam counts 30% towards the final grade. Students need to get at least 34% of exam points in order to pass the course.
Classes	credit with grade, project	Compulsory to attend. If unable, a supplementary task will be given. Students will get 2 points (out of a total of 100) which counts towards the final grade. Exercises count 38% towards the final grade. The course includes two sets of 5 "basic" problems each. All of these needs to be completed and a student needs to get a minimum of 50% of the points. The course also includes one set of approximately 10 "advanced" tasks (longer calculations, essays, mini-projects). A student needs to choose 4 of these tasks and complete them and a student needs to get a minimum of 50% of the points. The poster counts 30% towards the final grade. There is no minimum as to how many points the students need to get for this assignment in order to pass the course.

Entry requirements

No formal prerequisites, but high-school level understanding of chemistry or physics highly recommended.

Literature

Obligatory

- 1. There is no official coursebook. Lecture notes will be distributed via Moodle. For deeper understanding, any of the following books could be useful. Jacob's book is freely available online (though a bit old by now). Holloway & Wayne especially recommended as a relatively cheap and modern introductory book.
- 2. D. J. Jacob: Introduction to atmospheric chemistry, Princetown Univ. Press, 1999. (Available online: http://acmg.seas.harvard.edu/people/faculty/djj/book/index.html)
- 3. J. H. Seinfeld & S.N. Pandis: Atmospheric chemistry and physics, 2nd/3rd ed, Wiley, 2006/2016
- 4. R. P. Wayne: Chemistry of atmospheres, 3rd ed., Oxford University Press, 2000
- 5. A. M. Holloway, R. P. Wayne: Atmospheric Chemistry, RSC Publishing, 2010

Effects

Code	Content
JBS_K1_U02	The graduate can present and report knowledge, methodologies, ideas, problems and solutions, clearly and comprehensively, in different forms destined for different audiences – including discussions and debates which require defending a substantiated opinion, as well as conversations in a foreign language at the CEFR B2 level.
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_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.