

Mathematical Tools for Sustainable Chemistry and Physics

Educational subject description sheet

Basic information

<p>Field of study Joint Bachelor in Sustainability</p> <p>Speciality Sustainable Physics & Chemistry</p> <p>Organizational unit Faculty of Law and Administration</p> <p>Study level first cycle (joint degree programme)</p> <p>Study form full-time degree programme</p> <p>Education profile General academic</p> <p>Mandatory obligatory</p>		<p>Education cycle 2025/26</p> <p>Subject code UJ.WPAJBSSPCS.840.16403.25</p> <p>Lecture languages english</p> <p>Disciplines Maths, Chemical sciences, Physical sciences</p> <p>ISCED classification 0541 Mathematics</p> <p>USOS code</p>	
Subject coordinator	Piotr Szwedo		
Lecturer	Bernhard Reischl		
Period Semester 3	Examination exam	Activities and hours E-learning (lecture): 14, including: • Asynchronous classes: 14 Classes: 30	Number of ECTS points 5.0

Goals

C1	The aim of the course is to equip the students with maths skills necessary to successfully complete the courses in the sustainable chemistry and physics track and to show them how math is relevant for sustainable chemistry and physics.
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Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge - Student knows and understands:			
W1	how mathematics is relevant for sustainable chemistry and physics	JBS_K1_W06, JBS_K1_W07	written exam, credit
W2	what the geometric meaning of vectors and matrices and their calculation rules is	JBS_K1_W07	written exam, credit
W3	the basics of complex analysis	JBS_K1_W07	written exam, credit
W4	the difference between systematic and statistical errors	JBS_K1_W07	written exam, credit
W5	the concept of integral function of a real function, its geometric interpretation and the connection to the concept of definite integral	JBS_K1_W07	written exam, credit
W6	how to recognise and classify differential equations with respect to their order.	JBS_K1_W07	written exam, credit
W7	how to recognise differential operators, line and surface integrals and know their calculation rules	JBS_K1_W07	written exam, credit
Skills - Student can:			
U1	carry out basic vector calculations	JBS_K1_U03	written exam, credit
U2	carry out basic calculations with complex numbers	JBS_K1_U03	written exam, credit
U3	conduct basic error calculations	JBS_K1_U03	written exam, credit
U4	carry out basic integration calculations	JBS_K1_U03	written exam, credit
U5	choose a suitable solution for first- and second-order differential equations.	JBS_K1_U03	written exam, credit
U6	carry out basic calculations with differential operators, line and surface integrals	JBS_K1_U03	written exam, credit

Calculation of ECTS points

Activity form	Activity hours*
E-learning (lecture)	14
Classes	30
preparation for classes	24
exercises performance	28
preparation for the exam	39
Student workload	Hours 135
	ECTS 5.0

* hour means 45 minutes

Study content

No.	Course content	Subject's learning outcomes
1.	Introduction to the course and course structure. Examples of mathematics as a tool in sustainable chemistry and physics.	W1
2.	Pre-recorded lecture on Linear Algebra: Vector basics, Coordinate systems, Vector Algebra, Scalar Product and its geometric interpretation, Vector Product and its geometric interpretation, Scalar triple product, Multiple products, Matrices	W2, U1
3.	Interactive lecture: Example applications of Linear Algebra in sustainable chemistry and physics and discussions about this week's material.	W1, W2, U1
4.	Pre-recorded lecture on complex numbers: Definition and representation, Rules, Exponential representation of complex numbers, Complex exponentiation and complex roots, Representation of curves with complex numbers.	W3, U2
5.	Interactive lecture: Example applications of complex numbers in sustainable chemistry and physics and discussions about this week's material.	W1, W3, U2
6.	Pre-recorded lecture on error calculations: Systematic and statistical errors, mean and variance, distributions and histograms, error propagation, fitting.	W4, U3
7.	Interactive lecture: Example applications of error calculations in sustainable chemistry and physics and discussions about this week's material.	W1, W4, U3
8.	Pre-recorded lecture on integration: indefinite integrals, rules, techniques of integration (integration by parts, integration by substitution)	W5, U4
9.	Interactive lecture: Example applications of integration in sustainable chemistry and physics and discussions about this week's material.	W1, W5, U4
10.	Pre-recorded lecture on integration: definite (Riemann) integrals, rules, Fundamental Theorem of Calculus	W5, U4
11.	Interactive lecture: Example applications of integration in sustainable chemistry and physics and discussions about this week's material.	W1, W5, U4
12.	Pre-recorded lecture on differential equations: Differential equations, definitions, first order differential equations, second order differential equations	W6, U5
13.	Interactive lecture: Example applications of differential equations in sustainable chemistry and physics and discussions about this week's material.	W1, W6, U5
14.	Pre-recorded lecture on Differentiation and integration of fields	W7, U6
15.	Interactive lecture: Differentiation and integration of fields in sustainable chemistry and physics and discussions about this week's material.	W1, W7, U6

Course advanced

Teaching methods :

conversation lecture, solving tasks, e-learning methods, practicals

Activities	Examination methods	Credit conditions
E-learning (lecture)	written exam	The final exam counts 70% towards the final grade. Students need to obtain more than 45% of total course points in order to pass the course.

Activities	Examination methods	Credit conditions
Classes	credit	Points obtained from exercises done throughout the course count 30% towards the final grade. Students can pass the course without having completed the exercises, but 45% of total course points are needed in order to pass the course.

Entry requirements

None

Literature

Obligatory

1. A.J. Hobson, Just the maths (<https://archive.uea.ac.uk/jtm/contents.htm>) and D. Guichard, Single Variable Calculus (<https://www.whitman.edu/mathematics/calculus/calculus.pdf>)

Effects

Code	Content
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_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.