Mathematical Tools for Sustainability

Educational subject description sheet

Basic information

Field of study Joint Bachelor in Sustainability **Speciality** - **Organizational unit** Faculty of Law and Administration **Study level** first cycle (joint degree programme) **Study form** full-time degree programme **Education profile** General academic **Mandatory** obligatory	**Education cycle** 2025/26 **Subject code** UJ.WPAJBSS.810.16345.25 **Lecture languages** english **Disciplines** Maths **ISCED classification** 0541 Mathematics **USOS code**

Subject coordinator	Bogdan Batko
Lecturer	Bogdan Batko

Period	**Examination**	**Number of ECTS points**
Semester 1	graded credit **Activities and hours** Lecture with elements of a discussion class: 16 Classes: 14	3.0

Goals

C1	The goal of this course is to equip students with fundamental mathematical skills and knowledge necessary for the study of the subsequent tracks, mainly Physics & Chemistry; Environmental & Life Sciences; Economics, Business & Engineering; and Economics & Geography.

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	the notions of sequences and functions	JBS_K1_W06	written credit, credit with grade
W2	the concept of a limit and its role in defining and approximating numbers and functions, especially in relation to numerical and functional series. Knows the basic ways of testing the convergence and determining the limits of sequences, functions and series	JBS_K1_W06	written credit, credit with grade
W3	the concept of continuity of functions and the main properties of continuous functions	JBS_K1_W06	written credit, credit with grade
W4	the concept of derivative and differential of a function of one variable and is able to interpret them geometrically. Knows derivatives of elementary functions and theorems that facilitate calculating derivatives and examining the properties of functions using derivatives.	JBS_K1_W06	written credit, credit with grade
W5	the concept of higher order derivative, polynomial and Taylor series for functions of one variable and applications of these concepts	JBS_K1_W06	written credit, credit with grade
Skills – Student can:			
U1	prove simple properties of sequences and functions	JBS_K1_U03	written credit, credit with grade
U2	effectively examine the convergence of limits, sequences and functions	JBS_K1_U03	written credit, credit with grade
U3	verify continuity of a function	JBS_K1_U03	written credit, credit with grade
U4	compute manually derivatives of simple functions	JBS_K1_U03	written credit, credit with grade
U5	calculate higher order derivatives and the Taylor polynomial	JBS_K1_U03	written credit, credit with grade
Social competences – Student is ready for:			
K1	to describe and solve real-world problems using mathematical concepts	JBS_K1_K04	credit with grade

Calculation of ECTS points

Activity form	Activity hours*
Lecture with elements of a discussion class	16
Classes	14
preparation for classes	60

Student workload	Hours 90	ECTS 3.0

* hour means 45 minutes

Study content

No.	Course content	Subject's learning outcomes
1.	Introduction to the course. Numbers, sequences, properties, limits, equations, inequalities	W1, W2, W3, W4, W5, U1, U2, U3, U4, U5, K1
2.	Functions: graphs, properties. Elementary functions	W1, W2, W3, W4, W5, U1, U2, U3, U4, U5, K1
3.	Limits, continuity of functions	W1, W2, W3, W4, W5, U1, U2, U3, U4, U5, K1
4.	Derivatives of functions, important derivatives, differentiation rules	W1, W2, W3, W4, W5, U1, U2, U3, U4, U5, K1
5.	Derivatives: function composition and inversion, chain rule, l'Hospital theorem	W1, W2, W3, W4, W5, U1, U2, U3, U4, U5, K1
6.	Series and convergence, tests for convergence	W1, W2, W3, W4, W5, U1, U2, U3, U4, U5, K1
7.	Taylor series	W1, W2, W3, W4, W5, U1, U2, U3, U4, U5, K1
8.	Taylor expansion applications	W1, W2, W3, W4, W5, U1, U2, U3, U4, U5, K1

Course advanced

Teaching methods :

conversation lecture, solving tasks, practicals

Activities	Examination methods	Credit conditions
Lecture with elements of a discussion class	written credit, credit with grade	attendance and quizzes (15%), practical classes (40%), final choice test (20%), final open problems exam (25%)
Classes	written credit, credit with grade	attendance and quizzes (15%), practical classes (40%), final choice test (20%), final open problems exam (25%)

Entry requirements

None

Literature

Obligatory

1. A.J. Hobson, Just the maths, https://archive.uea.ac.uk/jtm/contents.htm D. Guichard, Single Variable Calculus, https://www.whitman.edu/mathematics/calculus/calculus.pdf Calculus https://openstax.org/subjects/math

Effects

Code	Content
JBS_K1_K04	The graduate can critically assess and verbalize own competencies and skills related to different aspects of sustainability as well as their need for development.
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).