DISCIPLINE DESCRIPTION

1. About the program

1.1 Higher education institution	"BABEȘ-BOLYAI" UNIVERSITY OF CLUJ-NAPOCA
1.2 Faculty	FACULTY OF ENVIRONMENTAL SCIENCE AND ENGINEERING
1.3 Department	ENVIRONMENTAL ANALYSIS AND ENGINEERING
1.4 Field of study	ENVIRONMENTAL ENGINEERING
1.5 Study cycle	BACHELOR
1.6 Study Program / Qualification	ENVIRONMENTAL ENGINEERING/ ENGINEER

2. Data about the discipline

2.1 Subject name	Information technology						
2.2 Holder of course activities	CS III PhD. Deaconu Lucia-Timea						
2.3 Holder of seminar activities	CS III PhD. Deaconu Lucia-Timea						
2.4 Year of study	III	2.5 Semester	V	2.6. Type of evaluation	C	2.7 Disciplinary regime	DD- opt

3. Total estimated time (hours per semester of teaching activities)

3.1 Number of hours per week	4	Of which: 3.2 course	2	3.3 seminar	2
3.4 Total curriculum hours	56	Of which: 3.5 course	28	3.6 seminar	28
Time fund distribution:					hours
Study from the textbook, course materials, bibliography and notes					32
Additional documentation in the library, on specialized electronic platforms and in the field					26
Preparation of seminars/workshops, homework, reports, portfolios and essays					0
Tutorials					8
Reviews					4
Other activities:					-

3.7 Total individual study hours	70
3.8 Total hours per semester	126
3.9 Number of credits	5

4. Prerequisites (where applicable)

4.1 of curriculum	• Applied Informatics • Statistics and Data processing
4.2 of skills	• Basic knowledge for analysing and interpreting experimental scientific data • Ability to represent, evaluate and interpret experimental / environmental data • Application of descriptive statistical concepts, data representations and interpretation • Research skills

5. Conditions (where applicable)

5.1 The course	• classroom equipped with video projector
5.2 Seminar	• seminar room with computer for each student

6. Specific skills to be acquired

Professional skills	• The courses are designed according to international standards, equipping students with fundamental skills for analyzing, visualizing, and interpreting climate and environmental datasets using Python and other scientific computing tools. • The structure of the course and seminar fosters hands-on experience in Python programming, including the use of Jupyter Notebooks and essential libraries like NumPy, Pandas, and Matplotlib for data processing and representation. • Students acquire both foundational and practical knowledge necessary for creating research projects, reports, and presentations in environmental engineering and climate science. • Gain proficiency in managing and analyzing geospatial and time-series data relevant to climate science, emphasizing the integration of statistical and computational methods. • Develop a professional and ethical approach to scientific computing, fostering responsibility and critical thinking in the application of computational tools to real-world environmental challenges.
transversal competences	• ability to represent, evaluate and interpret experimental data • research skills • application of descriptive statistics concepts, data representation and interpretation

7. Objectives of the subject (from the grid of competences)

7.1 Overall aim of the subject	• to know, understand and deepen computer science concepts with specific reference to data representation and processing
7.2 Specific objectives	• developing knowledge and skills in computer operation, using specific programs for data processing and representation • developing the ability to analyze experimental data from scientific work • developing skills in using scientific databases with environmental applications

8. Contents

8.1 Course	**Teaching methods**	**Remarks**
C1. Information Technology - objectives and organization	Participative lecture, dialog	
C2. Introduction to Programming Languages for Climate Science and Scientific Computing; Python Basics for Scientific Computing; Foundational programming concepts, syntax, and problem-solving in Python. Jupyter Notebook	Participatory lecture, dialog	

C3. Data Structures and Algorithms in Python: Building Efficient Programs for Scientific Data Handling: Lists and Tuples, Dictionaries and Sets	Participative lecture, dialog, exposition	
C4. Scientific Libraries in Python: NumPy and Pandas Core libraries for numerical and data analysis.	Participative lecture, dialog	
C5. Data Visualization with Matplotlib and Seaborn Creating and interpreting impactful visualizations.	Participative lecture, dialog, exposition, demonstration	
C6. 7. Introduction to Geospatial Analysis Using Python Handling and visualizing geospatial data for environmental applications.	Participative lecture, dialog, exposition, demonstration	
C7. Statistical Modeling and Hypothesis Testing in Python Application of statistical concepts to scientific datasets	Participative lecture, dialog, exposition, demonstration	
C8. Python for Climate Data Analysis; Analyzing climate datasets, including temperature, precipitation, and emissions.	Participative lecture, dialog, exposition, demonstration	
C9. Time Series Analysis for Climate and Environmental Data Analyzing temporal trends in environmental and climate data.	Participative lecture, dialog, exposition	
C10. Introduction to Satellite Data and Ground-Based Observations Using Python; Overview of remote sensing and satellite imagery	Dialogue, presentation	
C11. Analyzing Satellite Data with Python and Jupyter Notebooks; Understand satellite data formats; Apply Python tools to analyze satellite data, Visualize and interpret satellite data using Python libraries	Participative lecture, dialog, exposition	
C12. In-Situ Data and Satellite Collocations: A Comparative Approach Using Python; Understand the concept of collocations (matching satellite data with in-situ measurements).	Dialogue, presentation	
C13. Discussions and questions before the written assessment	Participative lecture, dialog	
C14. Colloquium	Evaluation	

Bibliography

Deaconu L., Information technology - course support (electronic format - CD)
Allen B. Downey, Think Stats: Exploratory Data Analysis in Python, 2014, O'Reilly Media; 2nd ed. Edition, ISBN-13: 978-1491907337
Maurizio Petrelli, Introduction to Python in Earth Science Data Analysis, 2022, EAN 9783030780579
Daniel S. Wilks, Statistical Methods in the Atmospheric Sciences 4th Edition, 2019, Elsevier;, ISBN-13 : 978-0128158234
Alex Decaria, Grant W Petty, Linda Weidemann, Python Programming and Visualization for Scientists 2nd ed. Edition, Sundog Publishing, LLC; ISBN-13 : 978-0972903356

8.2 Seminar	Teaching methods	Remarks
L1. Getting Started with Python: Your First Steps into Programming; Overview of tools needed (Python installation, Jupyter Notebook setup; Variables and Data Types: integers, floats, strings, and Booleans; arithmetic operations, string concatenation;	Dialogue, computer exercise	
L2. Hands-on Python Programming Exercises Practice foundational Python concepts through exercises. Conditional Statements: if, elif, else; Loops: Introduction to for and while loop; Hands-On Mini Project	Dialog, computer exercise	
L3. Solving Real-World Problems with Python Algorithms: Finding Extremes in Data; Filtering Environmental Data; Data Aggregation Algorithms	Dialog, computer exercise	

L4. Case Studies in Data Analysis with Python Libraries; Data Loading with Pandas; Analyzing Trends; Visualizing Environmental Data	Dialog, computer exercise	
L5. Creating and Interpreting Visualizations for Environmental Data; Bar and Line Graphs, Customizing Plots, Interpreting	Dialog, computer exercise	
L6. Geospatial Data Manipulation: Practical Applications, Introduction to GeoPandas/ Cartopy; Create basic maps	Dialogue, computer exercise	
L7. Statistical Techniques for Analyzing Environmental Data Hands-on application of statistical methods to environmental datasets. Descriptive Statistics with Pandas; Calculate mean, median, mode, and standard deviation of environmental data. Correlation and Regression - correlations between variables and linear regression;	Dialogue, computer exercise	
L8. Climate Data Exploration: Hands-On Python Practice In-depth exercises on handling climate datasets.	Dialogue, computer exercise	
L9. Analyzing and Visualizing Time Series Data Practically Interactive sessions on time series analysis.	Dialogue, computer exercise	
L10. Introduction to common satellite datasets (MODIS, CALIOP, SEVIRI etc.) and file formats (GeoTIFF, HDF5, NetCDF). Introduction to In-Situ Data. Loading and processing satellite and in-situ data in Python using Pandas and Matplotlib.		
L11. Working with Satellite Data in Python and Jupyter Notebooks; Practice loading and preprocessing satellite data. Apply Python tools to analyze and visualize satellite images. Use Jupyter Notebooks for documentation and reporting of satellite data analysis.	Dialogue, computer exercise	
L12. Hands-On Collocations and Comparisons of In-Situ and Satellite Data; Extract satellite data at specific locations and match it with in-situ measurements. Perform statistical comparisons between the two datasets. Visualize the results and interpret the findings.	Dialogue, computer exercise	
L13. Capstone Seminar: Python in Climate Science. Preparation for the final examination	Dialogue, computer exercise	
L14. Verification of the knowledge acquired in L1 - L13	Evaluation	

Bibliography

Deaconu L. – Information technology - seminar documentation (electronic format - CD)

Aileen Nielsen, Practical Time Series Analysis: Prediction with Statistics and Machine Learning 1st Edition, 2019, O'Reilly Media;, ISBN-13 : 978-1492041658

David Landup, Data Visualization in Python with Pandas and Matplotlib, 2021, ISBN-13 : 979-8521342877

Bonny P. McClain, Python for Geospatial Data Analysis, 2022, O'Reilly Media, ISBN 109810479X

9. Corroboration of subject contents with the expectations of representatives of the epistemic community, professional associations and representative employers in the field related to the program

The content is consistent with the curricula of similar centers in the country and abroad. The structure was determined after studying the content of the curricula **of the Faculty of Physics (Babeș-Bolyai University), the Faculty of Economics and Business Management (Babeș-Bolyai University)**, and the Master's program in **Bioinformatics and Biostatistics (Iuliu Haţieganu University of Medicine and Pharmacy)**. Also, the global trend towards **e-learning platforms such as Coursera, Udemy, Lynda**, etc. has allowed an update of the content, including as video clips containing hints on how to solve the exercises.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Assessment methods	10.3 Weighting in the final mark
10.4 Course	Knowledge of the concepts presented in the course	Written assessment	3,0 points
10.5 Seminar	Checking your ability to solve the exercises using the programs covered	Computer assessment	6.0 points*
10.6 Minimum performance standard			
• Making graphs and simple calculations using spreadsheets • Understanding the basics of how to represent quantitative/qualitative data			

* 1,0 point will be added to the final mark.

Date of completion Signature of course holder Signature of seminar holder

05.12.2024

Date of departmental approval Signature of the head of department

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