SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeș-Bolyai University**
1.2 Faculty	**Faculty of Physics**
1.3 Department	**Department of Physics – Hungarian Line of Study**
1.4 Field of study	**Physics**
1.5 Study cycle	**Master**
1.6 Study programme / Qualification	**Computational physics / High Energy Physics**

2. Information regarding the discipline

2.1 Name of the discipline	**Interdisciplinary Applications / Programming through Python**						
2.2 Course coordinator	**Járai-Szabó Ferenc**						
2.3 Laboratory coordinator	**Járai-Szabó Ferenc**						
2.4. Year of study	1	2.5 Semester	2	2.6. Type of evaluation	E	2.7 Type of discipline	DC

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	4	Of which: 3.2 course	2	3.3 seminar/laboratory	2
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar/laboratory	28

Time allotment:	hours
Learning using manual, course support, bibliography, course notes	28
Additional documentation (in libraries, on electronic platforms, field documentation)	14
Preparation for seminars/labs, homework, papers, portfolios and essays	49
Tutorship	4
Evaluations	3
Other activities:	

3.7 Total individual study hours	98
3.8 Total hours per semester	154
3.9 Number of ECTS credits	6

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competencies	Basic programming skills, basic physics knowledge, logical thinking, interdisciplinary thinking, English communication skills

5. Conditions (if necessary)

5.1. for the course	Video projector, blackboard
5.2. for the seminar /lab activities	Computers with Linux and Windows operating systems, Video projector

6. Specific competencies acquired

Specific competences	C1. Capacities for analyzing and synthetizing physical data, capacities for modelling complex phenomena. C2. Working and mastering with software packages for analyzing and processing experimental data. Using C, Python and Mathematica software for modelling complex phenomena. Capacities for using information technologies in describing complex phenomena from physics, biology, chemistry and social sciences. Advanced programming techniques. C3. Trans- and Interdisciplinary thinking. C4. Planning and Performing computer experiments for validating physical models. Abilities for making high performance computations in physics. Capacities for writing computer codes and running them on modern supercomputers. C5. Communicating efficiently modern scientific ideas. Presenting in a professional manner results of a research or scientific projects. Capacities for writing scientific publications, to interact and have a scientific debate with Editors and Referees. Capacities for arguing and defending scientific views and ideas.
Transversal competences	CT1. To deal with professional duties efficiently and in a responsible manner, keeping in mind the laws and scientific ethics. Being responsible for the published scientific results and taking all actions for their proper use. CT2. Working in an Interdisciplinary environment respecting the professional hierarchy. Having initiative, new ideas and approaches to classical problems. Promoting the dialogue, cooperation and positive attitude in a group. Respecting multicultural environment and helping the others. CT3. Efficient use of information technology tools and presentation methods in English. Learning and applying auto evaluation methods, f or keeping the professional training up to date, in agreement with the demands of the market.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	The main objective of this course is to familiarize the students with the application of high-level programming languages in solving tasks related to physics.
7.2 Specific objective of the discipline	• Learn the usage of the Linux operating system and bash tools • Learn to optimally apply Python in physics • Learn about data processing and visualization • Learn about symbolic calculation tools like SymPy and Mathematica

8. Content

8.1 Course	Teaching methods	Remarks
• Introduction. • Linux basics. • Bash programming, bash tools. • Python basics. • Numpy and SciPy basics. • Problem solving with Python. • Vectorization and problem solving in Python. • Data processing and visualization with Python • Symbolic calculations in Python • Wolfram's Mathematica basics • Problem solving with Wolfram's Mathematica	Problem formulation Presentation Demonstrations Software packages Discussions	

Bibliography

1. Ferenc Jarai-Szabo: Course webpage at the Moodle platform https://atom.ubbcluj.ro/moodle
2. H. Gould and J. Tobochnik Introduction to Computer Simulation Methods and applications in physics (Addison Wesley, 1996).
3. Introduction to Linux basics at https://www.digitalocean.com/community/tutorials/an-introduction-to-linux-basics
4. Awk tutorial at https://www.tutorialspoint.com/awk/index.htm
5. Bash scripting tutorial at https://www.freecodecamp.org/news/bash-scripting-tutorial-linux-shell-script-and-command-line-for-beginners/
6. Python introduction at https://www.w3schools.com/python/python_intro.asp
7. NumPy introduction at https://www.w3schools.com/python/numpy/numpy_intro.asp
8. SciPy introduction at https://www.w3schools.com/python/scipy/scipy_intro.php
9. Introduction to Wolfram's Mathematica at https://www.wolfram.com/language/fast-introduction-for-math-students/en/

8.2 Laboratory	Teaching methods	Remarks
• Programming basics. • Linux exercises. • Bash programming exercises, bash tools. • Python exercises. • Numpy and SciPy exercises. • Problem solving with Python. • Vectorization and problem solving in Python. • Data processing exercises in Python. • Data visualization in Python. • Exercises for practicing symbolic calculations in Python. • Wolfram's Mathematica basic problems. • Problem solving with Wolfram's Mathematica.	Explanations Presentations Discussions Problem formulation Individual work Programming	

References:

Ferenc Jarai-Szabo: Course webpage at the Moodle platform https://atom.ubbcluj.ro/moodle

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

The syllabus and the studied material agree with similar courses from other universities in Romania and abroad. For helping the integration with the demands of the work-force market, the syllabus was harmonized with the demands of the pre-university and university educations, of those of research institutes and the business sector.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Knowledge, understanding and capacity of application of the thought material	Continuous evaluation	20%
10.5 Seminar/lab activities	Homework, lab activity	Continuous evaluation	50%
	Realization degree and presentation of the research project	Oral presentation	30%
10.6 Minimum performance standards			
Understanding the methods presented at the course and laboratory. Addressing the laboratory requirements in proportion of at least 75%. Successful Developing a project of medium complexity.			

Date

11.05.2023

Signature of course coordinator

conf. dr. Ferenc Járai-Szabó

[redacted]

Signature of laboratory coordinator

conf. dr. Ferenc Járai-Szabó

[redacted]

Date of approval

11.05.2023

Signature of the head of department

conf. dr. Ferenc Járai-Szabó

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