SYLLABUS

Mathematical Software

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babeş-Bolyai University
1.2. Faculty	Mathematics and Computer Science
1.3. Department	Mathematics
1.4. Field of study	Mathematics
1.5. Study cycle	Bachelor
1.6. Study programme/Qualification	Mathematics and Computer Science in English
1.7. Form of education	Full-time study

2. Information regarding the discipline

2.1. Name of the discipline	**Mathematical Software**					Discipline code	**MLE0026**
2.2. Course coordinator	Lect. Dr. Parajdi Lorand Gabriel						
2.3. Seminar coordinator	Lect. Dr. Parajdi Lorand Gabriel						
2.4. Year of study	3	2.5. Semester	5	2.6. Type of evaluation	E	2.7. Discipline regime	Optional Package 3

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

3.1. Hours per week	**5**	of which: 3.2 course	**2**	3.3 seminar/laboratory	**0/2/1**
3.4. Total hours in the curriculum	70	of which: 3.5 course	28	3.6 seminar/laborator	**0/28/ 14**
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
Learning using manual, course support, bibliography, course notes (SA)					20
Additional documentation (in libraries, on electronic platforms, field documentation)					10
Preparation for seminars/labs, homework, papers, portfolios and essays					12
Tutorship					4
Evaluations					8
Other activities: academic consultations and software-related support					2
3.7. Total individual study hours	**70 + 56**				
3.8. Total hours per semester	**126**				
3.9. Number of ECTS credits	**5**				

4. Prerequisites (if necessary)

4.1. curriculum	• Programming backgrounds
4.2. competencies	• Programming skills

5. Conditions (if necessary)

5.1. for the course	• Videoprojector (offline), MSTeams or Zoom (online)
5.2. for the seminar /lab activities	• Computer Network, Mathematical Software (Maple, MATLAB)

6.1. Specific competencies acquired

Professional/essential competencies	• C3.1. Identifying the basic concepts used in the construction and specification of algorithms • C3.3 Applying specific techniques and methods for designing algorithms
Transversal competencies	• CT3. Using effective methods and techniques for learning, information gathering, research, and developing the ability to apply knowledge, adapt to the demands of a dynamic society, and communicate in Romanian and in an international language.

6.2. Learning outcomes

Knowledge	The student knows: • the basic concepts and fundamental principles of using mathematical software in solving mathematical and applied problems • the functionalities and usage of specialized mathematical software packages • methods for graphical visualization of functions, data, and numerical solutions • techniques for numerical and symbolic computation assisted by computer • elementary notions of mathematical programming and automation of computational processes • ways of integrating mathematical software into the processes of modeling, analysis, and result verification
Skills	The student is able to: • use mathematical software to perform numerical and symbolic computations • graphically represent functions, equation solutions, data, and mathematical models • apply specialized software packages to solve problems in linear algebra, numerical analysis, and related fields • develop and interpret simple codes or scripts for automating mathematical computations • critically analyze results obtained using software by comparing numerical and analytical solutions • integrate software tools into individual research projects or mathematical assignments
Responsibility and autonomy:	The student has the ability to work independently to obtain: • applying acquired knowledge to solve mathematical problems using specialized software • developing and testing computational solutions in various contexts, with minimal guidance from the instructor • conducting individual research and deepening the understanding of advanced software functionalities • preparing and delivering assignments, projects, or presentations involving mathematical digital tools • critically evaluating one's own results and adopting alternative solutions when necessary • managing study time and digital resources in a responsible and efficient manner

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

7.1 General objective of the discipline	• Introducing students to the use of mathematical software and computational tools • Providing foundational knowledge in computer-assisted computation and numerical software
7.2 Specific objective of the discipline	• Using computers to solve routine mathematical problems • Applying mathematical software as a teaching and learning tool

8. Content

8.1 Course	**Teaching methods**	**Remarks**
1. Introduction to mathematical software. Introduction to Maple	Lecture, lecture with demonstrations, demonstration using electronic teaching tools, problem-based learning, individual study, and the use of mathematical software.	
2. Differential and integral calculus in Maple	Lecture, lecture with demonstrations, demonstration using electronic teaching tools, problem-based learning, individual study, and the use of mathematical software.	
3. Functions, procedures, and programming in Maple	Lecture, lecture with demonstrations, demonstration using electronic teaching tools, problem-based learning, individual study, and the use of mathematical software.	
4. Graphical representations and data visualization using Maple	Lecture, lecture with demonstrations, demonstration using electronic teaching tools, problem-based learning, individual study, and the use of mathematical software.	
5. Matrix operations in MATLAB. Programming in MATLAB	Lecture, lecture with demonstrations, demonstration using electronic teaching tools, problem-based learning, individual study, and the use of mathematical software.	
6. Graphical representations and data visualization using MATLAB	Lecture, lecture with demonstrations, demonstration using electronic teaching tools, problem-based learning, individual study, and the use of mathematical software.	
7. Mathematical computations in MATLAB: linear algebra, numerical analysis, data analysis, and solving differential equations	Lecture, lecture with demonstrations, demonstration using electronic teaching tools, problem-based learning, individual study, and the use of mathematical software.	

Bibliography

1. The Mathworks, MATLAB *set of manuals*.
2. Cleve Moler, *Numerical Computing in* MATLAB, SIAM, 2005
3. D. J. Higham, N. J. Higham, MATLAB *Guide, 2nd edition*, SIAM, 2005
4. Radu Trimbitas, *Numerical Analysis in* MATLAB, Cluj University Press, 2009
5. P. Marchand, O. T. Holand, *Graphics and GUI with* MATLAB*, 3rd edition*, Barnes and Noble, 2003
6. Robert M. Corless, *Essential* Maple *7*, Springer 2002
7. A. Heck, *Introduction to* Maple*, 3rd edition*, Springer, 2003
8. V. Anisiu, *Calcul simbolic cu* Maple*.* Presa Universitara Clujeana, 2006
9. T.A. Driscoll, *Learning* MATLAB, SIAM 2009
10. Ian Thompson, *Understanding* Maple*,* Cambridge University Press, 2017
11. W. Fox, W. Bauldry, *Advanced Problem Solving with* Maple™ *A First Course*, CRC Press, 2020

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Introduction to Maple	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
2. Assignments and unassignment in Maple	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
3. Symbolic representation and simplification of expressions in Maple; applying the *assume* command	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
4. Differentiation, integration, and sum computation in Maple	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
5. Maple: instructions, functions, procedures	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
6. Two-dimensional and three-dimensional plotting in Maple. Special plots and animations	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
7. Maple: equations, recurrence relations, and linear algebra	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
8. Introduction to MATLAB	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
9. Matrices in MATLAB: generation, indexing, matrix and vector operations	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
10. Control flow, M-files, data types, and advanced data structures in MATLAB	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
11. 2D and 3D graphical representations in MATLAB, in Cartesian and other coordinate systems	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
12. Advanced graphics in MATLAB: animations, special plots, volume visualization, and GUI development	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	

13. Numerical methods in MATLAB: interpolation, least squares approximation, solving systems of equations, and computing eigenvectors and eigenvalues	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	
14. Numerical methods for solving differential equations in MATLAB	Demonstrations supported by digital teaching tools, combined with individual study and practical use of mathematical software.	

Bibliography

1. Radu Trimbitas, *Numerical Analysis in* MATLAB, Presa Universitara Clujeana 2009
2. A. Heck, *Introduction to* Maple, *3rd edition*, Springer, 2003
3. V. Anisiu, *Calcul simbolic cu* Maple. Presa Universitara Clujeana, 2006
4. Driscoll T.A., *Learning* MATLAB, SIAM 2009
5. W. Fox, W. Bauldry, *Advanced Problem Solving with* Maple™ *A First Course*, CRC Press, 2020

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 course is included in the study programs of prestigious universities in Romania and abroad
- The practical importance of mathematical software
- The use of mathematical software as an auxiliary tool in teaching and research

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	Ability to solve mathematical problems using Maple and MATLAB	Practical final exam	80%
10.5 Seminar/laboratory	Completing mandatory assignments and actively participating in lab sessions	Individual evaluation	20%
10.6 Minimum standard of performance			
• A minimum grade of 5 in the final test and a minimum grade of 5 for laboratory activity			

11. Labels ODD (Sustainable Development Goals)

Not applicable.

Date:
11.04.2025

Signature of course coordinator

Lect. Dr. Parajdi Lorand Gabriel

Signature of seminar coordinator

Lect. Dr. Parajdi Lorand Gabriel

Date of approval:
25.04.2025

Signature of the head of department

Prof. dr. Andrei Mărcuș