

## COURSE DESCRIPTION

### Metode numerice si aplicatii / Numerical Methods and applications

Academic year 2026-2027

#### 1. Programme-related data

1.1. Higher Education Institution	Babes-Bolyai University
1.2. Faculty	Mathematics and Computer Science
1.3. Doctoral School	Mathematics and Computer Science
1.4. Field of study	Mathematics
1.5. Level of study	doctoral

#### 2. Course-related data

2.1. Course title	<b>Etică și integritate academică. / Academic ethics and integrity</b>	Course code	<b>MDE8172</b>
2.2. Course coordinator	Cătinaș Teodora Maria		
2.3. Seminar coordinator	Cătinaș Teodora Maria		
2.4. Year of study	2.5. Semester	1	2.6. Type of assessment <a href="#">Exam</a>
2.7. Course status	<a href="#">Optional</a>	2.8. Course type	<a href="#">Core subject</a>

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

3.1. Number of hours per week	<b>3</b>	of which: 3.2. course	<b>2</b>	3.3. seminar/ laboratory/ project	<b>1</b>
3.4. Total of hours in the curriculum	36	of which: 3.5. course	24	3.6. seminar/ laboratory	<b>12</b>
<b>Time allocation for individual study (IS) and self-taught activities (ST)</b>					<b>hours</b>
Learning from textbooks, course materials, bibliography, and notes (IS)					60
Additional research in the library, on subject-specific electronic platforms, and on-site					60
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					52
Tutoring (professional guidance)					24
Examinations					4
Other activities					14
<b>3.7. Total hours of individual study (IS) and self-taught activities (ST)</b>				<b>214</b>	
<b>3.8. Total hours per semester</b>				<b>250</b>	
<b>3.9. Number of credits</b>				<b>10</b>	

#### 4. Prerequisites (where applicable)

4.1. curriculum-related	
4.2. skills-related	

#### 5. Specific conditions (where applicable)

5.1. course-related	
5.2. seminar/laboratory-related	

#### 6. Subject-specific learning outcomes

<b>Knowledge</b>
CP1 1. Knows advanced concepts, theories, and models in the field. 2. Identifies frontier literature in the field.
CP2 1. Knows methods and techniques for identifying and formulating problems. 2. Understands the criteria for relevance and originality of scientific problems.
CP3 1. Knows advanced research methods and techniques, both theoretical and experimental. 2. Understands the scientific methodology applied to their field.

CP4 1. Knows the stages and procedures of project planning. 2. Understands monitoring and reporting tools.
CT1 1. Knows the rules of oral and written scientific communication. 2. Understands the structure of scientific presentations and articles.
CT2 1. Knows international academic terminology. 2. Understands complex scientific documents in foreign languages.
<b>Skills</b>
1. Applies knowledge to the analysis of complex problems. 2. Integrates theoretical and practical concepts for innovative solutions.
1. Formulates original problems and proposes creative solutions. 2. Applies innovative methods to solve identified problems.
1. Designs and applies sophisticated methods for investigating problems. 2. Uses data processing and interpretation techniques.
1. Plans and manages resources, deadlines, and objectives. 2. Applies risk assessment and performance optimization techniques.
1. Drafts and presents scientific information coherently. 2. Adjusts communication according to the audience.
1. Drafts and formulates complex ideas in international contexts. 2. Participates in multicultural collaborations.
<b>Responsibility and autonomy</b>
1. Works autonomously in investigating and expanding knowledge. 2. Assumes responsibility for the validity of the conclusions.
1. Assumes responsibility for the quality and impact of the solutions. 2. Works autonomously in defining research directions.
1. Takes autonomous decisions regarding the choice and adaptation of methods. 2. Assumes responsibility for the correctness of the applied procedures.
1. Assumes responsibility for the success of the project. 2. Coordinates team activities autonomously.
1. Assumes responsibility for the clarity and accuracy of the communication. 2. Works autonomously in preparing the materials.
1. Works autonomously in international academic communication. 2. Assumes responsibility for the accuracy of the transmitted message.

## 7. Contents

7.1 Course	Teaching methods	Remarks
1. Introductory notions. Peano type theorems	Exposure: description, explanation, examples.	
2. Classical interpolation methods. Study of the interpolation error.	Exposure: description, explanation, examples, proofs.	
3. Polynomial spline interpolation operators.	Exposure: description, explanation, examples.	
4. Spline interpolation operators of Lagrange type, Hermite and Birkhoff type. Study of the interpolation error.	Exposure: description, explanation, examples, proofs.	
5. Interpolation operators on rectangular domains. Examples of interpolation operators for square and cube.	Exposure: description, explanation, examples, proofs.	
6. Interpolation operators on simplex domains. Examples of interpolation operators for triangle and tetrahedron.	Exposure: description, explanation, examples, proofs, dialogue.	
7. Interpolation operators on arbitrary domains. Univariate Shepard interpolation.	Exposure: description, explanation, examples.	
8. Bivariate Shepard interpolation.	Exposure: description, explanation, examples.	

9. Numerical differentiation and integration. Newton-Cotes quadrature formulas. Gauss type quadrature formulas. Chebyshev type quadrature formulas.	Exposure: description, explanation, examples.	
10. Numerical methods for solving nonlinear equations in R. Inverse interpolation of Lagrange, Hermite and Birkhoff type.	Exposure: description, explanation, examples.	
11. Numerical methods for solving nonlinear systems.	Exposure: description, explanation, examples.	
12. Numerical methods for solving differential equations.	Exposure: description, explanation, examples.	
Bibliography		
1. O. Agratini, <i>Aproximare prin operatori liniari</i> , Ed. Presa Univ. Clujeană, 2000.		
2. O. Agratini, I. Chiorean, Gh. Coman, R.T. Trîmbițaș, <i>Analiză Numerică și Teoria Aproximării</i> , vol. III, Ed. Presa Univ. Clujeană, 2002;		
3. R. L. Burden, J. D. Faires, <i>Numerical Analysis</i> , PWS Publishing Company, 2010.		
4. T. Căținaș, <i>Interpolation of scattered data</i> , Ed. Casa Cărții de Știință, 2007.		
5. I. Chiorean, T. Căținaș, R. Trîmbițaș, <i>Analiză numerică</i> , Ed. Presa Univ. Clujeană, 2010.		
6. Gh. Coman, T. Căținaș, și alții, <i>Interpolation operators</i> , Ed. Casa Cărții de Știință, Cluj-Napoca, 2004.		
7. Gh. Coman, I. Chiorean, T. Căținaș, <i>Numerical Analysis. An Advanced Course</i> , Ed. Presa Univ. Clujeană, 2007.		
8. S. D. Conte, Carl de Boor, <i>Elementary Numerical Analysis. An Algorithmic Approach</i> , SIAM, 2017.		
9. W. Gander, M.J. Gander, F. Kwok, <i>Scientific Computing</i> , Springer Internat. Publishing, 2014.		
10. W. Gautschi, <i>Numerical Analysis. An introduction</i> , Birkhauser, Basel, 1997		
11. D.D. Stancu, Gh. Coman, O. Agratini, R. Trîmbițaș, <i>Analiză Numerică și Teoria Aproximării</i> , vol. I, Ed. Presa Univ. Clujeană, 2001;		
12. D.D. Stancu, Gh. Coman, P. Blaga, <i>Analiză Numerică și Teoria Aproximării</i> , vol. II, Ed. Presa Univ. Clujeană, 2002;		
13. R. Trîmbițaș, <i>Numerical Analysis</i> , Ed. Presa Univ. Clujeană, 2007.		
<b>7.2 Seminary/Laboratory</b>	Teaching methods	Remarks
1. Introductory examples and problems.	Explanation, dialogue.	
2. Applied problems to polynomial interpolation. Applied problems to spline interpolation.	Explanation, dialogue, examples.	
3. Computation of some tensorial product and boolean sum operators for square and triangle. Graphical representations.	Explanation, dialogue, practical examples. Evaluation.	
4. Examples of some univariate and bivariate Shepard interpolation operators.	Explanation, dialogue, practical examples. Evaluation.	
5. Numerical integrations formulas and algorithms: examples and applied problems. Numerical methods for solving nonlinear equations and systems.	Explanation, dialogue, practical examples. Evaluation.	
6. Presentation of a synthesis work. Possible research directions. Ending of evaluation for seminar/lab work. Final results	Explanation, dialogue, practical examples. Evaluation.	
Bibliography		
1. R. L. Burden, J. D. Faires, <i>Numerical Analysis</i> , PWS Publishing Company, 2010.		
2. W. Gander, M.J. Gander, F. Kwok, <i>Scientific Computing</i> , Springer Internat. Publishing, 2014.		
3. W. Gautschi, <i>Numerical Analysis. An introduction</i> , Birkhauser, Basel, 1997		
2 R. Trîmbițaș, <i>Numerical Analysis</i> , Ed. Presa Univ. Clujeană, 2007.		

## 8. Evaluation

Type of activity	8.1 Evaluation criteria	8.2 Evaluation methods	8.3 Percentage of final grade
8.4 Course	- know the basic principles of Numerical Analysis;	Written exam	60%

	- apply the course concepts in problem solving		
8.5 Seminar/laboratory	- be able to implement course concepts and algorithms	Evaluation and continuous observations during the semester.	30%
	- apply techniques for different practical problems	Study for preparing a synthesis work.	10%
8.6 Minimum standard of performance			
<ul style="list-style-type: none"> <li>At least grade 5 (from a scale of 1 to 10) at both written exam and laboratory work.</li> </ul>			

### 9. SDG labels (Sustainable Development Goals)<sup>1</sup>

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<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
								No label applies
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					

Date of entry:  
13.02.2026

Signature of course coordinator

Assoc. Prof. Teodora Căținaș



Signature of seminar coordinator

Assoc. Prof. Teodora Căținaș



Date of approval in the department:

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Signature of the head of department

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<sup>1</sup> Select a single label which, according to the [Implementation of SDG labels in the academic process](#), best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: "No label applies".