

COURSE DESCRIPTION

Geometry

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Babeş-Bolyai University
1.2. Faculty	Mathematics and Computer Science
1.3. Department	Mathematics
1.4. Field	Computer Science
1.5. Level of study	Bachelor
1.6. Degree programme / Qualification	Artificial Intelligence (English)
1.7. Form of education	Full-time

2. Course-related data

2.1. Course title	Geometry	Course code	MLE0014		
2.2. Course coordinator	Lect. dr. Iulian Simion				
2.3. Seminar coordinator	Lect. dr. Iulian Simion				
2.4. Year of study	1	2.5. Semester	2	2.6. Type of assessment	VP
2.7. Course status	Compulsory	2.8. Course type	DC		

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 / laboratory / project	2
3.4. Total of hours in the curriculum	56	of which: 3.5. course	28	3.6. seminar / laboratory	28
Time allocation for individual study (IS) and self-taught activities (ST)					hours
Learning from textbooks, course materials, bibliography, and notes (IS)					20
Additional research in the library, on subject-specific electronic platforms, and on-site					10
Preparing seminars / laboratories / projects, assignments, reports, portfolios, and essays					14
Tutoring (professional guidance)					14
Examinations					11
Other activities					
3.7. Total hours of individual study (IS) and self-taught activities (ST)				69	
3.8. Total hours per semester				125	
3.9. Number of credits				5	

4. Prerequisites (where applicable)

4.1. curriculum-related	A first course in linear algebra and analysis respectively.
4.2 skills-related	Skills acquired after successfully passing the above mentioned courses.

5. Specific conditions (where applicable)

5.1. course-related	blackboard, projector
5.2. seminar/laboratory-related	blackboard

6.1. Competencies resulting from the completion of the degree programme (as referred to in the curriculum)¹

Professional competencies

¹ The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

Competency code	Competency
-	the indicated codes don't apply
Transversal competencies	
Competency code	Competency
TC2	Solve problems
TC3	Gândește analitic

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)²

Learning outcomes targeted by the subject		
Competency code	Knowledge and comprehension	Specific academic skills
TC1	The student/graduate has the knowledge necessary to understand and solve complex problems, and to plan and organize advanced processes in various fields.	<p>The graduate is able to identify complex problems and examine related issues to develop solving options and implement solutions.</p> <p>The graduate has the ability to apply general rules to specific problems and produce relevant solutions.</p> <p>The graduate is able to combine diverse information to formulate solutions and generate ideas for developing new products and applications.</p>

7. Subject-specific learning outcomes

Knowledge and comprehension
The student has acquired the basic concepts specific to analytic geometry.
Specific academic skills
The student is able to model basic geometric requirements.

8. Contents

8.1. Course	Teaching and learning methods	Remarks ³
Weeks 1-2. Affine Space <ul style="list-style-type: none"> • Geometric vectors • Vector space structure • Cartesian coordinate frames • Changing coordinate frames • Orientation • Affine subspaces in dimension 2 and 3 	Exposition, proofs, examples	Two lectures
Weeks 3-4. Euclidean Space <ul style="list-style-type: none"> • Scalar product • Orthonormal frames • Gram-Schmidt process • Normal vectors • Angles • Loci of equidistant points 	Exposition, proofs, examples	Two lectures
Week 5. Area and Volume <ul style="list-style-type: none"> • Cross product • Box product • Common perpendicular 	Exposition, proofs, examples	
Week 6. Affine Maps	Exposition, proofs, examples	

² The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

³ For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

<ul style="list-style-type: none"> • Parallel projections and reflections • Orthogonal projections and reflections 		
Week 7. Isometries <ul style="list-style-type: none"> • Rotations in dimension 2 and 3 • Displacements • Classification of isometries 	Exposition, proofs, examples	
Week 8. Curves and Surfaces <ul style="list-style-type: none"> • Equations and parametrizations • Tangent lines • Arc length 	Exposition, proofs, examples	
Week 9. Quadratic Curves <ul style="list-style-type: none"> • Ellipse, hyperbola, parabola • Canonical equations • Relative position of a line 	Exposition, proofs, examples	
Week 10. Classification of Quadrics <ul style="list-style-type: none"> • Reduction to canonical form • Isometric classification of quadrics • Affine classification of quadrics 	Exposition, proofs, examples	
Weeks 11-12. Quadratic surfaces <ul style="list-style-type: none"> • Ellipsoid, Cone, Hyperboloid, Paraboloid • Canonical equation • Tangent planes 	Exposition, proofs, examples	Two lectures
Week 13. Curvatures <ul style="list-style-type: none"> • Curvature of curves • Curvatures of surfaces 	Exposition, proofs, examples	
Week 14. Quaternions <ul style="list-style-type: none"> • Algebraic description • Quaternions and rotations 	Exposition, proofs, examples	
Bibliography [1] I. Simion, Geometry – course material, 2026. [2] P.A. Blaga, Geometrie liniară, Cluj-Napoca, 2022. [3] M. Troyanov, Cours de géométrie, Lausanne, 2011.		
8.2. Seminar/ laboratory	Teaching and learning methods	Remarks
Weeks 1-2. Affine Space <ul style="list-style-type: none"> • Geometric vectors • Vector space structure • Cartesian coordinate frames • Changing coordinate frames • Orientation • Affine subspaces in dimension 2 and 3 	Dialog, problem solving	
Weeks 3-4. Euclidean Space <ul style="list-style-type: none"> • Scalar product • Orthonormal frames • Gram-Schmidt process • Normal vectors • Angles • Loci of equidistant points 	Dialog, problem solving	
Week 5. Area and Volume <ul style="list-style-type: none"> • Cross product • Box product • Common perpendicular 	Dialog, problem solving	
Week 6. Affine Maps <ul style="list-style-type: none"> • Parallel projections and reflections • Orthogonal projections and reflections 	Dialog, problem solving	
Week 7. Isometries <ul style="list-style-type: none"> • Rotations in dimension 2 and 3 • Displacements • Classification of isometries 	Dialog, problem solving	
Week 8. Curves and Surfaces	Dialog, problem solving	

<ul style="list-style-type: none"> • Equations and parametrizations • Tangent lines • Arc length 		
Week 9. Quadratic Curves <ul style="list-style-type: none"> • Ellipse, hyperbola, parabola • Canonical equations • Relative position of a line 	Dialog, problem solving	
Week 10. Classification of Quadrics <ul style="list-style-type: none"> • Reduction to canonical form • Isometric classification of quadrics • Affine classification of quadrics 	Dialog, problem solving	
Weeks 11-12. Quadratic surfaces <ul style="list-style-type: none"> • Ellipsoid, Cone, Hyperboloid, Paraboloid • Canonical equation • Tangent planes 	Dialog, problem solving	
Week 13. Curvatures <ul style="list-style-type: none"> • Curvature of curves • Curvatures of surfaces 	Dialog, problem solving	
Week 14. Quaternions <ul style="list-style-type: none"> • Algebraic description • Quaternions and rotations 	Dialog, problem solving	
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9. Evaluation



















Type of activity	9.1 Evaluation criteria ⁴	9.2 Evaluation methods ⁵	9.3 Percentage in the final grade
9.4. Course	Critical grasp of the learned material, ability to use what was learned	Two written partial exams at the middle and at the end of the semester (40% and 60% respectively)	30%
9.5. Seminar/ laboratory	Ability to use the theory for solving problems	included in the above	70%
9.6 Minimum standard for passing			
75% attendance at the seminar.			
The weighted average of the grades for the two partial exams needs to be at least 5			

10. SDG labels (Sustainable Development Goals)⁶

⁴ The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

⁵ Both final evaluation methods and ongoing evaluation strategies should be established.

⁶ 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.”

	<input type="radio"/>	Sustainable Development Generic Label						
								
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
								No label applies
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Date of entry:
11.04.2026

Signature of course coordinator

Lect. dr. Iulian-Ion Simion

Signature of seminar coordinator

Lect. dr. Iulian-Ion Simion

Date of approval in the department:
24.04.2026

Signature of the head of department

Prof. dr. Andrei Mărcuș