SYLLABUS

Geometry

University year 2025-2026

1. Information regarding the programme

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

2. Information regarding the discipline

2.1. Name of the discipline	**Geometry**					Discipline 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 evaluation	**VP**	2.7. Discipline regime	**Compulsory**

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/laborator	**28**
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					14
Tutorship					14
Evaluations					11
Other activities:					
3.7. Total individual study hours	**69**				
3.8. Total hours per semester	**125**				
3.9. Number of ECTS credits	**5**				

4. Prerequisites (if necessary)

4.1. curriculum	A first course in linear algebra and analysis respectively.
4.2. competencies	Competencies of using the above mentioned courses.

5. Conditions (if necessary)

5.1. for the course	blackboard and chalk or whiteboard and whiteboard marker, video projector
5.2. for the seminar /lab activities	blackboard and chalk or whiteboard and whiteboard marker

6.1. Specific competencies acquired [1]

Professional/essential competencies	• C1.1 Identifying specific concepts, describing specific theories and using domain specific language. • C2.3 Applying suitable analytical methods to specific problems and contexts.
Transversal competencies	• CT1. Applying the principles of rigorous and efficient work while demonstrating a responsible attitude toward science and education, in compliance with ethical and professional standards.

6.2. Learning outcomes

Knowledge	The student knows: - The specific language, methods, and algorithms required to solve specific problems. - How to derive mathematical proofs for specific statements and formulas.
Skills	The student is able to: - Apply appropriate methods and algorithms to solve specific problems. - Derive mathematical proofs for specific statements and formulas.
Responsibility and autonomy:	The student is capable of working independently to: - Expand acquired knowledge. - Critically engage with the relevant literature.

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

7.1 General objective of the discipline	• Basic concepts, methods, and algorithms in the context of analytic geometry.
7.2 Specific objective of the discipline	• Interfacing with linear algebra and analysis through affine subspaces, classification of isometries, different perspectives on curves and surfaces, tangent planes and tangent lines, classification of quadrics, and curvature.

[1] One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

8. Content

8.1 Course	**Teaching methods**	**Remarks**
Weeks 1-2. Affine Space • 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 • Scalar product • Orthonormal frames • Gram-Schmidt process • Normal vectors • Angles • Loci of equidistant points	Exposition, proofs, examples	Two lectures
Week 5. Area and Volume • Cross product • Box product • Common perpendicular	Exposition, proofs, examples	
Week 6. Affine Maps • Parallel projections and reflections • Orthogonal projections and reflections	Exposition, proofs, examples	
Week 7. Isometries • Rotations in dimension 2 and 3 • Displacements • Classification of isometries	Exposition, proofs, examples	
Week 8. Curves and Surfaces • Equations and parametrizations • Tangent lines • Arc length	Exposition, proofs, examples	
Week 9. Quadratic Curves • Ellipse, hyperbola, parabola • Canonical equations • Relative position of a line	Exposition, proofs, examples	
Week 10. Classification of Quadrics • Reduction to canonical form • Isometric classification of quadrics • Affine classification of quadrics	Exposition, proofs, examples	
Weeks 11-12. Quadratic surfaces • Ellipsoid, Cone, Hyperboloid, Paraboloid • Canonical equation • Tangent planes	Exposition, proofs, examples	Two lectures
Week 13. Curvatures • Curvature of curves • Curvatures of surfaces	Exposition, proofs, examples	
Week 14. Quaternions • Algebraic description • Quaternions and rotations	Exposition, proofs, examples	
Bibliography [1] I. Simion, Geometry – course material, 2025. [2] P.A. Blaga, Geometrie liniară, Cluj-Napoca, 2022. [3] M. Troyanov, Cours de géométrie, Lausanne, 2011.		
8.2 Seminar / laboratory	**Teaching methods**	**Remarks**
Weeks 1-2. Affine Space • Geometric vectors	Dialog, problem solving	

• Vector space structure • Cartesian coordinate frames • Changing coordinate frames • Orientation • Affine subspaces in dimension 2 and 3		
Weeks 3-4. Euclidean Space • Scalar product • Orthonormal frames • Gram-Schmidt process • Normal vectors • Angles • Loci of equidistant points	Dialog, problem solving	
Week 5. Area and Volume • Cross product • Box product • Common perpendicular	Dialog, problem solving	
Week 6. Affine Maps • Parallel projections and reflections • Orthogonal projections and reflections	Dialog, problem solving	
Week 7. Isometries • Rotations in dimension 2 and 3 • Displacements • Classification of isometries	Dialog, problem solving	
Week 8. Curves and Surfaces • Equations and parametrizations • Tangent lines • Arc length	Dialog, problem solving	
Week 9. Quadratic Curves • Ellipse, hyperbola, parabola • Canonical equations • Relative position of a line	Dialog, problem solving	
Week 10. Classification of Quadrics • Reduction to canonical form • Isometric classification of quadrics • Affine classification of quadrics	Dialog, problem solving	
Weeks 11-12. Quadratic surfaces • Ellipsoid, Cone, Hyperboloid, Paraboloid • Canonical equation • Tangent planes	Dialog, problem solving	
Week 13. Curvatures • Curvature of curves • Curvatures of surfaces	Dialog, problem solving	
Week 14. Quaternions • Algebraic description • Quaternions and rotations	Dialog, problem solving	
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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

- A solid understanding of geometry is a prerequisite for any job involving geometric modeling.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 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
10.5 Seminar/laboratory	Ability to use the theory for solving problems	Points during the tutorial for active participation	Can lead up to one extra point for the final grade
10.6 Minimum standard of performance			
• 75% attendance at the Seminar. • At least grade 5 for the final grade (excluding the bonus points obtained during the tutorials).			

11. Labels ODD (Sustainable Development Goals)[2]

	General label for Sustainable Development							
								

Date:
11.04.2025

Signature of course coordinator

Lect. dr. Iulian Simion

Signature of seminar coordinator

Lect. dr. Iulian Simion

Date of approval:
25.04.2025

Signature of the head of department

Prof. dr. Andrei Mărcuș

[2] Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable*.”.