SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babeş-Bolyai University
1.2 Faculty	Faculty of Mathematics and Computer Science
1.3 Department	Department of Computer Science
1.4 Field of study	Computers and Information Technology
1.5 Study cycle	Bachelor
1.6 Study programme / Qualification	Information Engineering

2. Information regarding the discipline

2.1 Name of the discipline	Linear algebra, analitical and differential geometry 2						
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 Type of discipline	Compulsory
2.8 Disciplinei code	MLE0014						

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

3.1 Hours per week	4	Of which: 3.2 course	2	3.3 seminar	2
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar	28
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					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	• Basic knowledege in algebra and calculus.
4.2 competencies	• Competencies of using the above mentioned curricula.

5. Conditions (if necessary)

5.1 for the course	
5.2 for the seminar /lab activities	

6. Specific competencies acquired

Professional competencies	• C1.1 Idetifying the notions, describing the theories and using the specific language • C2.3 Applying the adequate analytical theoretical methods to a given problem
Transversal competencies	CT1. Applying some rules of precise and efficient work, showing a responsible attitude regarding the the scientific domain and teaching training for an optimal and creative development of the personal potential in specific situations, respecting the deontological norms.

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

7.1 General objective of the discipline	Basic notions and methods în the context of analytic geometry
7.2 Specific objective of the discipline	Classification of quadratic curves and surfaces

8. Content

8.1 Course	Teaching methods	Remarks
1-2. Affine spaces • Geometric vectors • Vector space structure • Cartesian coordinate frames • Changing coordinates • Affine subspaces in dimension 2 and 3 • Hyperplanes	Exposition, proofs, examples	Two lectures
3-4. Euclidean spaces • Scalar product • Gram matrix • Orthonormal frames • Gram-Schmidt process • Applications • Spectral Theorem	Exposition, proofs, examples	Two lectures
5. Orientation • Box product • Cross product	Exposition, proofs, examples	

• Properties • Applications		
6. Affine maps • Parallel projections and reflections • Orthogonal projections and reflections	Exposition, proofs, examples	
7. Isometries • Rotations in dimension 2 and 3 • Displacements • Classification of isometries in dimension 2 and 3	Exposition, proofs, examples	
8-9. Quadratic curves • Ellipse, hyperbola, parabola • Canonical equations • Relative position of a line • Tangent lines	Exposition, proofs, examples	Two lectures
10. Classification of quadrics (dimension 2 and 3) • Reducing to canonical form • Isometric classification of quadrics • Affine classification of quadrics	Exposition, proofs, examples	
11-12. Quadratic surfaces • Ellipsoid, Cone, Hyperboloid, Paraboloid • Canonical equation • Tangent planes	Exposition, proofs, examples	Two lectures
13. Curvatures • Curvature of curves • Curvatures of surfaces	Exposition, proofs, examples	
14. Quaternions • Algebraic description • Quaternions and rotations	Exposition, proofs, examples	
Bibliography [1] I. Simion, Geometry – material de curs, 2024. [2] P.A. Blaga, Geometrie – material de curs, 2019. [3] M. Troyanov, Cours de géométrie, Lausanne, 2011. [4] E. Sernesi, Linear Algebra. A geometric Approach (Translated by J. Montaldi), 2009.		
8.2 Seminar	Teaching methods	Remarks
1-2. Affine spaces • Geometric vectors • Vector space structure • Cartesian coordinate frames • Changing coordinates • Affine subspaces in dimension 2 and 3 • Hyperplanes	Dialog, problem solving	Two tutorials
3-4. Euclidean spaces • Scalar product	Dialog, problem solving	Two tutorials

• Gram matrix • Orthonormal frames • Gram-Schmidt process • Applications • Spectral Theorem		
5. Orientation • Box product • Cross product • Properties • Applications	Dialog, problem solving	
6. Affine maps • Parallel projections and reflections • Orthogonal projections and reflections	Dialog, problem solving	
7. Isometries • Rotations in dimension 2 and 3 • Displacements • Classification of isometries in dimension 2 and 3	Dialog, problem solving	
8-9. Quadratic curves • Ellipse, hyperbola, parabola • Canonical equations • Relative position of a line • Tangent lines	Dialog, problem solving	Two tutorials
10. Classification of quadrics (dimension 2 and 3) • Reducing to canonical form • Isometric classification of quadrics • Affine classification of quadrics	Dialog, problem solving	
11-12. Quadratic surfaces • Ellipsoid, Cone, Hyperboloid, Paraboloid • Canonical equation • Tangent planes	Dialog, problem solving	Two tutorials
13. Curvatures • Curvature of curves • Curvatures of surfaces	Dialog, problem solving	
14. Quaternions • Algebraic description • Quaternions and rotations	Dialog, problem solving	
Bibliography [1] I. Simion, Geometry – material de curs, 2024. [2] P.A. Blaga, Geometrie – material de curs, 2019. [3] M. Troyanov, Cours de géométrie, Lausanne, 2011. [4] E. Sernesi, Linear Algebra. A geometric Approach (Translated by J. Montaldi), 2009.		

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 material of this course serves other courses
  - a deeper understanding of linear algebra
  - affine transformations are necessary examples for a group theory course
  - quadrics are necessary examples in calculus courses
  - coordinate changes, projections, affine transformations are necessary for computer graphics
- Applications of the theory are presented wherever appropriate

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Critical grasp of the learned material, ability to use what was learned	Two written partial exams and a written final exam	30%, 30%, 40% respectively
10.5 Seminar	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 performance standards			
75% attendance at the Seminar At least grade 5 for the final grade (excluding the bonus points obtained during the tutorials).			

Date	Signature of course coordinator	Signature of seminar coordinator
21. February 2024	Lect. Dr. Iulian Simion	Lect. Dr. Iulian Simion

Date of approval Signature of the head of department

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