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 Mathematics
1.4 Field of study	Mathematics
1.5 Study cycle	Bachelor
1.6 Study programme / Qualification	Mathematics and Computer Science

2. Information regarding the discipline

2.1 Name of the discipline (ro)	Geometrie 2 (Affine Geometry) Geometrie 2 (Geometrie afină)						
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	MLE0015						

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)					20
Preparation for seminars/labs, homework, papers, portfolios and essays					35
Tutorship					15
Evaluations					3
Other activities:					1

3.7 Total individual study hours	94
3.8 Total hours per semester	150
3.9 Number of ECTS credits	6

4. Prerequisites (if necessary)

4.1 curriculum	• Basic knowledege in algebra and calculus • A first course on analytic geometry
4.2 competencies	

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 affine geometry
7.2 Specific objective of the discipline	Affine transformations Classification of quadrics Projective transformations

8. Content

8.1 Course	Teaching methods	Remarks
1. Affine spaces • Affine subspaces • Convexity • An alternitive definition of affine spaces	Exposition, proofs, examples	
2. Affine subspaces • Parametric equations • Cartesian equations • Relative positions	Exposition, proofs, examples	
3. Affine subspaces în dimension 2 • Affine lines • Relative positions of lines	Exposition, proofs, examples	

• Pencils of lines • Theorems of Thales, Pappus and Desargues		
4. Affine subspaces în dimension 3 • Affine lines and planes • Relative positions of lines and planes • Pencils of planes	Exposition, proofs, examples	
5. Changing affine frames • Linear maps and matrices • Equations of affines subspaces în different reference frames	Exposition, proofs, examples	
6. Affine maps • Projections on a hyperplane along a line • Projections on a line along a hyperplane • Reflections in a hyperplane	Exposition, proofs, examples	
7. Eigenvalues and eigenvectors • Linear operators • Eigenvalues and eigenvectors • Characteristic polynomial	Exposition, proofs, examples	
8. Bilinear and quadratic forms • Bilinear forms • Quadratic forms • Diagonalizing quadratic forms	Exposition, proofs, examples	
9. Euclidean spaces • Euclidean spaces • Isometries • Rotations • Spectral Theorem	Exposition, proofs, examples	
10. Hyperquadrics • Reducing to canonical form • Isometric classification • Affine classification	Exposition, proofs, examples	
11-12. Quadratic surfaces • Ellipsoid, cone, hyperboloid, paraboloid • Canonical equations • Tangent planes	Exposition, proofs, examples	Two lectures
13-14. Projective Geometry • Projective line, plane and space • Projective transformations • Applications	Exposition, proofs, examples	Two lectures

Bibliography

[1] E. Sernesi, Linear Algebra. A geometric Approach (Translated by J. Montaldi), 2009.
[2] I. Simion, Geometry 2 – material de curs, 2021.
[3] P.A. Blaga, Geometrie – material de curs, 2019.
[4] M. Troyanov, Cours de géométrie, Lausanne, 2011.

8.2 Seminar	Teaching methods	Remarks
1. Affine spaces • Affine subspaces • Convexity • An alternitive definition of affine spaces	Dialog, problem solving	
2. Affine subspaces • Parametric equations • Cartesian equations • Relative positions	Dialog, problem solving	
3. Affine subspaces în dimension 2 • Affine lines • Relative positions of lines • Pencils of lines • Theorems of Thales, Pappus and Desargues	Dialog, problem solving	
4. Affine subspaces în dimension 3 • Affine lines and planes • Relative positions of lines and planes • Pencils of planes	Dialog, problem solving	
5. Changing affine frames • Linear maps and matrices • Equations of affines subspaces în different reference frames	Dialog, problem solving	
6. Affine maps • Projections on a hyperplane along a line • Projections on a line along a hyperplane • Reflections in a hyperplane	Dialog, problem solving	
7. Eigenvalues and eigenvectors • Linear operators • Eigenvalues and eigenvectors • Characteristic polynomial	Dialog, problem solving	
8. Bilinear and quadratic forms • Bilinear forms • Quadratic forms • Diagonalizing quadratic forms	Dialog, problem solving	
9. Euclidean spaces • Euclidean spaces • Isometries • Rotations • Spectral Theorem	Dialog, problem solving	
10. Hyperquadrics • Reducing to canonical form • Isometric classification • Affine classification	Dialog, problem solving	

11-12. Quadratic surfaces • Ellipsoid, cone, hyperboloid, paraboloid • Canonical equations • Tangent planes	Dialog, problem solving	Two tutorials
13-14. Projective Geometry • Projective line, plane and space • Projective transformations • Applications	Dialog, problem solving	Two tutorials

Bibliography

[1] E. Sernesi, Linear Algebra. A geometric Approach (Translated by J. Montaldi), 2009.
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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

- 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 analysis courses
- - coordinate changes, projections, affine and projective transformations are necessary for computer graphics
- - Building on a previous geometry course, classification results are presented
- 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 at the middle and at the end of the semester	each 50%
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			
At least grade 5 for the final grade.			

Date	Signature of course coordinator	Signature of seminar coordinator
12. February 2022	Lect. Dr. Iulian Simion	Lect. Dr. Iulian Simion

Date of approval	Signature of the head of department
....	Prof. Dr. Octavian Agratini