SYLLABUS

Analytic 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	Mathematics
1.5. Study cycle	Bachelor
1.6. Study programme/Qualification	Mathematics and Computer Science (English) / Mathematician
1.7. Form of education	Full-time

2. Information regarding the discipline

2.1. Name of the discipline	**Analytic Geometry**					Discipline code	**MLE0013**
2.2. Course coordinator				Lector dr. George-Cătălin Țurcaș			
2.3. Seminar coordinator				Lector dr. George-Cătălin Țurcaș			
2.4. Year of study	1	2.5. Semester	1	2.6. Type of evaluation	E	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/laboratory	**28**
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
Learning using manual, course support, bibliography, course notes (SA)					24
Additional documentation (in libraries, on electronic platforms, field documentation)					20
Preparation for seminars/labs, homework, papers, portfolios and essays					20
Tutorship					14
Evaluations					6
Other activities: individual projects; communication with the lecturer					10
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	None assumed
4.2. competencies	Basic knowledge of algebra, trigonometry and elementary geometry

5. Conditions (if necessary)

5.1. for the course	Board and projector
5.2. for the seminar /lab activities	Board and (ideally) projector

6.1. Specific competencies acquired [1]

[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.

Professional/essential competencies	• C1.1 The ability to identify concepts, theories and use of specific description language • C2.1 The ability to identify basic concepts used in the description of specific phenomena and processes • C4.5 The ability to produce a mathematical model for a certain problem.
Transversal competencies	• CT1. Applying rigorous and efficient work rules, displaying a responsible attitude towards the scientific and educational and creative order to maximize their potential in specific situations with respect to the basic principles and norms of professional ethics

6.2. Learning outcomes

Knowledge	The student knows: • fundamental concepts of analytic geometry, including vector algebra, coordinate systems, lines and planes in space, conic sections, and quadric surfaces; • the main geometric transformations (isometries and affine transformations) and their properties; • methods for reducing equations of curves and surfaces to canonical forms and interpreting their geometric meaning.
Skills	The student is able to: • apply vector and coordinate methods to solve geometric problems in both plane and space; • perform algebraic computations to analyze geometric configurations and transformations; • use mathematical reasoning to produce clear and rigorous solutions and arguments in both oral and written form.
Responsibility and autonomy:	The student has the ability to work independently to: • explore new problems involving geometric structures and transformations using analytical tools; • integrate knowledge from multiple sources (course material, bibliography, and personal study) to solve non-trivial geometric problems; • reflect critically on their own problem-solving strategies and improve them based on feedback and self-evaluation.

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

7.1 General objective of the discipline	• Acquiring theoretical and practical knowledge necessary for understanding the principles and methods of analytic geometry.
7.2 Specific objective of the discipline	• Introduction of basic notions for analytic geometry (vectors, coordinates, straight lines, planes, conic sections and quadric surfaces), the study of their properties and of the relations between them, by means of the geometric transformations.

8. Content

8.1 Course	**Teaching methods**	**Remarks**
Vector algebra and coordinates (3 lectures)	Lecture, description, examples using multimedia tools	
The straight line in the plane (1 lecture)	Lecture, description, examples using multimedia tools	
The line and plane in space (2 lectures)	Lecture, description, examples using multimedia tools	
Isometries and affine transformations in the plane (2 lectures)	Lecture, description, examples using multimedia tools	
Conic sections. Reduction to the canonical equation (3 lectures)	Lecture, description, examples using multimedia tools	
Quadric surfaces on the canonical equations (1 lecture)	Lecture, description, examples using multimedia tools	
Generated surfaces (1 lecture)	Lecture, description, examples using multimedia tools	
Isometries and affine transformations in space (1 lecture)	Lecture, description, examples using multimedia tools	

Bibliography

1. D. Andrica, L. Topan - Analytic Geometry, Cluj University Press, 2004
2. M. Audin - Geometry, Springer, 2003
3. P. A. Blaga – Geometrie liniară: cu un ochi către grafica pe calculator, Presa Universitară Clujeană, 2022.
4. P.A. Blaga – Geometrie si grafica I (lecture notes available on the author website)
5. P. A. Blaga - Lectures on Classical Differential Geometry, Risoprint, 2005
6. M. P. Deisenroth, A. A. Faisal, C. S. Ong - *Mathematics for Machine Learning,* Cambridge University Press, 2020.
7. C. Pintea - Geometrie. Elemente de geometrie analitica. Elemente de Geometrie diferențială a curbelor și suprafețelor, Cluj University Press, 2001.
8. D. Moulton – Geometry. Lecture notes from the Michaelmas Term 2021, University of Oxford (available on https://courses.maths.ox.ac)
9. M. Reid, B. Szendroi- *Geometry and Topology,* Cambridge University Press, 2005.

8.2 Seminar / laboratory	**Teaching methods**	**Remarks**
Vector algebra and coordinates (3 seminars)	Examples, dialogue, explanation, demonstration, problem-solving	
The straight line in the plane (1 seminar)	Examples, dialogue, explanation, demonstration, problem-solving	
The line and plane in space (2 seminars)	Examples, dialogue, explanation, demonstration, problem-solving	
Isometries and affine transformations in the plane (2 seminars)	Examples, dialogue, explanation, demonstration, problem-solving	
Conic sections. Reduction to the canonical equation (3 seminars)	Examples, dialogue, explanation, demonstration, problem-solving	
Quadric surfaces (1 seminar)	Examples, dialogue, explanation, demonstration, problem-solving	
Generated surfaces (1 seminar)	Examples, dialogue, explanation, demonstration, problem-solving	
Isometries and affine transformations in space (1 seminars)	Examples, dialogue, explanation, demonstration, problem-solving	

Bibliography

1. D. Andrica, L. Topan - Analytic Geometry, Cluj University Press, 2004
2. C. Blaga, P. Blaga – Geometrie analitică: culegere de probleme, Presa Universitară Clujeană, 2024.
3. D. Brannan, M. Esplen – Geometry, Cambridge University Press, Second Edition 2011
4. F. Rado - Culegere de probleme de geometrie, Lito UBB, 1979
5. D. Kletenik - Problems in Analytic Geometry, Arhiant, 2019
6. G. Simmons – Calculus with Analytic Geometry, McGraw-Hill Education, 1995
7. D. Moulton – Geometry. Problem sets from the Michaelmas Term 2021, University of Oxford (available on https://courses.maths.ox.ac)

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 notions assimilated are essential for any prospective mathematician or math teacher. Moreover, these competencies are very useful in activities related to computer graphics, computer aided geometric design or machine learning.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	Knowledge of fundamental concepts and results; problem solving ability	Midterm test	40%
		Final exam	50%
10.5 Seminar/laboratory	Problem-solving ability based on learned concepts and theorems; Ability to synthesize mathematical content and effectively communicate it through clear presentations	Solving problems at the board; Homework	10%
10.6 Minimum standard of performance			
• The arithmetic average of the grades obtained in the midterm test and the final exam should be greater than or equal to 5.			

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

	General label for Sustainable Development							
								

Date:
11.04.2025

Signature of course coordinator

Lector dr. George Țurcaș

Signature of seminar coordinator

Lector dr. George Țurcaș

[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*.".

Date of approval:
25.04.2025

Signature of the head of department

Prof. dr. Andrei Mărcuș