SYLLABUS

Linear Algebra, Analytical and Differential Geometry 2

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	"Babeş-Bolyai" University Cluj Napoca
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	Information Engineering, English
1.7. Form of education	Regular attendance

2. Information regarding the discipline

2.1. Name of the discipli	ne Linear A Differen	Linear Algebra, Analytical and Differential Geometry 2					Discipline code	MLE0089	
2.2. Course coordinator						Conf. dr. Paul Blaga			
2.3. Seminar coordinator					onf. o	dr. Paul	Blaga		
2.4. Year of study 1	2.5. Semester	Semester 2 2.6. Type of evaluati				2.7. Disc	cipline regime	DF	

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

3.1. Hours per week	4	of which: 3.2 course	3	3.3 seminar/laboratory/project	1
3.4. Total hours in the curriculum	56	of which: 3.5 course	42	3.6 seminar/laboratory/project	14
Time allotment for individual study (ID) and self-study activities (SA)					
Learning using manual, course support, bibliography, course notes (SA)					20
Additional documentation (in libraries, on electronic platforms, field documentation)					20
Preparation for seminars/labs, homework, papers, portfolios and essays					20
Tutorship					
Evaluations					4
Other activities:					0
3.7. Total individual study hours69					
3.8. Total hours per semester	3.8. Total hours per semester 125				
3.9. Number of ECTS credits 5					

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competencies	Elementary knowledge of linear algebra, geometry and trigonometry

5. Conditions (if necessary)

5.1. for the course	A lecture hall with videoprojector
5.2. for the seminar /lab activities	
6.1. Specific competencies acquire	d 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	 Using the specific terminology of analytic and differential geometry in various contexts of application, processing quantitative, qualitative, structural or contextual data specific to analytic and differential geometry contained in mathematical statements, using the algorithms specific to analytic and differential geometry and the concepts of analytic and differential geometry in solving problems, expressing and coherently writing in formal language the solution of a geometry problem, analysis of problem situations in order to identify strategies for optimizing solutions, generalizing some properties specific to I geometry by modifying the initial context of defining the problem or by generalizing the algorithms
Transversal competencies	Learning skills, communication skills, social skills

6.2. Learning outcomes

Knowledge	The student knows: the fundamentals of analytic and differential geometry.
Skills	The student is able to solve problems of analytic and differential geometry.
Responsibility and autonomy:	The student has the ability to work independently to obtain models based on analytic and differential geometry and to analyse them.

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

7.1 General objective of the discipline	 developing creative thinking, developing calculation skills, developing spatial vision, forming a pro-active attitude towards geometry developing independent learning skills
7.2 Specific objective of the discipline	• The purpose of the course is to familiarize the students of Information Engineering with the main notions and methods of analytic and differential geometry, taking into account, above all, the possible applications in computer graphics and geometric design assisted by computer, as well as in applications related to virtual reality.

8.1 Course Teaching methods Remarks Vector algebra, coordinate systems Lecture, description, exemplification using multimedia tools. Lecture, description, The straight line (in the plane and in exemplification using multimedia space), the plane tools. Conical sections Lecture, description, exemplification using multimedia tools. Generated surfaces Lecture, description, exemplification using multimedia tools. Quadric surfaces Lecture, description, exemplification using multimedia tools. Homogeneous coordinates, 2d affine Lecture, description, exemplification using multimedia transformations tools. Lecture, description, 3d affine transformations and projections exemplification using multimedia tools. Lecture, description, Parameterized curves, the tangent and the exemplification using multimedia normal plane, the normal to a plane tools. curve, the osculating plane The Frenet frame of a space curve, the Lecture, description, exemplification using multimedia Frenet equations, the curvature and the tools. torsion, intrinsic equations Lecture, description, Plane curves, signed curvature, exemplification using multimedia envelopes, evolvent and involvent of a tools. plane curve, intrinsic equation Parametrized surfaces, curves on a Lecture, description, exemplification using multimedia surface, tangent plane and normal to a tools. surface Lecture, description, The first fundamental form of a surface exemplification using multimedia and applications to the computation of tools. lengths, angles and areas The Gauss map and the second Lecture, description, exemplification using multimedia fundamental form of s surface, tools. classification of the points of a surface, asymptotic lines and curvature line The curvatures of a surface (normal, Lecture, description, exemplification using multimedia principal, total, mean), geodesic lines tools. Bibliography

8. Content

1. Dorin Andrica, Liana Topan -- Analytic Geometry, Cluj University Press, 2004

- 2. Michele Audin Geometry, Springer, 2003
- 3. Paul A. Blaga Geometrie liniară, cu un ochi către grafica pe calculator, vol. I, Presa Universitară Clujeană, 2022
- 4. Paul A. Blaga Lectures on Classical Differential Geometry, Risoprint, 2005
- John Oprea Differential Geometry and its Applications (2nd edition), Mathematical Association of America, 2007
- 6. A. Pogorelov Analytical Geometry, Mir Publishers, 1980
- 7. A. Pogorelov Geometry, Mir Publishers, 1987
- D. Rogers, J. Adams Mathematical Elements for Computer Graphics (2nd edition), McGraw Hill, 1990

8.2 Seminar / laboratory	Teaching methods	Remarks
Problems with vectors, lines and planes	Description, explanation, conversation, individual study and / or teamwork.	
Problems with conical sections	Description, explanation, conversation, individual study and / or teamwork.	
Problems with quadrics and generated surfaces	Description, explanation, conversation, individual study and / or teamwork.	
Problems with affine transformations and projections	Description, explanation, conversation, individual study and / or teamwork.	
Problems related to the differential geometry of curves	Description, explanation, conversation, individual study and / or teamwork.	
Problems with surfaces (tangent plane, normal, the first fundamental form)	Description, explanation, conversation, individual study and / or teamwork.	
Problems with surfaces (the second fundamental form, curvatures, special families of lines)	Description, explanation, conversation, individual study and / or teamwork.	

Bibliography

1. Cristina Blaga, Paul A. Blaga – Geometrie analitică, culegere de probleme, Presa Universitară Clujeană, 2023

2. A. .Fedenko -- Recueil d'exercices de geometrie differentielle, Ed. MIR, 1982

3.T. Fomenko, A.S. Mishchenko, Yu. Soloyev - Selected Problems in Differential Geometry and

Topology, Cambridge Scientific Publishers, 2013

4. D. Kletenik - Problems in Analytic Geometry, Mir Publishers, 1969

1. 5. M. Lipschutz – Schaum's Outline of Differential Geometry, McGraw Hill, 1969

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 the course will prove useful in courses of algorithms (especially computational geometry) and it is necessary prerequisite for any serious course of Computer Graphics, CAGD or Computer Vision and Virtual Reality.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade					
	The completeness	Exam	3/5					
	and correctness of the							
10.4 Course	knowledge							
10.4 Course	The degree of							
	assimilation of the							
	specialized language							
	The ability to use the	Midterm exam,	2/5					
	assimilated	Continuous						
	knowledge in solving	evaluation of student						
10.5 Seminar/laboratory	problems	participation in						
		educational activities						
	Analytical capacity,							
	originality							
10.6 Minimum standard of	performance							
The minimum passing grade is 5, for both course and seminar								

11. Labels ODD (Sustainable Development Goals)²

Eticheta generală pentru Dezvoltare durabilă						
						9 INDUSTRIE. INOVATIE SI INFRASTRICTURA

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."*.

ſ					

Date: April 25, 2025 Signature of course coordinator

Assoc. Prof. Paul Blaga

Signature of seminar coordinator

Assoc. Prof. Paul Blaga

ma

Date of approval:

...

And

Signature of the head of department Prof. Andrei Mărcuș