DESCRIPTION OF THE COURSE OF STUDY

Course code	0541.6.MAT2.C.GA	
Name of the course in	Polish	**Geometria algebraiczna**
	English	**Algebraic Geometry**

1. LOCATION OF THE COURSE OF STUDY WITHIN THE SYSTEM OF STUDIES

1.1. Field of study	Mathematics
1.2. Mode of study	full-time studies
1.3. Level of study	Graduate (Master)
1.4. Profile of study*	general academic profile of studies
1.5. Person/s preparing the course description	dr Mateusz Masternak
1.6. Contact	mateusz.masternak@ujk.edu.pl

2. GENERAL CHARACTERISTICS OF THE COURSE OF STUDY

2.1. Language of instruction	English and Polish
2.2. Prerequisites*	basics of algebra

3. DETAILED CHARACTERISTICS OF THE COURSE OF STUDY

3.1. Form of classes		lectures and classes
3.2. Place of classes		classes in the UJK teaching room
3.3. Form of assessment		Exam (lectures), graded credit (classes)
3.4. Teaching methods		Information lecture, discusions, workshop, solving problems.
3.5. Bibliography	**Required reading**	1. William Fulton, Algebraic Curves, An Introduction to Algebraic Geometry, 2008, which is available for free (legally) here: http://www.math.lsa.umich.edu/~wfulton/CurveBook.pdf ; 2. Igor R. Shafarevich, Basic Algebraic Geometry 1, Varieties in Projective Space, Third Edition, Springer-Verlag Berlin Heidelberg, 2013; 3. Robin Hartshorne, (Graduate Texts in Mathematics), Algebraic geometry, Springer, 1977;
	Further reading	1. Otto Forster, Lectures on Riemann Surfaces, Springer, New York, 1999; 2. Armin Rainer, Introduction to Riemann Surfaces, Lecture Notes, 2018, which is available for free (legally) here: https://www.mat.univie.ac.at/~armin/lect/Riemann_surfaces.pdf ; 3. David Mumford, Algebraic geometry I: Complex projective varieties, Classics in Mathematics, Springer-Verlag, 1995; 4. Egbert Brieskorn, Horst Knörrer, Plane Algebraic Curves, (translated by John Stillwell), Birkhäuser, Basel, 2012.

4. OBJECTIVES, SYLLABUS CONTENT AND INTENDED LEARNING OUTCOMES

4.1. Course objectives

The subject is an introduction to algebraic geometry. During the course, affine algebraic sets will be presented and the basics of algebraic projective geometry and properties of algebraic varieties will be discussed. In particular, elements of algebraic curves theory will be considered in more detail.

Lecture

C1 - learning about affine algebraic sets,
C2 - learning the basics of algebraic projective geometry and properties of algebraic varieties
C3 - presentation of the basic theory of algebraic curves.

Classes

C1 - mastering the ability to study the geometric properties (and arithmetic properties) of algebraic manifolds with particular emphasis on the study of the properties and description of algebraic curves.
C2 - to develop the habit of learning, improving one's own work, and formulating questions that serve to deepening one's own understanding of a given topic.

4.2. Detailed syllabus

Lecture:

Affine algebraic sets and Zariski topology. Hilbert Zeros Theorem (Nullstellensatz). Affine varieties over an algebraically closed field. Regular mappings. Irreducible sets. Homogeneous polynomials. Projective varieties. Affine plane and projective plane. Regular maps of projective subsets and rational maps. Plane curves. Local properties of curves. Projective plane curves. Intersection numbers. Bézout Theorem. Resolution of singularities (quadratic transformations, blowing up). Riemann surfaces. Divisors. Sheaves. Cohomologies. Riemann-Roch Theorem. Hurvitz Theorem. Elliptic curves.

Seminar sessions:

Testing of geometrical (and arithmetical) properties of algebraic sets, in particular, complex plane curves will be considered in more detail. Testing of local properties of curves and their singularities. The intersection multiplicity and its properties. Determination of

the intersection multiplicity of curves. Puiseux Theorem. Branch. Number of branches. Singularity invariants. Milnor number and its calculation. The Newton diagram and the Newton polygon. Estimations of the intersection multiplicity and the number of branches and the Milnor number in terms of the Newton diagrams. Information about the Newton algorithm. Information about the semi-group of a branch. Kouchnirenko Theorems (local and global version). Berntstein Theorem as a reinforcement of Bέzout Theorem.

4.3 Intended learning outcomes

Code	**A student, who passed the course**	**Relation to learning outcomes**
within the scope of **KNOWLEDGE:**		
W01	understands well the role and importance of mathematical reasoning in algebraic geometry relating to the study and description of properties of algebraic sets and manifolds.	MAT2A_W01 MAT2A_W02 MAT2A_W11
W02	knows the most important concepts, theorems and hypotheses in the field of the foundations of algebraic geometry with particular emphasis on the theory of flat algebraic curves.	MAT2A_W01 MAT2A_W02 MAT2A_W11
W03	knows examples of applications of algebraic methods (in possible combination with the use of tools from other branches of mathematics, inter alia in topology, algebraic topology, complex analysis and differential geometry) in solving problems in the field of algebraic geometry (including solving practical tasks).	MAT2A_W01 MAT2A_W02 MAT2A_W11
within the scope of **ABILITIES:**		
U01	can construct reasoning and proof of the basics of algebraic geometry and can select counterexamples to refute erroneous hypotheses in this area, as well as the ability to verify the correctness of the reasoning in the formal proofs of theorems in its field.	MAT2A_U01 MAT2A_U03 MAT2A_U10
U02	can see and distinguish formal structures related to the basic objects studied within algebraic geometry and understands the importance of these structures.	MAT2A_U01 MAT2A_U03 MAT2A_U10
U03	is able to carry out theorem proofs from the basics of algebraic geometry, in which he uses and combines, if necessary, also techniques from other branches of mathematics, inter alia from the field of commutative algebra, topology, algebraic topology, complex analysis and differential geometry.	MAT2A_U01 MAT2A_U03 MAT2A_U10
within the scope of **SOCIAL COMPETENCE:**		
K01	recognizes the importance of knowledge of the basics of algebraic geometry in solving theoretical and practical problems.	MAT2A_K02

4.4. Methods of assessment of the intended learning outcomes

Teaching outcomes *(code)*	**Method of assessment (+/-)**																				
	Exam oral/written*			**Test***			**Project***			**Effort in class***			**Self-study***			**Group work***			**Others* e.g. standardized test used in e-learning**		
	Form of classes			***Form of classes***			***Form of classes***			***Form of classes***			***Form of classes***			***Form of classes***			***Form of classes***		
	L	*C*	...	*L*	*C*	...	*L*	*C*	...	*L*	*C*	...	*L*	*C*	...	*L*	*C*	...	*L*	*C*	...
W01	+					+				+		+	+		+						
W02	+					+				+		+	+		+						
W11	+					+				+		+	+		+						
U01						+				+		+	+		+						
U03						+				+		+	+		+						
U10						+				+		+	+		+						
K01	+					+				+		+	+		+						

delete as appropriate

4.5. Criteria of assessment of the intended learning outcomes

Form of classes	**Grade**	**Criterion of assessment**
lecture (L) (including e-learning)	**3**	at least 50% and no more than 60% of the total number of points possible
	3,5	more than 60% and no more than 70% of the total number of points possible
	4	more than 70% and no more than 80% of the total number of points possible
	4,5	more than 80% and no more than 90% of the total number of points possible
	5	more than 90% of the total number of points possible

classes (C)* (including e-learning)	**3**	at least 50% and no more than 60% of the total number of points possible
	3,5	more than 60% and no more than 70% of the total number of points possible
	4	more than 70% and no more than 80% of the total number of points possible
	4,5	more than 80% and no more than 90% of the total number of points possible
	5	more than 90% of the total number of points possible

5. BALANCE OF ECTS CREDITS – STUDENT'S WORK INPUT

Category	**Student's workload**	
	Full-time studies	**Extramural studies**
NUMBER OF HOURS WITH THE DIRECT PARTICIPATION OF THE TEACHER /CONTACT HOURS/	***47***	
*Participation in lectures**	15	
*Participation in classes, seminars, laboratories**	30	
*Preparation in the exam/ final test**	2	
INDEPENDENT WORK OF THE STUDENT/NON-CONTACT HOURS/	***28***	
*Preparation for the lecture**	8	
*Preparation for the classes, seminars, laboratories**	10	
*Preparation for the exam/test**	10	
TOTAL NUMBER OF HOURS	***75***	
ECTS credits for the course of study	**3**	

delete as appropriate

Accepted for execution *(date and legible signatures of the teachers running the course in the given academic year)*

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