UNIWERSYTET IM. ADAMA MICKIEWICZA W POZNANIU

Algebraic curves

Educational subject description sheet

Basic information

Study programme
Matematyka

Speciality
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Organizational unit
Faculty of Mathematics and Computer Sciences

Study level
Second-cycle programme

Study form
Full-time

Education profile
General academic

Didactic cycle
2023/24

Subject code
06MATS.28K.16224.23

Lecture languages
English

Course type
Elective

Block
Major subjects

Subject coordinator	Wojciech Gajda
Lecturer	Wojciech Gajda

Period	Activities and hours	Number of ECTS points
Semester 4	• Lecture: 30, Exam • Classes: 30, Graded credit	6

Goals

Code	Goal
C1	This is an introductory course in algebraic geometry designed for mathematics students of all specializations. We will begin by establishing a solid foundation and delve deeply into the theory of curves over complex numbers, and subsequently, over any algebraically closed field. Following this, we will explore affine and projective algebraic varieties, covering morphisms, local rings, function fields, dimension, and nonsingular varieties. This groundwork will enable us to prove the Riemann-Roch theorem over an algebraically closed field. The primary objective of the course is to familiarize students with the fundamentals of algebraic geometry, examine a wide array of examples, and prove several significant theorems in the field.

Subject learning outcomes

Code	Outcomes in terms of	Learning outcomes	Examination methods
Knowledge – Student:			
W1	The student is familiar with the basic concepts related to curves over the field of complex numbers as well as over any algebraically closed field.	MAT_K2_W01, MAT_K2_W02, MAT_K2_W03, MAT_K2_W04	Oral exam, Written colloquium
W2	The student is familiar with fundamentals of affine and projective algebraic varieties, covering morphisms, local rings, function fields, dimension, and nonsingular varieties.	MAT_K2_W01, MAT_K2_W03, MAT_K2_W04	Oral exam, Written colloquium
W3	The student knows the statement of the Riemann-Roch theorem.	MAT_K2_W01, MAT_K2_W03, MAT_K2_W04	Oral exam, Written colloquium
Skills – Student:			
U1	The student can describe selected properties of algebraic curves.	MAT_K2_U01, MAT_K2_U06, MAT_K2_U08, MAT_K2_U09	Oral exam, Written colloquium
U2	The student can describe selected properties of affine and projective varietes.	MAT_K2_U01, MAT_K2_U02, MAT_K2_U08, MAT_K2_U09	Oral exam, Written colloquium
U3	The student can formulate and knows the steps of the proof of the Riemann-Roch theorem.	MAT_K2_U01, MAT_K2_U02, MAT_K2_U08, MAT_K2_U09	Oral exam, Written colloquium
Social competences – Student:			
K1	The student is prepared to independently study topics related to algebraic geometry.	MAT_K2_K01, MAT_K2_K02, MAT_K2_K03, MAT_K2_K05	Oral exam

Study content

No.	Course content	Subject learning outcomes	Activities
1.	Conics and Cubics. Higher degree curves.	W1, U1	Lecture, Classes
2.	Bezout Theorem.	W1, U1	Lecture, Classes
3.	Riemann-Roch Theorem.	W3, U3, K1	Lecture, Classes
4.	Affine varieties.	W2, U2, K1	Lecture, Classes
5.	Projective varieties.	W2, U2, K1	Lecture, Classes

Additional information

Activities	Teaching and learning methods and activities
Lecture	Conversation lecture, Problem-based lecture
Classes	Discussion, Problem-based learning, Classes method

Activities	Credit conditions
Lecture	Required to take an oral exam to get a final grade. The condition for taking the exam is to obtain passing grades in exercises. Grading scale with applied percentage distribution: excellent (5.0): achievement of the student's expected learning outcomes at a minimum of 90.0%. very good (4.5): achievement by the student of the desired learning outcomes ranging from 80.0% - 89.9%. good (4.0): achievement of student learning outcomes 70.0% - 79.9%. average (3.5): achievement of student learning outcomes 60.0% - 69.9%. satisfactory (3.0): attainment of the student learning outcomes within 50.0% - 59.9%. unsatisfactory (2.0): failure of the student to achieve the expected learning outcomes below 50.0%.
Classes	Required to pass the written colloquium. Grading scale with applied percentage distribution: excellent (5.0): achievement of the student's expected learning outcomes at a minimum of 90.0%. very good (4.5): achievement by the student of the desired learning outcomes ranging from 80.0% - 89.9%. good (4.0): achievement of student learning outcomes 70.0% - 79.9%. average (3.5): achievement of student learning outcomes 60.0% - 69.9%. satisfactory (3.0): attainment of the student learning outcomes within 50.0% - 59.9%. unsatisfactory (2.0): failure of the student to achieve the expected learning outcomes below 50.0%.

Literature

Obligatory

1. William Fulton, Algebraic Curves, An Introduction to Algebraic Geometry, Benjamin (1969)
2. Thomas Garrity et. al., Algebraic Geometry, A problem Solving Approach, AMS (2010)

Optional

1. Philip Griffiths, Introduction to Algebraic Curves, AMS (1989)
2. Klaus Hulek, Elementary Algebraic Geometry, AMS (2003)
3. I.R.Shafarevich, Basic Algebraic Geometry I, II, Springer (1994)
4. Robin Hartshorne, Algebraic Geometry, Springer (1977)
5. Ulrich Goertz, Torsten Wedhorn, Algebraic Geometry I, Vieweg (2010)

Calculation of ECTS points

Activities	Activity hours*
Lecture	30
Classes	30
Preparation for classes	20
Preparation for the exam	35

Preparation for the assessment	35
Student workload	**Hours** 150
Number of ECTS points	**ECTS** 6

* academic hour = 45 minutes

Efekty uczenia się dla kierunku

Kod	Treść
MAT_K2_K01	The graduate is ready to dalszego ustawicznego kształcenia
MAT_K2_K02	The graduate is ready to formułowania adekwatnych pytań służących zrozumieniu danego tematu i identyfikacji brakujących elementów rozumowania
MAT_K2_K03	The graduate is ready to samodzielnego wyszukiwania informacji w literaturze i bazach danych, także w językach obcych
MAT_K2_K05	The graduate is ready to krytycznego przyjmowania i weryfikacji twierdzeń i wniosków, a także do wskazywania braków w ich uzasadnieniu
MAT_K2_U01	The graduate can wyrażać treści matematycznych w mowie i piśmie, w opracowaniach o różnym charakterze, dostosowując precyzję sformułowań i języka do poziomu i potrzeb odbiorcy opracowania
MAT_K2_U02	The graduate can przeprowadzać rozumowania matematyczne, dowodzenie twierdzeń, jak i weryfikację hipotez drogą doboru odpowiednich przykładów
MAT_K2_U06	The graduate can odnosić pojęcia matematyczne do niematematycznych kontekstów, w analizowanych problemach potrafi dostrzec i wykorzystać struktury formalne opisywane w wybranych działach matematyki
MAT_K2_U08	The graduate can rozpoznawać podstawowe struktury algebraiczne i ich własności oraz potrafi wykorzystać działania i przekształcenia algebraiczne w innych działach matematyki
MAT_K2_U09	The graduate can posługiwać się zaawansowanymi metodami i narzędziami przynajmniej z jednej dziedziny matematyki
MAT_K2_W01	The graduate knows and understands klasyczne pojęcia z zakresu matematyki i jej zastosowań oraz najważniejsze metody i twierdzenia z głównych jej działów
MAT_K2_W02	The graduate knows and understands rolę, znaczenie i zasady poprawnego prowadzenia rozumowań matematycznych oraz zna różne techniki dowodzenia
MAT_K2_W03	The graduate knows and understands podstawy konstruowania modeli matematycznych przydatnych w zastosowaniach matematyki w różnych dziedzinach wiedzy
MAT_K2_W04	The graduate knows and understands specjalistyczne zagadnienia z wybranej dziedziny matematyki