Department of Mathematics

College of Science

Salahaddin Univesity-Erbil

Subject: Introduction to Algebraic Geometry

Module leader: Dr.Wuria Muhammad Ameen Hussein

Academic Year: 2022-2023

Course Book

1. Course name	Introduction to Algebraic Geometry
2. Lecturer in charge	Dr.Wuria Muhammad Ameen
3. Department/ College	Mathematics/Science
4. Contact	e-mail: wuria.hussein@su.edu.krd Tel:
5. Time (in hours) per week	Theory: 3 Practical: 0
6. Office hours	
7. Course code	
8. Teacher's academic profile	-Name: Wuria Muhammad Ameen Hussein - Place-Date of birth: Erbil-14/2/1971 -Academic title: Lecturer -PhD in Mathematics at Plymouth University-United Kingdom in 2016 -M.Sc. in Mathematics at Salahaddin University in 2002 -B.Sc. in Mathematics at Salahaddin University in 1994 - General field: Mathematics -Specific field: Application of Algebraic Geometry -Job title and address: Lecturer in Mathematics Department/College of Science/Salahaddin University
9. Keywords	Affine varieties, Zariski closure, Hilbert's Nullstellensatz, Irreducible varieties, projective space.

10. Course overview:

Algebraic geometry is a branch of mathematics. It deals with the study of common zeros of a set of polynomials. In this course we study an introduction of algebraic geometry.

The aim of this course is to introduce elementary concepts in algebraic geometry. A dictionary between algebra and geometry is the main goal of this course. We start with the study of affine spaces, affine varieties and algebraic sets. Later, we investigate Zariski topology and Hilbert's Nullstellensatz results. Irreducibility of affine verities is the next topic. We will finish this course by study the projective spaces. Students will be provided with definitions and theoretical tools that are needed to understand various topics.

11. Course objective:

This course will cover the following topics:

- Affine space and algebraic sets.
- Zariski topology and Hilbert's Nullstellensatz results.
- Irreducibility of algebraic sets and decomposition of affine varieties.
- Projective spaces.

12. Student's obligation

1. Students are required to attend each lecture on time, staying and listening until the end. Students can leave the class for a short time if necessary.
2. Students are not allowed to be out of attendance for more than 9 hours.
3. Any discussion among the students during the lectures is not allowed unless they get permission.

13. Forms of teaching

1. We use the slide visualiser if available, otherwise the white board.
2. Data show projector.

14. Assessment scheme

Students are required to get at least %50 in order to pass this module.
The marks are counted as follows:

1- %40 for annual average.
2- %60 for the final exam.

15. Student learning outcome:

دوای ئەوەی قوتابی ئەم کۆرسە دەخوێنێت و بە سەرکەوتوویی تەواوی دەکات، بنچینەییەکی پتەو بە دەست دەهێنێت لەسەر affine variety و algebraic sets و algebra-geometry dictionary و Irreducible varieties, Zariski toplogy و Hilbert's Nullstellensatz results وprojective spaces .

ئەو کۆرسە دەست پێدەکات بە خوێندنی بابەتی affine variety , affine space ، وە دوای ئەوە بابەتی Zariski topology و Hilbert's Nullstellensatz و فەرهەنگی نێوان جەبر و ئەندازە دەبێتە بابەتی سەرەکی دوای ئەوە، وە لەکۆتاییدا باس لە projective space دەکەین.

16. Course Reading List and References:

1. Cox D.A., Little J. and O'shea D., An introduction to computational algebraic geometry and commutative algebra (4th edition). Springer Cham Heidelberg, 2010.
2. Hasset B., Introduction to algebraic geometry. Printed in the United Kingdom at the University Press, Cambridge, 2007.

Syllabus of Introduction to algebraic geometry 2022-2023	
Chapter 1: Basic concepts in algebra 1.1 Basic concepts in linear algebra Linear combination, span, subspace, basis and dimension.	

1.2 Commutative algebra (an introduction) rings, subrings, ideals, polynomial rings and fields. **Chapter 2: Affine space and Algebraic sets** 2.1 What is algebraic geometry? 2.2 Polynomial rings in several numbers. 2.3 Affine subspace. 2.4 Affine variety. 2.5 Algebraic sets. 2.6 Zariski topology. **Chapter 3: The algebra-geometry dictionary** 3.1 Hilbert's Nullstellensatz. 3.2 Zariski closure. 3.3 Irreducible varieties. 3.4 Decompositions of varieties into irreducible. **Chapter 4: Projective space** 2.1 Projective plane. 2.2 The *n*-dimensional projective spaces.	
18. Practical Topics (If there is any)	

19. Examinations:

1. Compositional: In exams, the questions are usually started with: Prove that …, or Prove or disprove, for this type of question, if it is correct, then students must prove it generally. Otherwise he/she must provide a counterexample for disprove.
For example: Prove or disprove: The union of two algebraic sets is an algebraic set.

2. True or false type of questions: In this type, a short sentence about a specific subject will be provided. Then students should comment on the trueness or falseness of this particular sentence. Explanation and examples should be provided.

20. Extra notes:

1. Students should work in groups.
2. Solving examples as much as he/she can.