Algebraic Geometry 2

Joseph Bernstein Feb 02, 2005

This is a basic course in algebraic geometry for tor sheny complemented by necessary facts from commutative algebra.

This is a continuation of the course given by Professor S. Alesker in Semester A.

Course description

First we will briefly go over the first part of the course covered in semester A. I will mostly emphasize the geometric structures in Algebraic Geometry.

Content of the first part:

1. Affine algebraic varieties
2. Zariski topology
3. Noether's normalization lemma
4. Hilbert's basis theorem and Nullstellensatz
5. Projective varieties and general algebraic varieties
6. Products of algebraic varieties
7. Separated and complete varieties
8. Decomposition into irreducible components
9. Dimension
10. Smooth points and tangent spaces
11. Degree
11. Classical examples of algebraic varieties

The main (interrelated) topics of the second part of the course are:
(i) Theory of algebraic curves (including Riemann-Roch theorem)
(ii) Sheaf theory and its applications in Algebraic Geometry

Content of the second part of the course:

1. Algebraic curves and their non-singular models
2. Riemann-Roch theorem - elementary approach
3. Sheaves
4. Coherent sheaves and localization. Serre's lemma
5. Cohomologies and elements of homological algebra.
6. Higher cohomological operations with sheaves. Base change
7. Different versions of Riemann-Roch theorem and its applications.
8. Jacobians of curves
9. Weil's proof of Riemann hypothesis for curves over finite fields.

Books

I will mostly follow the book by
G.R.Kempf "Algebraic varieties",
Cambridge University Press (London Math. Society, Lecture Notes Series, v.172)

Sometimes for exercises I will use the book by
M.F. Atiyah, I.G.MacDonald "Introduction to commutative algebra"