

**G364. Topics in Algebra (Invariant Theory, Spring 2010.
Syllabus.**

Time: Tuesday, Thursday, 7:30-9pm to be changed after first meeting.

Place: 544 NI.

Instructor: Jerzy Weyman.

In this course I will cover the basics of Invariant Theory and Moduli Problems. The prerequisites will involve:

- a) Some commutative algebra (rings, modules, homomorphisms, Hilbert Basis Theorem, basic facts on localizations).
- b) Some representation theory of classical groups, but the used facts and references will be stated,
- c) In covering more advanced topics some sheaves and cohomology will appear, (not going beyond Hartshorne's book chapters 2 and 3) but most of the course can be understood without it.

The useful textbooks for understanding/complementing the course are.

1. Kraft, H.P. Geometrische Methoden in der Invarianttheorie, Friedr. Vieweg, Braunschweig, Wiesbaden, 1985,
2. Springer, T. Invariant Theory, Lecture Notes in Math, 585, 1977,
3. Mukai, S. An Introduction to Invariants and Moduli, Cambridge Studies in advanced mathematics, no. 81, Cambridge University Press, 2003.

Another helpful book might be Kraft, Geometrische Methoden in Invarianttheorie, but it does not exist in English.

We will cover the following topics.

1. The examples of rings of invariants:
 - a) Invariants of finite groups (Kleinian groups),
 - b) Binary forms,
 - c) Ternary forms (plane cubics, i.e. elliptic curves),
2. Rings of invariants and affine quotients,
 - a) Hilbert Theorem,
 - b) Separation of orbits,
 - c) Surjectivity of affine quotient map,
 - d) Stability.
 - e) Linearly reductive groups and some representation theory.
3. Projective quotients,
 - a) Stability conditions,

- b) Semi-invariants, moving quotients and flops,
- c) Examples.
- 4. Hilbert-Mumford criterion and applications.
- 5. Advanced examples
 - a) Moduli of curves,
 - b) Moduli of vector bundles over curves.

Grading will be based on homework assignments. We will set the office hours during the first meeting.