INVARIANT THEORY AND AUTOMORPHISMS OF POLYNOMIAL AND FREE ALGEBRAS

VESSELIN DRENSKY

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1. Invariant theory of finite groups:
Basic notions of invariant theory. Theorem of Emmy Noether for the finite generation of the algebra of invariants. The Molien formula for the Hilbert (or Poincaré) series of the algebra of invariants.

2. Classical invariant theory:
Invariant theory of the special linear group SL(2,C) and the unitriangular group UT(2,C). Hilbert series. Finite generation. As a consequence - Theorem of Weitzenboeck for the finite generation of the algebra of constants of a linear locally nilpotent derivation.

3. Automorphisms of polynomial algebras:
Tame and wild automorphisms. Tameness of the automorphisms of the polynomial algebras in two variables. Wild automorphisms. The Nagata automorphism. Locally nilpotent derivations and automorphisms. Stable tameness of classes of automorphisms.

4. Noncommutative invariant theory:
Invariant theory of finite groups acting of free associative and free Lie algebras. Algebras with polynomial identities. Relatively free algebras and their invariant theory. Invariant theory of matrices.

5. Automorphisms of free associative and Lie algebras:
Tame automorphisms of the free associative algebra C<x,y> and the free Lie algebra in any number of variables. Automorphisms of relatively free algebras.

References:

Standard texts in invariant theory and locally nilpotent derivations:

T.A. Springer, Invariant Theory,
Lecture Notes in Mathematics, 585, Berlin-Heidelberg-New York: Springer-Verlag, 1977.

H. Derksen, G. Kemper, Computational Invariant Theory,
Encyclopaedia of Mathematical Sciences.
Invariant Theory and Algebraic Transformation Groups, 130(1).
Berlin: Springer, 2002.

B. Sturmfels,
Algorithms in Invariant Theory,
Texts and Monographs in Symbolic Computation. Wien: Springer-Verlag, 1993.

H. Kraft, C. Procesi, Classical Invariant Theory, a Primer,
http://jones.math.unibas.ch/~kraft/Papers/KP-Primer.pdf.

A. Nowicki,
Polynomial Derivations and Their Rings of Constants,
Uniwersytet Mikolaja Kopernika, Torun, 1994.
Available at: http://www-users.mat.uni.torun.pl/~anow/polder.html.

G. Freudenburg,
Algebraic Theory of Locally Nilpotent Derivations,

Encyclopaedia of Mathematical Sciences 136.
Invariant Theory and Algebraic Transformation Groups 7. Berlin: Springer, 2006.

A. van den Essen,
Polynomial Automorphisms and the Jacobian Conjecture,
Progress in Math. (Boston, Mass.) 190, Birkhaeuser, Basel, 2000.

A.A. Mikhalev, V. Shpilrain, J.-T. Yu,
Combinatorial Methods. Free Groups, Polynomials, and Free Algebras,
CMS Books in Mathematics/Ouvrages de Math\'matiques de la SMC 19. New York, NY: Springer, 2004.

V. Drensky,
Free Algebras and PI-Algebras. Graduate Course in Algebra,
Singapore: Springer, 2000.

V. Drensky, E. Formanek,
Polynomial Identity Rings,
Advanced Courses in Mathematics - CRM Barcelona. Basel: Birkhaeuser, 2004.

Necessary background: Standard knowledge of linear algebra,
polynomials, groups, and rings, on the level of the
Undergraduate Algebra Course.