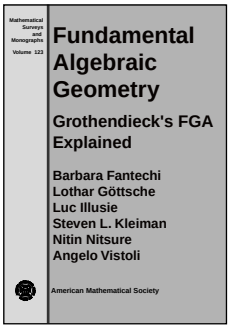
New Publications Offered by the AMS

Algebra and Algebraic Geometry



Fundamental Algebraic Geometry
Grothendieck's FGA Explained

Barbara Fantechi, *SISSA, Trieste, Italy*, **Lothar Göttsche**, *International Centre for Theoretical Physics, Trieste, Italy*, **Luc Illusie**, *Université Paris–Sud, Orsay, France*, **Steven L. Kleiman**, *MIT, Cambridge, MA*, **Nitin Nitsure**, *Tata Institute of Fundamental Research, Mumbai, India*, and **Angelo Vistoli**, *Università di Bologna, Italy*

Alexander Grothendieck's concepts turned out to be astoundingly powerful and productive, truly revolutionizing algebraic geometry. He sketched his new theories in talks given at the Séminaire Bourbaki between 1957 and 1962. He then collected these lectures in a series of articles in *Fondements de la géométrie algébrique* (commonly known as FGA).

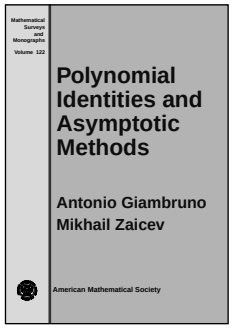
Much of FGA is now common knowledge. However, some of it is less well known, and only a few geometers are familiar with its full scope. The goal of the current book, which resulted from the 2003 Advanced School in Basic Algebraic Geometry (Trieste, Italy), is to fill in the gaps in Grothendieck's very condensed outline of his theories. The four main themes discussed in the book are descent theory, Hilbert and Quot schemes, the formal existence theorem, and the Picard scheme. The authors present complete proofs of the main results, using newer ideas to promote understanding whenever necessary, and drawing connections to later developments.

With the main prerequisite being a thorough acquaintance with basic scheme theory, this book is a valuable resource for anyone working in algebraic geometry.

Contents: *Grothendieck topologies, fibered categories and descent theory:* Introduction; Preliminary notions; Contravariant functors; Fibered categories; Stacks; *Construction of Hilbert and Quot schemes:* Construction of Hilbert and Quot schemes; *Local properties and Hilbert scheme of points:* Introduction; Elementary deformation theory; Hilbert schemes of points; *Grothendieck's existence theorem in formal geometry:* Grothendieck's existence theorem in formal geometry with a letter of Jean-Pierre Serre; *The Picard scheme:* The Picard scheme; Bibliography; Index.

Mathematical Surveys and Monographs, Volume 123

December 2005, approximately 352 pages, Softcover, ISBN 0-8218-3541-6, LC 2005053614, 2000 *Mathematics Subject Classification*: 14–01, 14C20, 13D10, 14D15, 14K30, 18F10, 18D30, **Individual member US$51**, List US$85, Institutional member US$68, Order code SURV/123



Polynomial Identities and Asymptotic Methods

Antonio Giambruno, *Universitá di Palermo, Italy*, and **Mikhail Zaicev**, *Moscow State University, Russia*

This book gives a state of the art approach to the study of polynomial identities satisfied by a given algebra by combining methods of ring theory, combinatorics, and

representation theory of groups with analysis. The idea of applying analytical methods to the theory of polynomial identities appeared in the early 1970s and this approach has become one of the most powerful tools of the theory.

A PI-algebra is any algebra satisfying at least one nontrivial polynomial identity. This includes the polynomial rings in one or several variables, the Grassmann algebra, finite-dimensional algebras, and many other algebras occurring naturally in mathematics. The core of the book is the proof that the sequence of codimensions of any PI-algebra has integral exponential growth – the PI-exponent of the algebra. Later chapters further apply these results to subjects such as a characterization of varieties of algebras having polynomial growth and a classification of varieties that are minimal for a given exponent. Results are extended to graded algebras and algebras with involution.

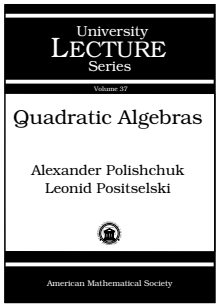
The book concludes with a study of the numerical invariants and their asymptotics in the class of Lie algebras. Even in algebras that are close to being associative, the behavior of the sequences of codimensions can be wild.

The material is suitable for graduate students and research mathematicians interested in polynomial identity algebras.

Contents: Polynomial identities and PI-algebras; S_n-representations; Group gradings and group actions; Codimension and colength growth; Matrix invariants and central polynomials; The PI-exponent of an algebra; Polynomial growth and low PI-exponent; Classifying minimal varieties; Computing the exponent of a polynomial; G-identities and $G \wr S_n$-action; Superalgebras, *-algebras and codimension growth; Lie algebras and non-associative algebras; The generalized-six-square theorem; Bibliography; Index.

Mathematical Surveys and Monographs, Volume 122

December 2005, 352 pages, Hardcover, ISBN 0-8218-3829-6, LC 2005053010, 2000 *Mathematics Subject Classification*: 16R10, 16R20, 16R30, 16R40, 16R50, 16P90, 16W22, 16W55, 17B01, **Individual member US$51**, List US$85, Institutional member US$68, Order code SURV/122



Quadratic Algebras

Alexander Polishchuk, *University of Oregon, Eugene, OR*, and **Leonid Positselski**, *Independent University of Moscow, Russia*

This book introduces recent developments in the study of algebras defined by quadratic relations. One of the main problems in the study of these (and similarly defined) algebras is how to control their size. A central notion in solving this problem is the notion of a Koszul algebra, which was introduced in 1970 by S. Priddy and then appeared in many areas of mathematics, such as algebraic geometry, representation theory, noncommutative geometry, K-theory, number theory, and noncommutative linear algebra.

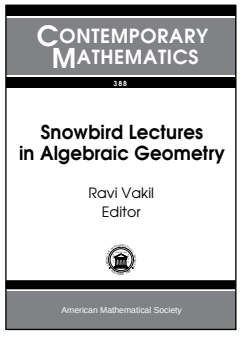
The authors give a coherent exposition of the theory of quadratic and Koszul algebras, including various definitions of Koszulness, duality theory, Poincaré–Birkhoff–Witt-type theorems for Koszul algebras, and the Koszul deformation principle. In the concluding chapter of the book, they explain a surprising connection between Koszul algebras and one-dependent discrete-time stochastic processes.

The book can be used by graduate students and researchers working in algebra and any of the above-mentioned areas of mathematics.

Contents: Preliminaries; Koszul algebras and modules; Operations on graded algebras and modules; Poincaré-Birkhoff-Witt bases; Nonhomogeneous quadratic algebras; Families of quadratic algebras and Hilbert series; Hilbert series of Koszul algebras and one-dependent processes; DG-algebras and Massey products; Bibliography.

University Lecture Series, Volume 37

December 2005, approximately 176 pages, Softcover, ISBN 0-8218-3834-2, LC 2005048198, 2000 *Mathematics Subject Classification*: 16S37, 16S15, 16E05, 16E30, 16E45, 16W50, 13P10, 60G10, **Individual member US$21**, List US$35, Institutional member US$28, Order code ULECT/37



Snowbird Lectures in Algebraic Geometry

Ravi Vakil, *Stanford University, CA*, Editor

A significant part of the 2004 Summer Research Conference on Algebraic Geometry (Snowbird, UT) was devoted to lectures introducing the participants, in particular, graduate students and recent Ph.D.'s, to a wide swathe of algebraic geometry and giving them a working familiarity with exciting, rapidly developing parts of the field. One of the main goals of the organizers was to allow the participants to broaden their horizons beyond the narrow area in which they are working. A fine selection of topics and a noteworthy list of contributors made the resulting collection of articles a useful resource for everyone interested in getting acquainted with the modern topic of algebraic geometry.

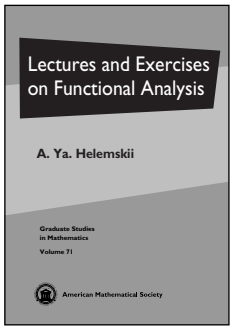
The book consists of ten articles covering, among others, the following topics: the minimal model program, derived categories of sheaves on algebraic varieties, Kobayashi hyperbolicity, groupoids and quotients in algebraic geometry, rigid analytic varieties, and equivariant cohomology. Suitable for independent study, this unique volume is intended for graduate students and researchers interested in algebraic geometry.

Contents: **C. Araujo**, Rationally connected varieties; **C. Cadman**, **I. Coskun**, **K. Jabbusch**, **M. Joyce**, **S. J. Kovács**, **M. Lieblich**, **F. Sato**, **M. Szczesny**, and **J. Zhang**, A first glimpse at the minimal model program; **A. Căldăraru**, Derived categories of sheaves: A skimming; **I. Coskun**, The arithmetic and the geometry of Kobayashi hyperbolicity; **S. Grushevsky**, Multiplier ideals in algebraic geometry; **D. Lehavi**, Mikhalkin's classification of M-curves in maximal position with respect to three lines; **M. Lieblich**, Groupoids and quotients in algebraic geometry; **B. Osserman**, Two degeneration techniques for maps of curves; **M. Papikian**, Rigid-analytic geometry and the uniformization of abelian varieties; **N. Proudfoot**, Geometric invariant theory and projective toric varieties; **J. S. Tymoczko**, An introduction to equivariant cohomology and homology, following Goresky, Kottwitz, and MacPherson.

Contemporary Mathematics, Volume 388

November 2005, 188 pages, Softcover, ISBN 0-8218-3719-2, LC 2005053606, 2000 *Mathematics Subject Classification*: 14–02, 14–06, **All AMS members US$47**, List US$59, Order code CONM/388

Analysis



Lectures and Exercises on Functional Analysis

For Classroom Use

A. Ya. Helemskii, *Moscow State University, Russia*

This book contains a unique exposition intended to serve as an introduction to functional analysis. Topics covered include normed spaces and bounded operators, Banach spaces, polynormed spaces and distributions, compact operators, C^*-algebras, spectral theorems, Fourier transform, and more.

A distinguishing feature of the book is the wide use of the language and elementary constructions of category theory, which are explained in the opening chapter of the book. Among nonstandard topics discussed in the book are the theory of Banach tensor products, basics of quantum functional analysis, and Borel operator calculus. General definitions and main results are supplemented with many examples and exercises.

Prerequisites for the main part of the book include standard undergraduate courses in algebra and analysis. It is suitable for graduate students and researchers interested in functional analysis.

Contents: Foundations: Categories and the like; Normed spaces and bounded operators ("Waiting for completeness"); Banach spaces and their advantages; From compact spaces to Fredholm operators; Polynormed spaces, weak topologies, and generalized functions; At the gates of spectral theory; Hilbert adjoint operators and the spectral theorem; Fourier transform; Bibliography; Index.

Graduate Studies in Mathematics, Volume 71

December 2005, approximately 496 pages, Hardcover, ISBN 0-8218-3552-1, LC 2005053605, 2000 *Mathematics Subject Classification*: 46–01, 47–01, **All AMS members US$63**, List US$79, Order code GSM/71

Real Analysis and Applications

For Classroom Use

Including Fourier Series and the Calculus of Variations

Frank Morgan, *Williams College, Williamstown, MA*

Real Analysis and Applications starts with a streamlined, but complete, approach to real analysis. It finishes with a wide variety of applications in Fourier series and the calculus of variations, including minimal surfaces, physics, economics, Riemannian geometry, and general relativity. The basic theory includes all the standard topics: limits of sequences, topology, compactness, the Cantor set and fractals, calculus with the Riemann integral, a chapter on the Lebesgue theory, sequences of functions, infinite series, and the exponential and Gamma functions. The applications conclude with a computation of the relativistic precession of Mercury's orbit, which Einstein called "convincing proof of the correctness of the theory [of General Relativity]."

The text not only provides clear, logical proofs, but also shows the student how to derive them. The excellent exercises come with select solutions in the back. This is a text that makes it possible to do the full theory and significant applications in one semester.

Frank Morgan is the author of six books and over one hundred articles on mathematics. He is an inaugural recipient of the Mathematical Association of America's national Haimo award for excellence in teaching. With this applied version of his *Real Analysis* text, Morgan brings his famous direct style to the growing numbers of potential mathematics majors who want to see applications along with the theory.

The book is suitable for undergraduates interested in real analysis.

Contents: *Part I: Real numbers and limits:* Numbers and logic; Infinity; Sequences; Subsequences; Functions and limits; Composition of functions; *Part II: Topology:* Open and closed sets; Compactness; Existence of maximum; Uniform continuity; Connected sets and the intermediate value theorem; The Cantor set and fractals; *Part III: Calculus:* The derivative and the mean value theorem; The Riemann integral;

The fundamental theorem of calculus; Sequences of functions; The Lebesgue theory; Infinite series $\sum_{n=1}^{\infty} a_n$; Absolute convergence; Power series; The exponential function; Volumes of n-balls and the gamma function; *Part IV: Fourier series:* Fourier series; Strings and springs; Convergence of Fourier series; *Part V: The calculus of variations:* Euler's equation; First integrals and the Brachistochrone problem; Geodesics and great circles; Variational notation, higher order equations; Harmonic functions; Minimal surfaces; Hamilton's action and Lagrange's equations; Optimal economic strategies; Utility of consumption; Riemannian geometry; Noneuclidean geometry; General relativity; Partial solutions to exercises; Greek letters; Index.

January 2006, approximately 208 pages, Hardcover, ISBN 0-8218-3841-5, LC 2005041221, 2000 *Mathematics Subject Classification*: 26–01, 49–01, 42–01, 83Cxx, **All AMS members US$31**, List US$39, Order code REALAPP

This volume is recommended for independent study and is suitable for graduate students and researchers interested in symplectic geometry, algebraic geometry, and geometric combinatorics.

This item will also be of interest to those working in algebra and algebraic geometry.

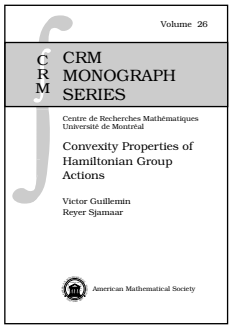
Contents: Introduction; The convexity theorem for Hamiltonian G-spaces; A constructive proof of the non-abelian convexity theorem; Some elementary examples of the convexity theorem; Kähler potentials and convexity; Applications of the convexity theorem; Bibliography.

CRM Monograph Series, Volume 26

November 2005, 88 pages, Hardcover, ISBN 0-8218-3918-7, LC 2005044490, 2000 *Mathematics Subject Classification*: 53D20; 14L24, 53–02, 53C55, **All AMS members US$28**, List US$35, Order code CRMM/26

New AMS-Distributed Publications

Geometry and Topology

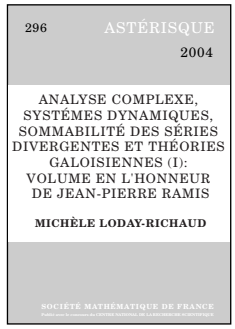


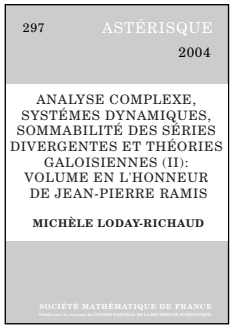
Convexity Properties of Hamiltonian Group Actions

Victor Guillemin and **Reyer Sjamaar**

This is a monograph on convexity properties of moment mappings in symplectic geometry. The fundamental result in this subject is the Kirwan convexity theorem, which describes the image of a moment map in terms of linear inequalities. This theorem bears a close relationship to perplexing old puzzles from linear algebra, such as the Horn problem on sums of Hermitian matrices, on which considerable progress has been made in recent years following a breakthrough by Klyachko. The book presents a simple local model for the moment polytope, valid in the "generic" case, and an elementary Morse-theoretic argument deriving the Klyachko inequalities and some of their generalizations. It reviews various infinite-dimensional manifestations of moment convexity, such as the Kostant type theorems for orbits of a loop group (due to Atiyah and Pressley) or a symplectomorphism group (due to Bloch, Flaschka and Ratiu). Finally, it gives an account of a new convexity theorem for moment map images of orbits of a Borel subgroup of a complex reductive group acting on a Kähler manifold, based on potential-theoretic methods in several complex variables.

Differential Equations





Analyse Complexe, Systémes Dynamiques, Sommabilité des Séries Divergentes et Théories Galoisiennes (I) (II)

Michèle Loday-Richaud, *Université d'Angers, France*, Editor

These two bound volumes present the proceedings of the conference, Complex Analysis, Dynamical Systems, Summability of Divergent Series and Galois Theories, held in Toulouse on the occasion of J.-P. Ramis' sixtieth birthday.

The first volume opens with two articles composed of recollections and three articles on J.-P. Ramis' works on complex analysis and ODE theory, both linear and non-linear. This introduction is followed by papers concerned with Galois theories, arithmetic

or integrability: analogies between differential and arithmetical theories, q-difference equations, classical or p-adic, the Riemann–Hilbert problem and renormalization, b-functions, descent problems, Krichever modules, the set of integrability, Drach theory, and the VIth Painlevé equation.

The second volume contains papers dealing with analytical or geometrical aspects: Lyapunov stability, asymptotic and dynamical analysis for pencils of trajectories, monodromy in moduli spaces, WKB analysis and Stokes geometry, first and second Painlevé equations, normal forms for saddle-node type singularities, and invariant tori for PDEs.

The volumes are suitable for graduate students and researchers interested in differential equations, number theory, geometry, and topology.

This item will also be of interest to those working in geometry and topology and number theory.

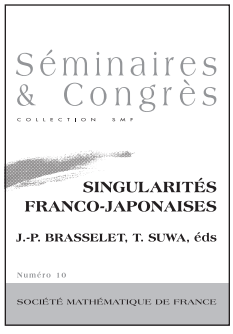
A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: Volume I: B. Malgrange, Les premiers travaux de Jean-Pierre Ramis; **G. Ruget**, Témoignage; **D. Bertrand**, Travaux de J.-P. Ramis sur les équations différentielles linéaires; **D. Cerveau**, Travaux de J.-P. Ramis sur les équations différentielles non linéaires; **M. Loday-Richaud**, Souvenirs strasbourgeois; **Y. André**, Galois representations, differential equations, and q-difference equations: sketch of a p-adic unification; **Y. André** and **L. Di Vizio**, q-difference equations and p-adic local monodromy; **A. Connes**, Renormalisation et ambiguité galoisienne; **Y. Laurent**, b-functions and integrable solutions of holonomic $\mathcal{D}$-module; **A. L. Neto**, Curvature of pencils of foliations; **M. van der Put**, Skew differential fields, differential and difference equations; **M. van der Put** and **M. Reversat**, Krichever modules for difference and differential equations; **J. Sauloy**, Algebraic construction of the Stokes sheaf for irregular linear q-difference equations; **H. Umemura**, Monodromy preserving deformation and differential Galois group I; **Volume II: F. Cano**, **R. Moussu**, and **F. Sanz**, Pinceaux de courbes intégrales d'un champ de vecteurs analytique; **B. Dubrovin**, On analytic families of invariant tori for PDEs; **N. Joshi**, **K. Kahwara**, and **M. Mazzocco**, Generating function associated with the determinant formula for the solutions of the Painlevé II equation; **V. Kaloshin**, **J. N. Mather**, and **E. Valdinoci**, Instability of resonant totally elliptic points of symplectic maps in dimension 4; **T. Kawai**, **T. Koike**, **Y. Nishikawa**, and **Y. Takei**, On the Stokes geometry of higher order Painlevé equations; **F. Loray**, Versal deformation of the analytic saddle-node; **C. Simpson**, Asymptotics for general connections at infinity.

Astérisque, Number 296–297

Volume I: April 2005, 270 pages, Softcover, ISBN 2-85629-167-8, 2000 *Mathematics Subject Classification*: 01A70, 11R32, 11R39, 11S80, 12Hxx, 13Nxx, 17B15, 32G34, 32S65, 33E17, 34A30, 34A34, 34Mxx, 35A27, 35D10, 37F75, 39A13, 58B34, 81T15, 14F10, 14H70, 32D20, 32Gxx, 34C08, 34C10, 34D20, 34D23, 34Exx, 35Q53, 37Jxx, 37K10, 37K20, **Individual member US$74,** List US$82, Order code AST/296
Volume II: April 2005, 232 pages, Softcover, ISBN 2-85629-168-6, 2000 *Mathematics Subject Classification*: 01A70, 11R32, 11R39, 11S80, 12Hxx, 13Nxx, 17B15, 32G34, 32S65, 33E17, 34A30, 34A34, 34Mxx, 35A27, 35D10, 37F75, 39A13, 58B34, 81T15, 14F10, 14H70, 32D20, 32Gxx, 34C08, 34C10, 34D20, 34D23, 34Exx, 35Q53, 37Jxx, 37K10, 37K20, **Individual member US$53,** List US$59, Order code AST/297
Set: April 2005, 502 pages, Softcover, 2000 *Mathematics Subject Classification*: 01A70, 11R32, 11R39, 11S80, 12Hxx, 13Nxx, 17B15, 32G34, 32S65, 33E17, 34A30, 34A34, 34Mxx, 35A27, 35D10, 37F75, 39A13, 58B34, 81T15, 14F10, 14H70, 32D20, 32Gxx, 34C08, 34C10, 34D20, 34D23, 34Exx, 35Q53, 37Jxx, 37K10, 37K20, **Individual member US$110**, List US$122, Order code AST/296/97

Geometry and Topology



Singularités Franco-Japonaises

Jean-Paul Brasselet, *CNRS, Marseille, France*, and **Tatsuo Suwa**, *Hokkaido University, Sapporo, Japan*, Editors

The second Franco-Japanese Singularity Conference was held in the CIRM (Marseille-Luminy) in September 2002. The proceedings of the meeting published in this volume show not only the diversity, but also the consistency of the fields discussed. The main topics covered by the lectures were characteristic classes, residues, stratifications, singularities of curves and surfaces, valuations, resolution of singularities, and toric varieties. Several papers present the results recently obtained in the field so as to be accessible to non-specialists and to users of singularity theory.

The volume is suitable for graduate students and research mathematicians interested in geometry and topology.

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: F. Aroca and **J. Snoussi**, Normal quasi-ordinary singularities; **R. Bondil**, General elements of an m-primary ideal on a normal surface singularity; **J.-P. Brasselet**, **J. Seade**, and **T. Suwa**, An explicit cycle representing the Fulton-Johnson class, I; **T. Brélivet**, Sur les paires spectrales de

polynômes à deux variables; **D. Garber**, On the connection between affine and projective fundamental groups of line arrangements and curves; **H. A. Hamm** and **D. T. Lê**, On the Picard group for non-complete algebraic varieties; **H. Hironaka**, Three key theorems on infinitely near singularities; **D. Juniati** and **D. Trotman**, Determination of Lipschitz stratifications for the surfaces $y^a = z^b x^c + x^d$; **V. P. Kostov**, On arrangements of the roots of a hyperbolic polynomial and of one of its derivatives; **K. Kurdyka** and **L. Paunescu**, Arc-analyticity is an open property; **I. Luengo** and **A. Pichon**, Lê's conjecture for cyclic covers; **Y. Nakamura** and **S. Tajima**, Unimodal singularities and differential operators; **M. Oka**, A survey on Alexander polynomials of plane curves; **H. Ohta** and **K. Ono**, Symplectic 1-manifolds containing singular rational curves with $(2,3)$-cusp; **A. Parusiński**, Integrability of some functions on semi-analytic sets; **P. Polo**, Construction d'hypersurfaces affines à cohomologie d'intersection prescrite; **T. Suwa**, Residues of Chern classes on singular varieties; **S. Tajima** and **Y. Nakamura**, Computational aspects of Grothendieck local residues; **H. Tokunaga**, 2-dimensional versal S_4-covers and rational elliptic surfaces; **T. Tomaru**, On some classes of weakly Kodaira singularities; **M. Tosun**, ADE surface singularities, chambers and toric varieties; **S. Tsuboi**, The Chern numbers of the normalization of an algebraic threefold with ordinary singularities; **N. C. Tu**, On semi-stable, singular cubic surfaces; **M. Vaquié**, Famille admise associée à une valuation de $K[x]$; **S. Yokura**, Generalized Ginzburg-Chern classes; **A. Y. Yoshikawa** and **K. Yoshikawa**, Isolated critical points and adiabatic limits of Chern forms.

Séminaires et Congrès, Number 10

March 2005, 460 pages, Softcover, ISBN 2-85629-166-X, 2000 *Mathematics Subject Classification*: 12D10, 13A18, 14B05, 14C05, 14C17, 14C22, 14D05, 14E15, 14E20, 32A27, 14H30, 14J17, 32B20, 32S05, 32S10, 32S15, 32S25, 32S45, 32S60, 53D35, 58K05, **Individual member US$74**, List US$82, Order code SECO/10