

New Publications Offered by the AMS

Algebra and Algebraic Geometry



Systèmes de Racines Infinis

Nicole Bardy, *University of Nancy I, France*

This work creates sets of axioms of root systems that are general enough to include Kac-Moody algebras and the systems that appear in Borcherds' generalization of these algebras or in their almost- K -split forms and compatible with Moody and Pianzola's axiomatization of "real root systems".

The author provides the basic theorems (essential to make the theory useful) that deal with the problems of subroot systems, conjugacy of bases, field extensions and quotient root systems (which appear in the study of almost- K -split forms). Text is in French.

Titles in this series are published by the Société Mathématique de France and distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Système de racines d'une algèbre de Kac-Moody-Borcherds; Systèmes de racines à base libre—axiomes et construction; Coracines des racines imaginaires dans le cas libre; Systèmes générateurs de racines et systèmes de racines engendrés; Sous-systèmes et Théorème de conjugaison des bases; Quotients d'un système générateur de racines; Bibliographie; Index des notations et des définitions; Index des définitions et axiomes; Index des propriétés.

Memoires de la Société Mathématique de France, Number 65
February 1998, 188 pages, Softcover, ISBN 2-85629-056-6,
1991 *Mathematics Subject Classification*: 17B67, 17B65, 20F55,
Individual member \$47, List \$52, Order code SMFMEM/65N



Conjugacy of Alt_5 and $\text{SL}(2, 5)$ Subgroups of $E_8(\mathbb{C})$

Darrin D. Frey, *Winona State University, MN*

Exceptional complex Lie groups have become increasingly important in various fields of mathematics and physics. As a result, there has been interest in expanding the representation theory of finite groups to include

embeddings into the exceptional Lie groups. Cohen, Griess, Lisser, Ryba, Serre and Wales have pioneered this area, classifying the finite simple and quasisimple subgroups that embed in the exceptional complex Lie groups.

This work contains the first major results concerning conjugacy classes of embeddings of finite subgroups of an exceptional complex Lie group in which there are large numbers of classes. The approach developed in this work is character theoretic, taking advantage of the classical subgroups of $E_8(\mathbb{C})$. The machinery used is relatively elementary and has been used by the author and others to solve other conjugacy problems. The results presented here are very explicit. Each known conjugacy class is listed by its fusion pattern with an explicit character afforded by an embedding in that class.

Contents: Introduction and preliminaries; The dihedral group of order 6; The dihedral group of order 10; The Alt_5 and $\text{SL}(2, 5)$ fusion patterns in G, \mathcal{A}, Δ and Ω ; Fusion patterns of Alt_5 and $\text{SL}(2, 5)$ subgroups of H ; Fusion patterns of Alt_5 subgroups of \mathcal{E} ; Conjugacy classes of Alt_5 subgroups of G ; Conjugacy classes of $\text{SL}(2, 5)$ subgroups of G ; Appendix; Table of notation; References.

Memoirs of the American Mathematical Society, Volume 133, Number 634

May 1998, 175 pages, Softcover, ISBN 0-8218-0778-1,
LC 98-2682, 1991 *Mathematics Subject Classification*: 22E40,
20C33, 20B35, 20D06, **Individual member \$28**, List \$47,
Institutional member \$38, Order code MEMO/133/634N

Supplementary Reading



Modern Aspects of Linear Algebra

S. K. Godunov, *Russian Academy of Sciences, Novosibirsk*

This book discusses fundamental ideas of linear algebra. The author presents the spectral theory of nonselfadjoint matrix operators and matrix pencils in a finite dimensional Euclidean space. Statements of

computational problems and brief descriptions of numerical algorithms, some of them nontraditional, are given.

Proved in detail are classical problems that are not usually found in standard university courses. In particular, the material shows the role of delicate estimates for the resolvent of an operator and underscores the need for the study and use of such estimates in numerical analysis.

Contents: *Introduction:* Euclidean linear spaces; Orthogonal and unitary linear transformations; Orthogonal and unitary transformations. Singular values; *Matrices of operators in the Euclidean space:* Unitary similar transformations. The Schur theorem; Alternation theorems; The Weyl inequalities; Variational principles; Resolvent and dichotomy of spectrum; Quadratic forms in the spectrum dichotomy problem; Matrix equations and projections; The Hausdorff set of a matrix; *Application of spectral analysis. The most important algorithms:* Matrix operators as models of differential operators; Application of the theory of functions of complex variable; Computational algorithms of spectral analysis; Bibliography; Index.

Translations of Mathematical Monographs

June 1998, approximately 309 pages, Hardcover, ISBN 0-8218-0888-5, LC 98-13024, 1991 *Mathematics Subject Classification:* 15-01, 65-01; 47Axx, 34A40, 35A40, **Individual member \$71**, List \$119, Institutional member \$95, Order code MMONO-GODUNOVIN



On the Search of Genuine p -adic Modular L -Functions for $GL(n)$

Haruzo Hida, *University of California, Los Angeles*

This volume states several conjectures concerning the existence and the meromorphy of many variable p -adic L -functions attached to many

variable Galois representations (for example having values in $GL_n(\mathbb{Z}_p[[X_1, \dots, X_r]])$) and presents supporting examples for the conjectures. The discussion begins speculatively but gradually becomes more concrete.

Titles in this series are published by the Société Mathématique de France and distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri

Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

Contents: Introduction; p -Acid Hecke algebras; Periods of motives; Periods of arithmetic Galois representations; Periods of tensor products of motives; p -Adic Rankin products; p Adic Rankin products in partially CM case; p -Ordinary Katz p -adic L -functions; Bibliography; Correction to [41]; List of symbols.

Memoires de la Société Mathématique de France, Number 67
February 1998, 110 pages, Softcover, ISBN 2-85629-054-X, 1991 *Mathematics Subject Classification:* 11F13, 11F41, 11F67, 11F70, 11F85, **Individual member \$28**, List \$31, Order code SMFMEM/67N



The Siegel Modular Variety of Degree Two and Level Four/Cohomology of the Siegel Modular Group of Degree Two and Level Four

Ronnie Lee, *Yale University, New Haven, CT*, and

Steven H. Weintraub and J. William Hoffman, *Louisiana State University, Baton Rouge*

The Siegel Modular Variety of Degree Two and Level Four, by Ronnie Lee and Steven H. Weintraub

Let M_n denote the quotient of the degree two Siegel space by the principal congruence subgroup of level n of $Sp_4(\mathbb{Z})$. M_n is the moduli space of principally polarized abelian surfaces with a level n structure and has a compactification M_n^* first constructed by Igusa. M_n^* is an almost non-singular (non-singular for $n > 1$) complex three-dimensional projective variety (of general type, for $n > 3$).

The authors analyze the Hodge structure of M_4^* , completely determining the Hodge numbers $h^{p,q} = \dim H^{p,q}(M_4^*)$. Doing so relies on the understanding of M_2^* and exploitation of the regular branched covering $M_4^* \rightarrow M_2^*$.

Cohomology of the Siegel Modular Group of Degree Two and Level Four, by J. William Hoffman and Steven H. Weintraub

The authors compute the cohomology of the principal congruence subgroup $\Gamma_2(4) \subset Sp_4(\mathbb{Z})$ consisting of matrices $\gamma \equiv 1 \pmod{4}$. This is done by computing the cohomology of the moduli space M_4 . The mixed Hodge structure on this cohomology is determined, as well as the intersection cohomology of the Satake compactification of M_4 .

Contents: *The Siegel Modular Variety of Degree Two and Level Four:* Introduction; Algebraic background; Geometric background; Taking stock; Type III A; Type II A; Type II B; Type IV C; Summing up; Appendix. An exact sequence in homology; References; *Cohomology of the Siegel Modular Group of Degree Two and Level Four:* Introduction; The building; Cycles; The main theorems; References.

Memoirs of the American Mathematical Society, Volume 133, Number 631

May 1998, 75 pages, Softcover, ISBN 0-8218-0620-3, LC 98-2692, 1991 *Mathematics Subject Classification*: 14J30; 11F46, 14C30, 32M15, 57T99, **Individual member \$23**, List \$38, Institutional member \$30, Order code MEMO/133/631N



Faisceaux Pervers, Transformation de Mellin et Déterminants

François Loeser, *École Polytechnique, Palaiseau, France*

The Mellin transformation of l -adic perverse sheaves on a torus associates a coherent module on the

scheme of l -adic characters of the torus to a perverse sheaf. In this volume, the author studies the arithmetical aspects of the Mellin transformation, such as the semi-linear Galois action on the Mellin transform. Specifically expressed are several determinants associated to perverse sheaves in terms of hypergeometric perverse sheaves. Text is in French.

Titles in this series are published by the Société Mathématique de France and distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Notations et conventions; Rappels et compléments; Faisceaux pervers hypergéométriques et calcul de \det_{int} ; Transformation de Mellin sur un corps fini; Démonstrations; Action du groupe de Galois sur le transformé de Mellin; Caractéristique 0; Appendice A; Appendice B; Bibliographie.

Memoires de la Société Mathématique de France, Number 66
February 1998, 105 pages, Softcover, ISBN 2-85629-053-1, 1991 *Mathematics Subject Classification*: 11K30, 14G10, **Individual member \$25**, List \$28, Order code SMFMEM/66N

Analysis



Algebraic Structure of Pseudocompact Groups

Dikran Dikranjan, *University of Udine, Italy*, and Dmitri Shakhmatov, *Ehime University, Matsuyama, Japan*

The fundamental property of compact spaces—that continuous functions defined on compact spaces are bounded—served as a motivation for E. Hewitt to introduce the notion of a pseudocompact space. The class of pseudocompact spaces proved to be of fundamental importance in set-theoretic topology and its applications.

This clear and self-contained exposition offers a comprehensive treatment of the question, *When does a group admit an introduction of a pseudocompact Hausdorff topology that makes group operations continuous?* Equivalently, what is the algebraic structure of a pseudocompact Hausdorff group?

The authors have adopted a unifying approach that covers all known results and leads to new ones. Results in the book are free of any additional set-theoretic assumptions.

Contents: Introduction; Principal results; Preliminaries; Some algebraic and set-theoretic properties of pseudocompact groups; Three technical lemmas; Pseudocompact group topologies on \mathcal{V} -free groups; Pseudocompact topologies on torsion Abelian groups; Pseudocompact connected group topologies on Abelian groups; Pseudocompact topologizations versus compact ones; Some diagrams and open questions; Diagram 2; Diagram 3; Bibliography.

Memoirs of the American Mathematical Society, Volume 133, Number 633

May 1998, 83 pages, Softcover, ISBN 0-8218-0629-7, LC 98-2683, 1991 *Mathematics Subject Classification*: 22A05, 54D30; 03E10, 03E35, 04A10, 20E05, 20E10, 20E26, 20E34, 20F50, 20K10, 20K20, 20K45, 22C05, 54A25, 54A35, 54C25, 54D05, 54D20, 54H11, **Individual member \$23**, List \$39, Institutional member \$31, Order code MEMO/133/633N

Differential Equations



Time-Dependent Subdifferential Evolution Inclusions and Optimal Control

Shouchuan Hu, *Southwest Missouri State University, Springfield*, and Nikolaos S. Papageorgiou, *National Technical University, Athens, Greece*

This volume studies multivalued evolution equations driven by time-dependent subdifferential operators and optimal control problems for such systems. The formulation is general enough to incorporate problems with time varying constraints. For evolution inclusions, existence relaxation and structural results for the solution set are proved. For optimal control problems, a general existence theory is developed, different forms of the relaxed problem are introduced and studied, well-posedness properties are investigated and the precise relation between the properties of relaxability and well-posedness is established. Various examples of systems which fit in the abstract framework are analyzed.

Contents: Introduction; Preliminaries: Mathematical background and terminology; Evolution inclusions; Optimal control; Applications; References.

Memoirs of the American Mathematical Society, Volume 133, Number 632

Continued

May 1998, 81 pages, Softcover, ISBN 0-8218-0779-X, LC 98-2684, 1991 *Mathematics Subject Classification*: 34A60, 34G20, 35K22, 35R70, 49J27, 49J40, 49J45, **Individual member \$23**, List \$38, Institutional member \$30, Order code MEMO/133/632N

General and Interdisciplinary

Supplementary Reading
Independent Study



Algebra in Ancient and Modern Times

V. S. Varadarajan, *University of California, Los Angeles*

This text offers a special account of Indian work in diophantine equations during the 6th through 12th centuries and Italian work on solutions of cubic and biquadratic equations from the 11th through 16th centuries. The volume traces the historical develop-

ment of algebra and the theory of equations from ancient times to the beginning of modern algebra, outlining some modern themes, such as the fundamental theorem of algebra, Clifford algebras and quaternions. It is geared toward undergraduates who have no background in calculus.

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

This book is co-published with the Hindustan Book Agency (New Delhi) and is distributed worldwide, except in India, Sri Lanka, Bangladesh, Pakistan, and Nepal by the American Mathematical Society.

Contents: *Some history of early mathematics:*

Eucild-Diophantus-Archimedes; Pythagoras and the Pythagorean triplets; Āryabhaṭa-Brahmagupta-Bhāskara; Irrational numbers: construction and approximation; Arabic mathematics; Beginnings of algebra in Europe; The cubic and biquadratic equations; *Solutions for the cubic and biquadratic equations:* Solution of the cubic equation; Solution of the biquadratic equation; *Some themes from modern algebra:* Numbers, algebra, and the physical world; Complex numbers; Fundamental theorem of algebra; Equations of degree greater than four; General number systems and the axiomatic treatment of algebra; References; Chronology; Index.

Mathematical World, Volume 12

April 1998, approximately 174 pages, Softcover, ISBN 0-8218-0989-X, LC 98-15355, 1991 *Mathematics Subject Classification*: 01-01, 12-01, 12-03; 01A20, 01A29, 01A30, 01A40, **All AMS members \$20**, List \$25, Order code MAWRDL/12N

Geometry and Topology



Stable and Unstable Homotopy

William G. Dwyer, *University of Notre Dame, IN, USA*
Steven Halperin, *University of Toronto, ON, Canada*,
Richard Kane, *University of Western Ontario, London, Canada*,
Stanley O. Kochman, *York University, Toronto, ON, Canada*,
Mark E. Mahowald,

Northwestern University, Evanston, IL, USA, and
Paul S. Selick, *University of Toronto, Scarborough, ON, Canada*, Editors

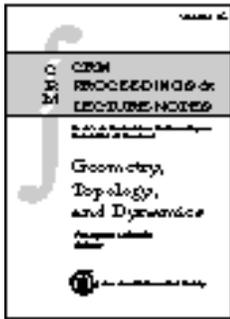
This volume presents the proceedings of workshops on stable homotopy theory and on unstable homotopy theory held at The Fields Institute as part of the homotopy program during the year 1996. The papers in the volume describe current research in the subject, and all included works were refereed. Rather than being a summary of work to be published elsewhere, each paper is the unique source for the new material it contains.

The book contains current research from international experts in the subject area, and presents open problems with directions for future research.

Contents: G. Arone and M. Kankaanrinta, A functorial model for iterated Snaith splitting with applications to calculus of functors; R. R. Bruner, Some remarks on the root invariant; F. R. Cohen, On the Lusternik-Schnirelmann category of an iterated loop space; F. R. Cohen and V. V. Vershinin, Thom spectra which are wedges of Eilenberg-MacLane spectra; O. Cornea, Some properties of the relative Lusternik-Schnirelmann category; E. S. Devinatz, The generating hypothesis revisited; B. Gray, The periodic lambda algebra; J. P. Greenlees, Rational $O(2)$ -equivariant cohomology theories; J. Grodal, The transcendence degree of the mod p cohomology of finite Postnikov systems; J. Harper, Cogroups which are not suspensions. II; M. J. Hopkins, D. C. Ravenel, and W. S. Wilson, Morava Hopf algebras and spaces $K(n)$ equivalent to finite Postnikov systems; N. E. Kechagias, The transfer between rings of modular invariants of subgroups of $GL(n, p)$; K. Y. Lam and D. Randall, Projectivity of $\text{Im } J$, cospherical classes, and geometric dimension; J.-M. Lemaire, Inert and lazy n -cones; J. P. Lin, Mod 3 truncated polynomial algebras over the Steenrod algebra; W.-H. Lin, A differential in the Adams spectral sequence for spheres; C. A. McGibbon, Some problems about phantom maps; N. Minami, On some BP_*BP -primitive elements related to the Kervaire invariant problem; J. M. Møller, Deterministic p -compact groups; P. Selick, Space exponents for loop spaces of spheres; J.-Y. Tai, On f -localization functors and connectivity; T. Yamaguchi, On characterizations of rational homotopy types with some rational cyclic cohomologies; List of participants.

Fields Institute Communications, Volume 19

May 1998, 316 pages, Hardcover, ISBN 0-8218-0824-9, LC 98-11194, 1991 *Mathematics Subject Classification*: 55-06; 55Pxx, **Individual member \$47**, List \$79, Institutional member \$63, Order code FIC/19N



Geometry, Topology, and Dynamics

François Lalonde, *University of Quebec at Montreal, PQ, Canada*, Editor

This volume contains the proceedings from the workshop on "Geometry, Topology and Dynamics" held at CRM at the University of Montreal. The event took place at a crucial time with respect to symplectic developments.

During the previous year, Seiberg and Witten had just introduced the famous gauge equations. Taubes then extracted new invariants that were shown to be equivalent in some sense to a particular form of Gromov invariants for symplectic manifolds in dimension 4. With Gromov's deformation theory, this constitutes an important advance in symplectic geometry by furnishing existence criteria.

Meanwhile, contact geometry was rapidly developing. Using both holomorphic arguments in symplectizations of contact manifolds and ad hoc topological arguments—or even gauge theoretic methods—several results were obtained on 3-dimensional contact manifolds and new surprising facts were derived about the Bennequin-Thurston invariant.

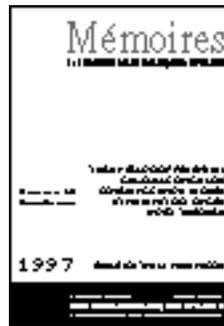
Furthermore, a fascinating relation exists between Hofer's geometry, pseudoholomorphic curves and the K -area recently introduced by Gromov. Finally, longstanding conjectures on the flux were resolved in a substantial number of specific cases by comparing various aspects of Floer-Novikov homology with Morse homology.

The papers in this volume are written by leading experts and are all clear, comprehensive, and original. The work covers a complete range of exciting new developments in symplectic and contact geometries.

Contents: A. Banyaga, Isomorphisms between classical diffeomorphism groups; Y. Eliashberg and M. Fraser, Classification of topologically trivial Legendrian knots; H. Geiges and C. B. Thomas, Contact structures on 7-manifolds; F. Lalonde, D. McDuff, and L. Polterovich, On the flux conjectures; V. Lizan, About the bubbling off phenomenon in the limit of a sequence of J -curves; J. D. McCarthy and J. G. Wolfson, Symplectic resolution of isolated algebraic singularities; D. Milinkovic and Y.-G. Oh, Generating functions versus action functional stable Morse theory versus Floer theory; M. Min-Oo, Scalar curvature rigidity of certain symmetric spaces; K. F. Siburg, Bi-invariant metrics for symplectic twist mappings on T^*T^n and an application in Aubry-Mather theory.

CRM Proceedings & Lecture Notes, Volume 15

May 1998, 148 pages, Softcover, ISBN 0-8218-0877-X, LC 98-13428, 1991 *Mathematics Subject Classification*: 03C15, 58Dxx, 58Fxx, **Individual member \$21**, List \$35, Institutional member \$28, Order code CRMP/15N



The b -Pseudo-differential Calculus on Galois Coverings and a Higher Atiyah-Patodi-Singer Index Theorem

Eric Leichtnam, *École Nationale Supérieure, Paris, France*, and Paolo Piazza, *Massachusetts Institute of Technology, Cambridge*

Let $\Gamma \rightarrow \tilde{M} \rightarrow M$ be a Galois covering with boundary. In this book, the authors develop a b -pseudodifferential calculus on the noncompact manifold \tilde{M} . The main application is the proof of a higher Atiyah-Patodi-Singer index formula for a generalized Dirac operator \tilde{D} on \tilde{M} , under the assumption that the group Γ is of polynomial growth with respect to a word metric and that the L^2 -spectrum of the boundary operator \tilde{D}_0 has a gap at zero. Results extend the work of Atiyah-Patodi-Singer, Connes-Moscovici, and Lott.

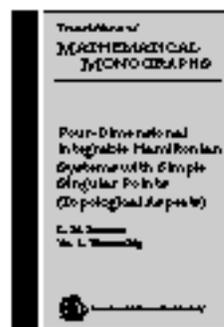
This text will also be of interest to those working in algebra and algebraic geometry.

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Contents: Introduction; Higher index theory on closed manifolds; Galois coverings and the b -calculus; Higher Atiyah-Patodi-Singer index theory; Appendices.

Memoires de la Société Mathématique de France, Number 68

January 1998, 121 pages, Softcover, ISBN 2-85629-060-4, 1991 *Mathematics Subject Classification*: 58G12, 58G20, 46L87, 58G15, **Individual member \$24**, List \$27, Order code SMFMEM/68N



Four-Dimensional Integrable Hamiltonian Systems with Simple Singular Points (Topological Aspects)

L. M. Lerman, *Research Institute for Applied Mathematics and Cybernetics, Nizhni Novgorod, Russia*, and Ya. L. Umanskiy, *Total System Services, Inc., Atlanta, GA*

The main topic of this book is the isoenergetic structure of the Liouville foliation generated by an integrable system with two degrees of freedom and the topological structure of the corresponding Poisson action of the group \mathbb{R}^2 . This is a first step towards understanding the global dynamics of Hamiltonian systems and applying perturbation methods. Emphasis is placed on the topology of this foliation rather than on analytic

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PLVHPVBW

New Publications Offered by the AMS

representation. In contrast to previously published works in this area, here the authors consistently use the dynamical properties of the action to achieve their results.

Contents: General results of the theory of Hamiltonian systems; Linear theory and classification of singular orbits; IHVF and Poisson actions of Morse type; Center-center type singular points of PA and elliptic singular points of IHVF; Saddle-center type singular points; Saddle type singular points; Saddle-focus type singular points; Realization; Normal forms of quadratic Hamilton functions and their centralizers in $sp(4, \mathbb{R})$; The gradient system on M compatible with the Hamiltonian; Bibliography.

Translations of Mathematical Monographs

May 1998, approximately 192 pages, Hardcover, ISBN 0-8218-0375-1, 1991 *Mathematics Subject Classification:* 58F05, 70Hxx, **Individual member \$47**, List \$79, Institutional member \$63, Order code MMONO-LERMANN

Mathematical Physics



The Γ -Equivariant Form of the Berezin Quantization of the Upper Half Plane

Florin Rădulescu, *University
of Iowa, Iowa City*

The author defines the Γ equivariant form of Berezin quantization, where Γ is a discrete lattice in $PSL(2, \mathbb{R})$. The

Γ equivariant form of the quantization corresponds to a deformation of the space \mathbb{H}/Γ (\mathbb{H} being the upper halfplane). The von Neumann algebras in the deformation (obtained via the Gelfand-Naimark-Segal construction from the trace) are type II_1 factors. When Γ is $PSL(2, \mathbb{Z})$, these factors correspond (in the setting considered by K. Dykema and independently by the author, based on the random matrix model of D. Voiculescu) to free group von Neumann algebras with a “fractional number of generators”. The number of generators turns out to be a function of Planck’s deformation constant. The Connes cyclic 2-cohomology associated with the deformation is analyzed and turns out to be (by using an automorphic forms construction) the coboundary of an (unbounded) cycle.

This text will also be of interest to those working in analysis.

Contents: Introduction; Definitions and outline of the proofs; Berezin quantization of the upper half plane; Smooth algebras associated to the Berezin quantization; The Berezin quantization for quotient space \mathbb{H}/Γ ; The covariant symbol in invariant Berezin quantization; A cyclic 2-cocycle associated to a deformation quantization; Bounded cohomology and the cyclic 2-cocycle of the Berezin’s deformation quantization; Bibliography.

Memoirs of the American Mathematical Society, Volume 133, Number 630

May 1998, 70 pages, Softcover, ISBN 0-8218-0752-8, LC 98-2681, 1991 *Mathematics Subject Classification:* 46L35; 46L37, 46L57, 81S99, 11F99, **Individual member \$23**, List \$38, Institutional member \$30, Order code MEMO/133/630N