# Scoala Normala Superioara
# Couses Proposals

## 2001 – 2002 Preliminary cycle

**I. Barbu Berceanu: Differentiable manifolds and maps**
**II. Stefan Papadima: Homology theory and duality**
**III. Barbu Berceanu: Homotopy theory of CW complexes**
**IV. Cristian Anghel: Riemann Surfaces**

### I. Barbu Berceanu: Differentiable manifolds and maps

1. Manifolds;immersions, submersions;Whitney embedding theorem. 1 week
2. Approximations theorems and functions spaces. 2 weeks
3. Sard theorem and transversality. 1 week
4. Degree and intersection numbers. 1 week
5. Regular and critical levels of Morse functions. 1 week
6. Poincare-Hopf index theorem. 1 week
7. Vector bundles and tubular neighborhoods. 1 1/2 week
8. Cobordism and Thom homomorphism. 1 1/2 week
9. de Rham cohomology theory. 3 weeks

### II. Stefan Papadima: Homology theory and duality

1. Homotopy of maps, homotopy groups. Van Kampen theorem. Covering spaces, the universal cover. Examples (spheres, closed surfaces, quotients). 2 weeks.
2. Singular homology : functoriality, homotopy invariance. Examples (relation between 1 and H1). 1 week.
3. Exactness, excision, Mayer-Vietoris sequence. Examples (suspensions, wedges). 1 week.
4. Applications : Brouwer fixed point theorem; vector fields on spheres; Jordan-Brouwer separation theorem; invariance of domain. 1 week.
5. CW-complexes, polyhedra. Cellular homology, simplicial homology. Betti numbers and Euler characteristic. Examples (projective spaces, closed surfaces). 1 week.
6. Singular cohomology : cup and cap products, axioms. Examples (H*- ring versus H*-groups). Tor and Ext groups, universal coefficient formulae. 2 weeks.
7. Acyclic models and Eilenberg-Zilber theorem. Künneth formulae. 1 week.
8. Topological manifolds, orientation. Examples (compact surfaces). 1 week.
9. Poincaré duality theorem. Examples (projective spaces). Application : Borsuk-Ulam theorem. 1 week.
10. Alexander and Lefschetz duality theorems. Applications : nonorientable closed surfaces do not embed in R3; signature and cobordism. 1 week.
11. Thom class and Lefschetz fixed point theorem. 1 week.

### III. Barbu Berceanu: Homotopy theory of CW complexes

1. Homotopy groups; fibrations and homotopy. 1 1/2 week
2. Whitehead and Hurewicz theorems. 1 1/2 week
3. Obstruction theory. 2 weeks
4. Spectral sequences. 1 week
5. Serre spectral sequence. 2 weeks
6. Eilenberg-MacLane spaces and classifications theorems. 1 week
7. Postnikov towers. 1 week
8. Suspension theorem. 1 week
9. Computations: homotopy groups of spheres, Lie Groups, Grassmannians, cobordism groups. 2 weeks

**IV. Cristian Anghel: Riemann Surfaces**

The course will constitute an introduction to the theory of compact analytic surfaces, insisting on the algebraic aspect (algebraic curves, Riemann-Roch theorem, Serre duality). Could be considered an introductory course in algebraic geometry and complex geometry.

## 2002 – 2003 Preliminary cycle

**1. Nicolae Popa: Wavelets and their applications**
**2. Steriu Ianus and Liviu Ornea: Variational calculus on Riemannian manifolds**
**3. Cristian Anghel: Derived categories of coherent sheaves and triangulated categories**
**4. Daniel Beltita: Infinite dimensional Lie groups**
**5. Ion Mihai: Topics in Submanifold Theory**
**6. Aurelian Gheondea: Introduction to Operator Theory**
**7. Cristian Cobeli: Lessons in Analytic Number Theory**
**8. Dr.Ovidiu Pasarescu: Complex Curves and Surfaces(the Compact Case)**

**1. Nicolae Popa: Wavelets and their applications**

Contents: Multiresolution analysis; Definition of wavelets;
Examples of wavelets: periodical wavelets, wavelets with compact
support, splines etc.; Applications of wavelets to expansion of
functions from different natural function spaces: Hardy spaces,
Lipschits spaces, Lebesgue spaces, Wiener algebra etc.

**2. Steriu Ianus and Liviu Ornea: Variational calculus on Riemannian manifolds.**

Contents: Variational calculus on geodesics (first and second
variation formulae, Jacobi fields, conjugate points, Myers, Weinstein,
Cartan-Hadamard theorems, Berger's sphere theorem etc.), Harmonic maps between
Riemannian manifolds, Stability.

**3. Cristian Anghel: Derived categories of coherent sheaves and triangulated categories.**

Aim: The aim of the course is to introduce the students
into the applications of the methods of axiomatic homotopy theory, to the
studies of triangulated categories and in particular to the study of derived
categories of coherent sheaves.

**4. Daniel Beltita: Infinite dimensional Lie groups.**

Description:
The course is independent upon and includes in particular the basic

finite dimensional Lie theory. The first part concerns the notion of infinite dimensional Lie group in the sense of Milnor, and the discussion of phenomena such like non-existence of exponential map or failure of Lie's third theorem in infinite dimensions. A final part of the course treats the totpology of certain classical Lie groups of Hilbert space operators which are important for representation theory. The seminary includes concrete examples intended to stimulate both the intuition in infinite dimensions and the applications to various fields of mathematics and physics.

**5. Ion Mihai: Topics in Submanifold Theory.**

Description:
Intrinsic and extrinsic geometry of submanifolds. Riemannian invariants. Estimates of extrinsic invariants in terms of intrinsic invariants. Ideal submanifolds. Obstructions.

**6. Aurelian Gheondea: Introduction to Operator Theory.**

Description: 1. Techniques of Banach and C*-algebras
2. Normal operators
3. Compact operators (including ideals of operators and duality)
4. Nonnormal operators (shifts, Toeplitz, Hankel, weighted shifts, Volterra, Bergman, subnormal)
5. Completely positive mappings
6. Compact perturbations

Remarks: 1. It is supposed that the students have the fundmental notions of complex functions, integration and measure, and functional analysis.

2. The course is offered for the first semester (autumn 2002).

**7. Cristian Cobeli: Lessons in Analytic Number Theory**

Description: The course introduces basic problems and develops methods, both classical and modern, to solve them.

Main topics covered:

1. Arithmetical functions; The Dirichlet divisor problem.
2. Characters (aditive and multiplicative)
3. Character Sums; Polya-Vinogradov Theorem, Burges's estimates

4. The large sieve -- applications (twin primes, Brun-Titchmarsh Theorem)
5. Farey sequences -- h-spasing distribution
6. Primitive roots -- Artin's Conjecture
7. Primes in arithmetic progression; Linik's constant
8. Distribution of some sequence of numbers (the sequence of primes, inverses (mod p), primitive roots)
9. Exponential sums method (Weyl method, Van der Corput method, applications of exponential pairs)

**8. Dr.Ovidiu Pasarescu: Complex Curves and Surfaces(the Compact Case)**

The aim of these lectures is to give an introduction in the theory of classification of compact complex varieties.The curves and the varieties of dimension > 1 are in complementary ranges,the surfaces being the starding point of the higher dimensional case. We insist also on the comparison between intrinsic and extrinsic proprieties of curves and surfaces(using the Harris-Eisenbud philosophy in the case of curves).

*Contents*

I Complex Curves
- Riemann-Roch' Theorem, Hurwitz' Theorem, Applications to the study of linear systems;
- the projectivity of compact complex curves(Chow Theorem,Riemann's Existence Theorem);
- Clifford' Theorem; the (d,r)-plane;
- Castelnuovo' bound; extremal curves; the (d,g)-plane;
- The Jacobian of a curve; Abel' Theorem; Jacobi inversion Theorem;
- The theta divisor;Torelli' theorem; the moduli space.

II Complex Surfaces
- the algebraic dimension and the Kodaira dimension;
- Castelnuovo contractions,minimal models;
- minimal models of rational sufaces;
- minimal models of ruled surfaces;
- K3 surfaces, Enriques surfaces, eliptic surfaces;
- non-algebraic surfaces;
- the Theorem of bimeromorphic classification of surfaces.

References:

1. Griffiths, Harris, Principles of Algebraic Geometry, J.Wiley and Sons, New York, 1978

2. Arbarello, Cornalba, Griffiths, Harris, Geometry

of Algebraic
Curves, vol.I, Springer 1984.

3. Barth, Peters, Van de Ven, Compact Complex
Surfaces, Berlin,
Springer, 1984.

4. Badescu,L., Suprafete algebrice, Edit. Acad.
Bucuresti, 1981.
(english translation by V.Masek, 2001)

## 2003 – 2004 Introductory courses

**1. Barbu Berceanu (IMAR) "Nineteenth Century Mathematics- Selected Topics"**

In 2003/2004 I taught an introductory course in the mathematics of 19th century, attended by former IMO participants, now the best students from the Faculty of Mathematics (1st and 2nd year) and also by two SNSB students. The main topics were:
- links between Z, R, and S^1 (injective and projective groups, Pontrjagin duality, coverings and \pi_1, Denjoy th. on Diffeo(S^1);
- complex plane, Riemann sphere, and complex tori;
- abelian integrals and elliptic functions;
- quadratic equations and Hilbert symbol;
- cubic equations (Mordell th.).

AUTHOR'S BEST PAPERS:
The last submitted, "Multiplicative models for configuration spaces of algebraic varieties", with M. Makl and St. Papadima, (see arXiv.org/abs/math. AT/0308243), could be my best.

## 2003 – 2004 Preliminary cycle

**I. Barbu Berceanu (Institute of Mathematics, Bucharest): " Learning Algebraic Topology through Examples"**
**II. Barbu Berceanu: "Elements of Lie Theory"**
**III. Adrian DUMA (Department of Mathematics, University of Craiova, Romania) "GENERALISED DEGREE THEORIES AND THEIR APPLICATIONS"**
**IV. Alexandru Gica (Lector Dr., University of Bucharest): "Additive Number Theory"**
**V. Paltin Ionescu (University of Bucharest) "Enriques classification of (complex) algebraic surfaces"**
**VI. Miodrag Mateljevic (professor, Department of Mathematics , University of Belgrade): "Quasiconformal Mappings, Riemann surface and Teichmuller spaces"**
**VII. Miodrag Mateljevic: "Quasiconformal Mappings and Complex dynamics"**
**VIII. Miodrag Mateljevic: "Geometric theory"**

**I. Barbu Berceanu (Institute of Mathematics, Bucharest): " Learning Algebraic Topology through Examples"**

0) Introduction (\pi _0, functors, graphs, CW-complexes, manifolds, etc);
1) Covering and \pi _1 (free groups and Nielsen-Schreier, surfaces and Galois groups, Seifert Th. on \pi_1(M^4), knots and word ploblem);
2) Homology and cohomology (Sing_*, Cell_*, surfaces and projective spaces, links, H-spaces, configuration spaces);
3) Duality (intersection form, signature, Sullivan Th. on H^*(M^3) );
4) Elementary homotopy theory (Hurewicz and Whitehead Ths, K(G,n), \Omega (X), Milnor's homotopy classification of 1-connected M^4 ).

Motivation: After a standard introduction (e.g. Hatcher's book) at Perugia '03 summer school, some of SNSB students asked for a deeper knowledge of basic examples. The beginners will find also the fundamental constructions and results.

Papers: The last submitted, "Multiplicative models for configuration spaces of algebraic varieties", with M. Makl and St. Papadima, ( see arXiv.org/abs/math. AT/0308243 ), could be my best.

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**II. Barbu Berceanu (Institute of Mathematics, Bucharest): "Elements of Lie Theory"**

0) Examples (Gl_n, O_n,..., gl_n, sl_n,....);
1) Basic dictionary Lie groups-Lie algebras;
2) Compact and semisimple Lie groups (maximal torus, root systems, integer lattice, Weyl Th );
3) Root systems and Dynkin diagrams;
4) PBW and Serre's presentations;
5) Elementary representation theory of compact Lie grps (R(G), complex versus real/quaternionic, Peter-Weyl Th );
6) Geometry and topology of Lie grps.

Warning: After 4+2 at University and 2+1 at SNSB, there are students who never heard on maximal torus and root systems, Dynkin diagram, representation ring.
The topics were chosen to fit in with the two French summer schools on Geometric group theory (Cluj '03 and Grenoble '04).

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**III. Adrian DUMA (Department of Mathematics, University of Craiova, Romania)**
**"GENERALISED DEGREE THEORIES AND THEIR APPLICATIONS"**

COURSE PROFILE
Course Objective

· To introduce students to some of the basic techniques of Nonlinear Analysis and their applications to existence of solutions for differential equations.
· Students should acquire a good knowledge and appreciation of Degree Theory and associated fixed-point principles. They should gain an appreciation of the role of Lipschitz conditions and compactness in existence theory. Students will be able to apply the theory to the analysis of concrete model problems such as, for example, proving existence of solutions of operator equations and ordinary differential equations (including existence of periodic solutions).

Where is it used:
Degree theory is a field of pure and applied mathematics studied by researchers in nonlinear analysis. The topological degree is an argument to count topologically the number of solutions of an operator equation. From this, the famous Brouwer fixed point theorem can be derived.
In infinite dimensions, we work in Banach spaces. The Schauder degree can be constructed with compact mappings because these behave like finite dimensional maps. An analogy to the Brouwer fixed point theorem is attained. Researchers are currently working on degree theories for noncompact operators. Research into fixed-point theory is a popular topic, especially with multivalued maps.
Who is interested:
Students with interests in the application of pure mathematics and the theory behind topics in applied mathematics will be interested. A research career in analysis requires good understanding of the topics in this courses such as operator equations, the topological degree, the Ascoli-Arzela theorem, the contraction mapping principle, and the Schauder fixed point theorem. The subject is suitable for both third and fourth year students.
Assumed background:
This course is based on some founding analysis. A knowledge of basic facts about metric spaces, Banach spaces, Hilbert spaces, and General Topology will be assumed. Results developed during the course will be applied to ODEs, PDEs and other problems in the setting of functional analysis.

Course content:
1. The axiomatic Amann-Weiss theory.
2. The (finite-dimensional) Brouwer degree. Classical applications.

3. Degree theories for discontinuous functions.
4. A generalized degree for maps between manifolds.
5. The Leray-Schauder topological degree. Applications to nonlinear Schroedinger-type equations.
6. The generalized (Browder-Petryshyn) topological degree. Some applications to strongly nonlinear boundary value problems.
7. The topological degree of strict set contractive vector fields. Applications to local and asymptotic bifurcation problems.
8. Topological degree theories for multivalued mappings. Surjectivity results.
9. Topological degrees for nonlinear operators of monotone type. Applications to nonlinear elliptic equations.
10. Infinite-dimensional versions of Borsuk's Theorem.
11. Embeddings of degree theories. Exotic topological degrees.
12. The edge of degree theory. The interrelation between nonlinear functional analysis and the nonlinear theory of Banach spaces.

R E F E R E N C E S

Deimling, Klaus, Nonlinear functional analysis. Springer-Verlag. (1985)
Browder, Felix E., Fixed point theory and nonlinear problems. Bull. Am. Math. Soc., New Ser. 9, 1-39 (1983).
van Mill, Jan, Infinite-dimensional topology. Prerequisites and introduction. North-Holland (1989).
Lloyd, N.G., Degree theory. Cambridge University Press (1978).
Ruiz del Portal, F.R. On a generalized degree for continuous maps between manifolds.
Tsukuba J. Math. 17, No.2, 323-338 (1993).
Petryshyn, W.V., Approximation-solvability of nonlinear functional and differential equations. Marcel Dekker, (1993).
Brézis, Haïm; Nirenberg, Louis, Degree theory of BMO. I: Compact manifolds without boundaries. Sel. Math., New Ser. 1, No.2, 197-263 (1995). II: Compact manifolds with boundaries. Sel. Math., New Ser. 2, No.3, 309-368 (1996).
Mawhin, Jean, Leray-Schauder degree: A half century of extensions and applications. Topol. Methods Nonlinear Anal. 14, No.2, 195-228 (1999).
Fonseca, Irene; Gangbo, Wilfrid, Degree theory in analysis and applications. Oxford: Clarendon Press (1995).
Duma, Adrian:
Mappings which preserve the topological degree. Stud. Cerc. Mat. 48 (1996), no. 5-6, 313--318.
On the embedding of degree theories. An. Univ. Craiova Ser. Mat. Inform. 23 (1996), 28--35 (1998).
Degree theory from an axiomatic viewpoint. Stud. Cerc. Mat. 46 (1994), no. 3, 339--346.
Banach spaces with topological degree. An. Univ. Craiova Ser. Mat. Inform. 20 (1993), 31--43 (1995).
Applications in the Browder-Petryshyn degree theory. Surjectivity theorems. (Romanian) An. Univ. Craiova Ser. Mat. Inform. 19 (1991/92), 21--25 (1994).
A surjective topological degree for discontinuous functions. An. Univ. Craiova Ser. Mat. Inform. 19 (1991/92), 26--28 (1994).

Adrian Duma's best five papers until now:

Approximation structures and applications to evolution equations , Abstract and Applied Analysis, Volume 2003, Number 12(2003), pp.685-696.

Degree theory from an axiomatic viewpoint. Stud. Cerc. Mat. 46 (1994), no. 3, 339--346.

Pre-numerical methods in the theory of nonlinear operators, Math. Sci. Res. J. 7(5)(2003), pp.173-194.

A generalised homotopy theory. Nonlinear Anal. TMA 30 (1997), no. 8, 4937--4948.

Zeeman's theorem in nondecomposable spaces. J. Korean Math. Soc. 34 (1997), no. 2, 265--277.
and also:
Semi-numerical approximation structures for nonlinear noncompact operators in Banach spaces , Numerical Functional Analysis and Optimization (to appear in 2004).

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**IV. Alexandru Gica (Lector Dr., University of Bucharest): "Additive Number Theory"**

Short description of the course:

The purpose of the course is to present some classical results in additive number theory:

1) Gauss's theorem concerning the nonnegative integers which could be written as the sum of three squares of integers. For the proof of this result it will be need for the theorem of Dirichlet concerning the prime numbers in an arithmetical progression. A proof of the famous result of Dirichlet will be given.

2) Wieferich-Kempner theorem which states that every nonnegative integer could be written as a sum of 9 cubes of nonnegative integers. It will be given some results of Fermat and Erdos concerning the nonnegative integers which could be written as a sum of two cubes of nonnegative integers.

3) Waring's problem which states that for every positive integer k, there exists a positive integer h such that every nonnegative integer could be written as a sum of h k-th powers. There will be given the initial proof of Hilbert, the Linnik's proof and also the proof of Hardy-Littlewood.

4) Vinogradov's theorem which states that every sufficiently large odd natural number could be written as the sum of three primes. For the proof I will use the famous "circle method" (introduced by Hardy, Littlewood and Ramanujan in 1918-1920).

I will use the folloowing books:

1)M. Nathanson, Additive Number Theory, Springer, 1996.
2)M. Nathanson, Elementary Methods in Number Theory, Springer, 2000.
3)A. Gica, L.Panaitopol, Probleme celebre de Teoria Numerelor, Editura Universitatii Bucuresti, 1998.

The list of my "best" scientific papers:

1) The Proof of a Conjecture of Additive Number Theory, Journal of Number Theory, 94, 80-89, 2002.

2) Another Proof of a Conjecture in Additive Number Theory, Mathematical Reports, 4(54), 2(2002),171-175.

3) A result similar to a theorem of Fermat, Analele Universitatii Bucuresti, 2002, nr.1, 31-34.

4) A conjecture which implies the theorem of Gauss-Heegner-Stark-Baker, Bull.Math.Soc.Sc.Math.Roumanie, 41(89), 2, 1998, 111-118.

5) Algorithms for the equation x^2-dy^2=k, Bull.Math.Soc.Sc.Math.Roumanie, 38(86),3-4, 1994-1995, 153-156.

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**V. Paltin Ionescu (University of Bucharest): "Enriques classification of (complex) algebraic surfaces"**

I was asked by a group of students at SNSB to propose a more advanced Algebraic Geometry course, continuing the introductory one I gave last year at the University of Bucharest and the one I shall give this year, also at the University. Let me quickly mention that the first course was a self-contained introduction to Commutative Algebra and Algebraic Geometry, covering the local theory and the elementary aspects of the theory of projective algebraic varieties. This course will be continued, this year (at the University) by one covering the basics of the cohomology

theory of coherent sheaves on Serre varieties, mainly following the book
by G.Kempf.
The course that I would like to propose for the SECOND SEMESTER at SNSB is devoted to the Enriques classification of (complex) algebraic surfaces. In principle I will follow the exposition in Beauville's book, but the presentation will be also an introduction to Mori Theory (or Minimal Model Program). This means that we shall follow the contemporary point of view, developped by Mori et al., that made possible to extend the classical results to higher dimensions.
The table of contents of the course is as follows:
1. Intersection theory and Riemann-Roch Theorem on a surface;
2. Various classes of linear systems, examples;
3. Blowing-ups and "minimal models";
4. Surfaces with non-nef canonical class;
5. Rational and ruled surfaces, examples;
6. Kodaira dimension, elliptic surfaces, examples;
7. The classification theorem according to the Kodaira dimension;
8. Comments on surfaces of general type.

Papers:
1. Generalized adjunction and applications, Math. Proc. Cambridge Phil. Soc. 99, 1986, p.457-472.
2. Embedded projective varieties of small invariants I, Springer Lecture Notes Math., 1056, 1984, p.142-186.
3. On varieties whose degree is small with respect to codimension, Math. Annalen, 271, 1985, p.339-348.
4. On very ample vector bundles on curves, Int. Journal. Math., 8(1997), p.633-643 (cu M.Toma).
5. Models of rationally connected manifolds, J. Math. Soc. Japan, 55 (2003), p. 143-164 (cu C.Voica).
On manifolds of small degree, Preprint 2000, 10p.
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**VI. Miodrag Mateljevic (professor, Department of Mathematics , University of Belgrade):**
**"Quasiconformal Mappings , Riemann surface and Teichmuller spaces"**

The course consists of 3 parts as it is indicated in the title .

A=QC , Quasiconformal Mappings
Section 1 introduces certain conformal invariants as Poincae metric and the conformal modules of path families which appear in the characterization of qc .
In Section 2 , qc is defined by means of the maximal dilatation of quasiconformal mappings. Certain compactness and distortion theorem are considered .
Section 3 explains the connections between various geometric and analytic properties of qc .
Section 4 is concerned with the characterization of qc as homeomorphic solutions of Beltrami equations ;
In Section 5 , isothermal coordinates , basic theorems about the existence , uniqueness and representation of a quasiconformal mapping are discussed .

B =RS , Riemann Surfaces
In Section 1 , standard definitions of manifolds , Riemann surfaces and differentials are given .
Using solutions of Beltrami equations a partion of a surface imbedded in euclidean space is mapped conformally into the plane .
Section 2 deals with covering surfaces and their toplogy.
In In Section 3 ,results of Section 2 are applied to Riemann surfaces :
a) every Riemann surface is the quotient of a disk by a discontinuous group of Mobius transformation
b) mappings between surfaces induce mappings between the covering surfaces and the covering groups .
Quadratic differentials play a remarkable role in the theory of Teichmuller spaces. Therefore, the geometry and the metric induced by a quadratic differential are studied extensively in Section 4 .

C= TeS , Teichmuller spaces
In this part , a lot of background knowledge is needed from the theory of quasiconfrmal mappings and of Riemann surfaces ( it was done in the parts A and B ) .
The theory of Teichmuller spaces studies the different conformal structures on a Riemann surface .
In the course , an approach which deals with classes consisting of quasiconformal mappings of a Riemann surface

which are homotopic modulo conformal mappings , is given .
The theory is remarkably connected with quadratic differentials .
On a compact Riemann surface of genus greater than one , every holomorphic quadratic differential determines a quasiconformal mapping which is a unique extremal in its homotopy class ( in the sense that it has the smallest deviation from conformal mappings ) and all
extremals are obtained in this manner .
This course is primarily concerned with Teichmuller spaces of compact surfaces . The Teichmuller space of a torus ( which is shown to be isomorphic to the upper half -plane
with the hyperbolic metric ) is first treated separately and then, via
the study of extremal quasiconformal mapping , compact surfaces of higher genus are discussed . Using these results , the Nielsen - Thurston classification of surface diffeomorphisms and a mapping of Teichmuller space of a compact surface onto the open unit ball in the space of holomorphic quadratic differentials , are discussed . Measured foliations , which Thurston originally used for classification of surface diffeomorphisms , are considered briefly .

LITERATURE
1 . Lehto Virtanen, Quasiconformal mappining in the plane
2 .Gardiner, Teichmuller theory ...
Chapter 1, 2 , 10 , 11
3.Strebel , Quadratic Differentials
4. Lehto ,Univalent Functions and Teichmuller Spaces

Papers:
1. Bovzin, V., Lakic, N., Markovic, V., Mateljevic, M.,
The unique extremality, J. d'Analyse Math. 75 (1998), 299--338.
2. Markovic, V., Mateljevic, M., New version of the
main inequality and uniqueness of harmonic maps,
J. d'Analyse Math. 79 (1999), 315 - 334.
3. Mateljevic, Miodrag; Pavlovic, Miroslav
$L\sp p$-behavior of power series with positive coefficients and Hardy spaces. (English)
Proc. Am. Math. Soc. 87, 309-316 (1983)
4. Mateljevic, M.; Pavlovic, M.
Multipliers of $H\sp p$ and BMOA. (English)
Pac. J. Math. 146, No.1, 71-84 (1990).
5. Mateljevic, M.; Pavlovic, M.
New proofs of the isoperimetric inequality and some generalizations. (English)
J. Math. Anal. Appl. 98, 25-30 (1984).

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**VII. Miodrag Mateljevic (professor, Department of Mathematics , University of Belgrade): "Quasiconformal Mappings and Complex dynamics"**

The course cosists of 2 parts .
In the first part of the course Quasiconformal Mappings are considered as in the item A
of the course VI.

D Complex dynamics
CoD , Complex dynamics is today very much a focus of interest
and it discusses the behavior of analytic functions under iteration .We plan to consider
1. the local behavior near fixed points and existence of canonical coordinate systems at fixed points
2 . a rational mapping R , partition the sphere into two disjoint invariant sets , on one of which R is well behaved ( the Fatou set ) ,on the other of which R has chaotic behavior ( the Julia set )
3. the use of quasiconformal mappings to consider two dynamical systems acting in different parts of the plane and to construct a new system that combines the dynamics of both .
This procedure is called quasiconformal surgery .
Among the other things we plan to prove :
3. the repelling periodic points are dense in the Julia set
4. every component of Fatou set of a rational function R is iterated to a periodic component and to classify the action of R on periodic components .

LITERATURE

1. Blanchard , Complex analytic dynamics on the Riemann sphere
BAMS 11 , 1 , 1984 ,85-141
2 .Carleson , Gamelin, Complex Dynamics Chapter I - IV

If these courses (i.e. VI and VII) are too ambitious we can focus the attention to some parts of them . For example : Quasiconformal Mappings , Complex Dynamic or Riemann surface .
Also , we offer the course:

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**VIII. Miodrag Mateljevic (professor, Department of Mathematics , University of Belgrade): "Geometric theory"**

The main subjects of this course are
a) various generalizations of Argument Principle and relations with other results , which show topological - geometrical nature of this result
b) the uniformaziation theorem and its corrolaries
and
c) the intimate link between holomorphic functions and hyperbolic distances
By the uniformaziation theorem ,the hyperbolic metric of the disk carries over to the Poincare metric on hyperbolic surface with constant curvature -1 ( see the item 5 ) .

The course consists of the following items :
1. In this part we discuss topological - geometrical results :
Crtical Points , Degree Theory , Index of Vector Fields
Index Poincare, Turning Tangent theorem
The results of this point are used in the proofs and applications of different versions of Argument Principle and Gauss-Bonnet theorem
2. In this part we discuss Geometric principles and related
results which have crucial role in complex analysis : Argument , Symertry ( Shwarz Reflection ) and Maxumum Modulus Principle .
In prticular , we consider hyperbolic geometry of the unit disc and prove
Shwarz's Lemma which states that every holomorphic function from the unit disk into itself
is distance- decreasing with respect to Poincare-hyperbolic distance .
3. The noneuclidean metric ,
Ultrahyperbolic and Poincare metrics .
Using the uniformization theorem ( as it is indicated in the item 5 ) , we conclude that every plane region whose complement with respect to the plane has more than one point carries a Poincare metric .
A proof of classical theorems known as the Picard-Schottky and Bloch theorem can be based on the estimates for Ultrahyperbolic and Poincare metrics .
4 . Normal families and The Riemann mapping theorem ,
which states that every simply-connected plane domain different than whole
complex plane is conformally equivalent with the unit disk .
5. Riemann surfaces and the uniformization theorem
The uniformization theorem, which is perhaps the single
most important theorem in the whole theory of analytic functions of one variable .
It does for Riemann surface what Riemann' s mapping theorem does for plane regions .
If a Riemann surface W is not conformally equivalent to a sphere , a plane , or a punctured plane, there exits a properely discontinous group G of fixed point -free liner transformations mapping the unit disk U onto itself such that the the Riemann surface U/G
obtained by identifying equivalent points under the group is conformally equivalent to W .
The hyperbolic metric of the disk carries over to the Poincare metric on W with constant curvature -1 . In particular , we conclude that every plane region whose complement with respect to the plane has more than one point carries a Poincare metric .
6 . In this point , we consider hyperbolic geometry of 3-dimensional unit ball . Its group of isometries is used in defining of 3- hyperbolic manifolds . So 3- hyperbolic manifolds can be
considered as a generalization of Riemann surfaces .
7. Complex manifold

We itroduce Kobyashi pseudodistnce on every complex manifold in an intrinsic manner .
Caratheodory and Kobyashi pseudodistnce share two basic properties :
a) they are agree with Poincare distance on the unit disk
b) every holomorphic mapping is decreasing .
Among the pseudodistances with these two properties Kobyashi pseudodistance is the smallest and Kobyashi is the largest . These pseudodistances enable us to gain a geometric insigth into function theoretic results .
Elementary properties of these pseudodistnces and of hyperbolic manifolds are given.

If the points 5 , 6 and 7 are too ambitious we can give short comperhensive review of these points and suggest some parts of the following :
8. Extremal length and qusiconformal mappings
9. short comperhensive review :
Trajectories of holomorphic functions and Geodesics ,
Gauss-Bonnet theorem and its applications in complex analysis concerning different versions of Argument Principle ,behavior of Geodesics ,...
In particular , the geometry and the metric induced by a quadratic differential are studied extensively in this item .
10 . Elementary theory of univalent functions , Koebe and Bloch theorem
11. Dirichlet Problem and harmonic maps

Literature

1. Ahlfors , Conformal Invariants
2. Ahlfors , Mobius transformations in several dimensions
3. Strebel , Quadratic Differentials
4. Coway , Functios of One complex Variable
5. Kobyashi , Hyperbolic Manifolds and Holomorphic Mappings


## 2003 – 2004 Master courses proposals

### Master in algebra-geometry-topology:
**I. Barbu Berceanu (Institute of Mathematics, Bucharest): "Fifty Years of Homological Algebra"**
**II. Vasile Brinzanescu (Institute of Mathematics, Bucharest): "An introduction to moduli spaces in algebraic and complex geometry"**
**III. Dorin Popescu (University of Bucharest) and Cristodor Ionescu (Institute of Mathematics, Bucharest): "Algebra and Combinatorics"**

### Master in analysis:
**I. Nicolae Popa (Institute of Mathematics, Bucharest): "Interpolation theory for linear and nonlinear operators: classical and modern problems"**
**II. Florin Radulescu (University of Iowa): ``Introducere in Teoria Probabilitatilor Libere"**
**III. Serban Stratila (Institute of Mathematics, Bucharest): "Teorie Modulara in Algebre de Operatori"**
**IV. Camil Muscalu (Institute of Advances Studies, Princeton): "Topics in harmonic analysis"**

**I. Barbu Berceanu (Institute of Mathematics, Bucharest): "Fifty Years of Homological Algebra"**

1) Basics: chain complexes, simplicial complexes; categories and functors, additive categories, sheaves;
2) Spectral sequences;
3) Derived funtors: Tor, Ext, products;
4) Resolutions: universal constructions versus (complete) presentations and collapsing schemes;
5) Koszulness and duality;
6) Cohomology and deformation theories;
7) Quillen homotopical algebra;
8) Hochschild and cyclic cohomology;
9) Derived categories and D-modules.

First part 1-5): stregthening computational skills (the first 25 years of Homological Algebra);
Second part 6-9): introducing new ideas (of the last 25 years).

Papers: The last submitted, "Multiplicative models for configuration
spaces of algebraic varieties", with M. Makl and St. Papadima,
( see arXiv.org/abs/math. AT/0308243 ), could be my best.

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**II. Vasile Brinzanescu (Institute of Mathematics, Bucharest): "An introduction to moduli spaces in algebraic and complex geometry"**

(first semester; October 2003 - January 2004)

Chap. I Some classical examples: moduli of elliptic curves, grassmannians.
Chap.II Hilbert schemes and quotient schemes.
Chap.III Moduli spaces of stable vector bundles over curves and surfaces (an introduction and examples).
Chap.IV Moduli of curves (an introduction).
Chap. V Numerical invariants of manifolds and applications (an introduction).

Papers:
1. V. Brinzanescu - P. Flondor; "Holomorphic 2-vector bundles on nonalgebraic 2-tori", J. Reine Angew. Math. (Crelle Journal) 363 (1985), 47-58.
2. V. Brinzanescu; "The Picard group of a primary Kodaira surface", Math. Ann. 296 (1993), no.4, 725-738.
3. V. Brinzanescu; "Holomorphic vector bundles over compact complex surfaces" (research monograph, 180 pages), Lect. Notes Math. 1624, Springer 1996.
4. M. Aprodu - V. Brinzanescu; "Moduli of vector bundles over ruled surfaces", Nagoya Math. J. 154 (1999), 111-122.
5. M. Aprodu - V. Brinzanescu - M. Toma; "Holomorphic vector bundles on primary Kodaira surfaces", Math. Z. 242 (2002), no.1, 63-73.

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**III. Dorin Popescu (University of Bucharest) and Cristodor Ionescu (Institute of Mathematics, Bucharest): "Algebra and Combinatorics"**

The subject is a domain of maximal importance and extremely actual in Commutative Algebra: its interactions with Combinatorics. The combinatorial objects considered are simplicial complexes to which one can attach as an algebraic object the associated Stanley-Reisner ring. The course contains the necessary tools(in the introduction)-Hilbert functions, the theorems of Macaulay, Green and Gotzmann. A second chapter presents the combinatorial objects(simplicial complexes, polytopes and their homology) and the associated algebraic objects(Stanley-Reisner ring, f-vectors, h-vectors).
Since monomial algebras defined by square-free monomials of degree 2 have an underlying graph structure, it is clear that interactions between monomial algebras, graph theory and polyhedral theory will appear. The 3-rd chapter presents connections between graphs and ideals. The 4-th chapter contains normality of monomial subrings, a combinatorial description of the integral closure of a monomial subring, as well as applications to graph theory.

Content:

1. Hilbert functions

Hilbert functions.Theorems of Green,Macaulay,Gotzmann.

2. Stanley-Reisner rings.

Simplicial complexes, polytopes, homology.Monomial ideals(primary decomposition). Stanley-Reisner rings. hilbert series for face rings(f-vectors, h-vectors).Upper-bounds theorems.

3. Edge ideals.

Graphs and ideals.Cohen-Macaulay graphs.Trees.

4.Monomial subrings.

Properties,integral closure, normality of some Rees algebras,degree bounds;subring associated to a graph,incidence matrix of a graph,circuits of a graph and Grobner basis.

Papers:

Dorin Popescu:

1)General Neron desingularization and approximation-Nagoya Math.J.,104(1986),85-115.

2)Polynomial rings and their projective modules-Nagoya Math.J.,113(1989),121-128.

3)Maximal CM-modules over the cone of an elliptic curve(with R.Laza and G.Pfister)-J.Algebra,253(2002),209-236.

Cristodor Ionescu:

4)Reduced morphisms and Nagata rings-Arch.Math.,60(1993),334-338.

5)Hochschild homoogy of a topological algebra and formal smoothness-Commun.algebra,22(1994),4801-4805.

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**I. Nicolae Popa (Institute of Mathematics, Bucharest): "Interpolation theory for linear and nonlinear operators: classical and modern problems"**

Description: An introduction in interpolation theory is given. A particular accent is put on applications and on modern aspects of theory.

Main Topics:

1. Function spaces and mainly, rearangement invariant spaces.
2. Classical theorems of interpolation: Riesz' theorem, Calderon'theorem, Marcinkiewicz; theorem.
3. Modern aspects of interpolation: Peetre functional for Hardy spaces ( P. Jones's theorem), interpolation for multilinear operators,(N. Kalton' contributions), continuity of commutators (Rochberg, G. Weiss, Jawerth papers).
4. Applications of theory of interpolation to harmonic analysis, Calderon-0Zygmund operators, wawelets, etc.

List of 5 publications:

1. Sur le problme de Levi dans les espaces de Silva base - C. R. Acad. Sci. Paris, 277, p.211-214, 1973.
2. Basic sequences and subspaces in Lorentz sequence spaces without local-convexity - Trans. Amer. Math. Soc., 263, p. 431-456, 1981.
3. Dual spaces of dyadic Hardy spaces generated by a rearrangement invariant space X on [0,1], Ark. Mat., 36 (1998), 163-175.

4. Unicity of the representation of dyadic Hardy spaces generated by
a rearrangement invariant space X on [0,1], in Proceedings of the fifth
Conference on Function Spaces - Poznan, 1998 Marcel Dekker, 2000.
5. Non-commutative BMO space, Archiv der Math., 74(2000),111-114.
6. Fejer' theory for matrices, (co-authored with S. Barza and Lars-Erik
Persson), to appear in Math. Nachr. 2003.

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**II. Florin Radulescu (University of Iowa): ``Introducere in Teoria Probabilitatilor Libere"**

Continut:
Introducere in Algebre von Neumann
Algebre von Neumann asociate gruprilor discrete
Variabile aleatore necomutative
Suma si produsul variabilelor aleatoare necomutative
R-transform (Transformarea Fourier necomutativa)
Elemente de teoria entropiei libere si aplicatii

Ar fi un curs in care cu o introducere mminimala in algebre de operatori
as incerca sa gasesc o cale spre rezultante recente si importante din
teoria introdusa de voiculescu, si deschiderile ei.

Daca acesta este un curs care ar fi prea avansat pt Master, desi cred ca nu,
pot propune o alternativa de Analiza functionala cu Aplicatii in
Algebre Banach si Operatori Toeplitz.

Papers:
1. F. Radulescu, A one parameter group of automorphisms
of $L(F_{\infty}) \otimes B(H)$ scaling the trace,
Comptes Rendu Acad. Sci. Paris, 314 (1992), 1027-1032.
2. F. Radulescu, Random matrices, amalgamated free products and
subfactors in free group factors of noninteger index,
Inv. Math., 115 (1994), 347-389.
3. F. Radulescu, The Gamma invariant form of
the Berezin quantization of the upper
halfplane, Memoirs American Mathematical Society, vol 535, 1998.
4. F. Radulescu, The fundamental group of the von Neumann algebra
of a free group with infinitely many generators is R+/{0},
Journal of the American Mathematical Society, 5 (1992), 517-532.
5. Dykema, Kenneth J.; Radulescu, Florin,
Compressions of free products of von Neumann algebras,
Math. Ann., 316 (2000), no. 1, 61--82.

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**III. Serban Stratila (Institute of Mathematics, Bucharest): "Teorie Modulara in Algebre de Operatori"**

Scopul cursului :
- Familiarizara cu una din tehnicile de baza in studiul algebrelor von Neumann
- Descrierea clasificarii Connes a factorilor de tip III

Descrierea cursului : Cursul va cuprinde rezultatele esentiale privind :
- Teoria lui Tomita (revedere si extinderea de la forme la ponderi)
- Corespondenta dintre ponderi normale si cocicli Connes
- Constructia Pedersen-Takesaki
- Sperante conditionate si ponderi operatoriale
- Teoria spectrala a grupurilor de automorfisme
- Grupuri cuantice (algebre Kac) si cross produse
- Descompunerea continua a factorilor de tip III
- Descompunerea discreta a factorilor de tip III
- Clasificarea Connes a factorilor de tip III

Bibliografie :
- S.Stratila, L.Zsido : Lectures on von Neumann Algebras, Abacus Press 1979
- S.Stratila : Modular Theory in Operator Algebras
- diverse articole din periodice

Dintre lucrarile mele mentionez :
1. Stratila, Voiculescu : Representations of AF-Algebras and of the group U(infinity), Lecture Notes in Mathematics vol 486, Springer Verlag 1975
2. Stratila, Voiculescu : On a class of KMS states for the unitary group U(infinity, Math.Ann., 235(1978), 87-110
3. Stratila, Voiculescu, Zsido : On crossed products, CR Acad Sc Paris 282(1976) 779-782, Revue Roumaine Math. Pures et Appl. 21(1976) 1411-1449, 22(1977) 83-117
4. Stratila, Zsido : The Commutation Theorem for Tensor Products over von Neumann Algebras, J. Fnal Analysis 165(1999), 293-346
5. Mbekhta, Stratila : Homotopy Classes of Partial Isometries in von Neumann Algebras, Acta Sci Math (Szeged), 66(2002), 271-277

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**IV. Camil Muscalu (Institute of Advances Studies, Princeton): "Topics in harmonic analysis"**
> ***Subiecte in Analiza Fourier Classica***
>
> Lucrurile pe care le am in vedere sint (printre
> altele):
>
> (1) teoria Calderon-Zygmund (revizitata...)
> (2) teoria paraproduselor-teorema Coifman-Meyer (noi
> demonstratii)
> (3) teorema lui Carleson de convergenta aproape
> peste tot
> (4) transformata Hilbert bilineara
> (5) operatori multi-lineari cu singularitati de-a
> lungul unui subspatiu
> (6) operatorul "biest"
> (7) operatorul "bi-Carleson"
> (8) paraproduse cu singularitati steag
> (9) legaturi cu teoria spectrala a operatorilor
> Schroedinger

## 2004 – 2005 Introductory courses

### 1. Barbu Berceanu (IMAR): "Nineteenth Century Mathematics- Selected Topics"

In 2003/2004 I taught an introductory course in the mathematics of 19th century, attended by former IMO participants, now the best students from the Faculty of Mathematics (1st and 2nd year) and also by two SNSB students. The main topics were:
- links between Z, R, and S^1 (injective and projective groups, Pontrjagin duality, coverings and \pi_1, Denjoy th. on Diffeo(S^1);
- complex plane, Riemann sphere, and complex tori;
- abelian integrals and elliptic functions;
- quadratic equations and Hilbert symbol;
- cubic equations (Mordell th.).

I propose to continue this course (two semesters, 2 hours/week) in the same informal style, with the stress on examples and general ideas:

1. hyperbolic geometry and compact surfaces
2. theta functions and modular groups (applications to the fifth degree equation and arithmetic)
3. the fundamental group and coverings

4. curves singularities and torus knots
5. invariant theory (Hilbert th.)

AUTHOR'S BEST PAPERS:
The last submitted, "Multiplicative models for configuration spaces of algebraic varieties", with M. Makl and St. Papadima, (see arXiv.org/abs/math. AT/0308243), could be my best.

## 2004 – 2005 Preliminary cycle

**1. Serban A. Basarab (IMAR): The Field "C" is Algebraically Closed: A Logical Viewpoint**
**2. Barbu Berceanu (IMAR): Vector Bundles and Characteristic Classes**
**3. Alexandru Gica (Univ. Bucharest): The class number for quadratic binary forms**
**4. Viorel Iftimie (Univ. Bucharest): Fourier Integral Operators and Weyl-H\"ormander-Bony Calculus**
**5. Cezar Joita (IMAR): Introduction to Several Complex Variables**
**6. Mosche Marcus (Technion - Israel Institute of Technology), Petru Mironescu (Univ. Paris 11): Semilinear elliptic equations. An introduction**
**6. Laurent Véron (Univ. Tours): Regularity theory for elliptic equations**
**7. Eugen Mihailescu (IMAR):Complex dynamics and ergodic theory**
**8. Sergiu Moroianu (IMAR): K-Theory and differential operators**
**9. Nicolae Popa (Univ. Bucharest): Dyadic Hardy Spaces Generated by Rearrangement Invariant Spaces; Some of Its Isomorphism-Invariant Properties**
**10. Angela SUTAN (Univ. Strasbourg 1): Game theory : applied mathematics to decision making**

**1. Serban A. Basarab (IMAR)**
**THE FIELD "C" IS ALGEBRAICALLY CLOSED: A LOGICAL VIEWPOINT**

In choosing the topic of the proposed course I was inspired by the memorable series of three lectures addressed by Professor Jean-Pierre Serre in May 2004 to the students of SNSB. Though the related logical aspects were not among the objectives of his lectures, in one of them he mentioned in a comment the Tarski-Seidenberg principle for real closed fields.

It is well known that basic algebraic-geometric facts are strongly related to basic logical concepts. For instance, Hilbert's Nullstellensatz is equivalent to the model completeness of the elementary theory {\bf ACF} of algebraically closed fields, while, according to a theorem of Macintyre, a necessary and sufficient condition for an infinite field $K$ to be algebraically closed is that its elementary theory $Th(K)$ admits elimination of quantifiers.

Boolean lattices (algebras) and profinite (compact and totally disconnected) spaces, naturally related by Stone's duality, are among the basic tools of a logician. Given a first order language $\cL$, for instance, the usual language of rings (fields), and a set $T$ of sentences in $\cL$ (a {\em theory}), for instance, the theory {\bf F} of fields, the {\em Lindenbaum-Tarski algebra} $L(T)$ of $T$ is the boolean algebra defined on the the set of the modulo $T$ equivalence classes of $\cL$-sentences (the $\cL$-sentences $\varphi$ and $\psi$ are equivalent modulo the theory $T$ iff the sentence $\varphi <--> \psi$ is a theorem in $T$), with the boolean operations induced by the logical connectors {\em and, or} and {\em negation}. By G\" odel completeness theorem, the points of the profinite space

$\cS(T)$, the dual space of the boolean lattice $\cL(T)$, are identified to the models of $T$ up to {\em elementary equivalence}(the $\cL$-structures $A$ and $B$ are {\em elementarily equivalent}, write $A \equiv B$, iff their $\cL$-theories $Th(A)$ and $Th(B)$ coincide, i.e., every $\cL$-sentence $\varphi$ is simultaneously true or false on $A$ and $B$). Thus the points of $\cS({\bf F})$ are fields up to elementary equivalence.

The map assigning to a field $K$ its characteristic induces a continuous map from the profinite space $\cS({\bf F})$ onto the spectral space $Spec(\mathbb{Z})$, whose restriction to the closed subspace $\cS({\bf ACF})$ is bijective, and this is essentially the Lefshetz principle.

On the other hand, to any field $K$ of characteristic $0$, one may assign the algebraic closure $Abs(K) := K \cap \tilde{\Q}$ of the prime subfield $\Q$ in $K$, and hence the conjugacy class of the absolute Galois group $Gal(Abs(K)$ of $Abs(K)$, seen as a closed subgroup of the absolute Galois group $\Gam := Gal(\Q)$ of $\Q$.
The correspondence above sends the one-point space $\cS({\bf ACF}_0)$, the Stone space of the theory {\bf ACF}$_0$ of algebraically closed fields of characteristic $0$, to the one-point space consisting of the conjugacy class of the identity, respectively, the one-point space $\cS({\bf RCF})$, the Stone space of the theory {\bf RCF} of real closed fields, to the one-point space consisting of the conjugacy class of all involutions of $\Gam$. Moreover, according to a theorem of Ax, it turns out that the correspondence above induces a homeomorphism of the profinite space $\cS({\bf PFF}_0)$ onto the profinite space of the conjugacy classes of procyclic closed subgroups of $Gal(\Q)$, where {\bf PFF}$_0$ denotes the theory of {\em pseudo finite} fields (i.e. infinite models of the theory of finite fields) of characteristic $0$. Note that, by a theorem of Ax, a necessary and sufficient condition for a field $K$ to be pseudo finite is that $K$ is perfect, quasi-finite (i.e. $Gal(K) \cong \widehat{\Z}$), and {\bf PAC}({\em pseudo algebraically closed}), i.e., $V(K) \neq \emptyset$ for every non-empty absolutely irreducible variety $V$ defined over $K$.

The examples above show that the arithmetic properties of a field $K$, encoded in $Th(K)$, are in certain circumstances (almost completely) determined by a suitable Galois theoretic information associated to $K$, for instance the absolute Galois group of $K$ or of $Abs(K)$ . In fact, there is a standard procedure to translate in logical terms the arithmetic information encoded in $Gal(K)$, defining a sort of a (co)theory of the profinite group $Gal(K)$ completely determined by $Th(K)$. In particular, assuming that $Gal(K)$ is small, i.e., there are only finitely many open subgroups of $Gal(K)$ of index $n$ for any positive integer $n$, (for instance, if $Gal(K)$ is (topologically) finitely generated), then for every field $F,\,F \equiv K \Lra Gal(F) \cong Gal(K)$. Thus the following question arises

in a natural way: classify (up to elementary equivalence)
the fields $K$ for which the (co)theory of $Gal(K)$,
respectively the isomorphism type of $Gal(K)$ in
the small case, determines completely $Th(K)$.
Very significative results concerning the question
above and related aspects were obtained recently
by F. Pop and J. Koenigsmann.

\section{Objectives}

The goal of the proposed course is to introduce
gradually the basic notions and results of the
model theoretic algebra and use them to the study
of the arithmetic and Galois theoretic properties of
certain classes of fields (algebraically closed,
real closed, $p$-adically closed, pseudo finite, PAC,
hilbertian, etc). Basic notions and results
of Galois theory, algebraic number theory and
valuation theory will be discussed and suitably
related with the model theoretic ones.

LIST OF 6 PAPERS RELATED TO THE PROPOSED COURSE:
1. A model theoretic transfer theorem for Henselian valued fields,
J.Reine Angew.Math. 311/312 (1979) 1-30; MR81h:03071, Zbl409.12030.
2. Extension of places and contraction properties for function fields
over p-adically closed fields, J.Reine Angew.Math. 326 (1981) 54-78;
MR82j:03040, Zbl491.12025.
3. On some classes of Hilbertian fields, Results Math.(Basel) 7 (1984)
1-34; MR86c:12002, Zbl547.12016.
4. The absolute Galois group of a pseudo real closed field with finitely
many orders, J.Pure Appl.Algebra 38 (1985) 1-18; MR87e:12001, Zbl595.12012.
5. Transfer principles for pseudo real closed e-fold ordered fields,
J. Symbolic Logic 4 (1986) 981-991; MR88f:12002, Zbl633.03030.
6. Relative elimination of quantifiers for Henselian valued fields,
Annals Pure Appl.Logic 53 (1991) 51-74; MR92j:03028, Zbl734.03021.

**2. Barbu Berceanu (IMAR): "Vector Bundles and Characteristic Classes"**

1. Vector bundles-algebraic theory (Serre-Swan theorem)
2. Classifying spaces and homotopy theory of vector bundles
3. Steenrod powers and Stiefel-Whitney classes
4. Euler class and orientability; obstruction theory
5. Chern and Pontrjagin classes
6. Invariants of Weyl groups and Borel theorem
7. Curvature and Chern-Weyl theory
8. K-theory and characteristic classes

Applications: immersions of manifolds, cobordism, division
algebras, H-structures on spheres, vector fields on spheres.

This course is intended for SNSB students who followed
the course "Algebraic topology through examples"

AUTHOR'S BEST PAPERS:
The last submitted, "Multiplicative models for configuration
spaces of algebraic varieties", with M. Makl and St. Papadima,
(see arXiv.org/abs/math. AT/0308243), could be my best.

**3. Alexandru Gica (Univ. Bucharest): "The class number for quadratic binary forms."**

Summary of the course:

The purpose of this course is to speak about a subject "which belongs to one of the most beautiful theories in mathematics" (quotation from E. Landau).

1) Primitive, positive definite, reduced forms.
The proper equivalence relation between binary quadratic forms.
The number of classes of primitive positive definite forms.

2) Genus Theory. Convenient numbers.

The presentation of these two chapters will follow the celebrated book of Gauss "Disquisitiones Arithmeticae" (Gauss treatment of quadratic forms occupies the fifth and longest section of the book) and the book of Landau "Vorlesung uber Zahlentheorie", Erster Band, "Aus der elementaren und additiven Zahlentheorie"(the fourth section of the book).

3) Numbers which are sum of 2,3 or 4 squares. How many representation they are?

4) The formula for the class number. As special cases:
a)If p is a prime, p=8k+7, then the
class number for the discriminant -p equals the difference between the quadratic residues and nonquadratic residues which lies between 1 and (p-1)/2.
b)If p is a prime, p=8k+3, then the class number for discriminant -p equals one third of the above difference.

5)They are only nine imaginary quadratic fields with a principal ring of the integers. This famous result was conjectured by Gauss and proved by Baker and Stark in 1966-1967.

6) The growth of the class number. The formula of Siegel.

AUTHOR'S BEST 5 PAPERS:
1)"The Proof of a Conjecture of Additive Number Theory", Journal of Number Theory 94, (2002), 80-89.
2)"Quadratic residues of certain types", will appear in the Rocky Mountain Journal of Mathematics.
3)"On Oblath's problem", together with L.Panaitopol, Journal of Integer Sequences, volume 6, 2003, Issue 3, Article 03.3.5 (12 pages).
4)"A conjecture which implies the theorem of Gauss-Heegner-Stark-Baker", Bull.Math.Soc.Sc.Math.Roumanie, Tome 41(89),nr.2, 1998, 111-118.
5)"An application of a theorem of Siegel", Rev. Roumaine Math. Pures Appl., 48(2003),5-6,487-490.

**4. Viorel Iftimie (Univ. Bucharest): "Fourier Integral Operators and Weyl-H\"ormander-Bony Calculus"**

Object: a development of the theory of pseudodifferential and Fourier integral operators associated to a Riemannian metric of H\"ormander type on the phase space, with applications to partial differential equations and spectral theory of differential operators.

Contents: In a facultative course organized by the SNS during the second semester of the academic year 2003--2004, the bases were laid for the Weyl-H\"ormander pseudodifferential calculus, with the improvements due to Bony. Thus, the following topics were presented: Weyl quantization, metaplectic operators, H\"ormander metrics and associated operators, confining theory, continuity properties of pseudodifferential operators, Sobolev spaces associated to a H\"ormander metric, composition of pseudodifferential operators and applications to hypoellipticity and sharp G\aa rding inequality.

The present course aims to continue the study, started in the facultative course, in the following directions:

- Characterization of pseudodifferential operators of Weyl-H\"ormander type using commutators. The model of such a result is the theorem of Beals for constant metrics, which uses commutators with operators whose symbols are linear forms. Bony and Chemin have given a characterization which holds for any metric (with a condition of geodesic temperation), having as a consequence the boundedness in $L^2$ of commutators with operators whose symbols belong to a fundamental space called $S^{+}(1, g)$. As a first application, certain one-parameter groups of self-adjoint operators are studied, and a functional calculus for elliptic pseudodifferential operators is developed.

- The study of integral Fourier operators (an essential extension of psedodifferential operators) for H\"ormander metrics. The theory developed by H\"ormander for such operators in the case of standard metrics is already intricate, and the construction of a rather simple theory for general metrics is due to Bony. The purpose of this course is to present the results of Bony, who has defined integral Fourier operators using commutators. Besides some general properties (composition, adjoint, associated symbol), one points out two applications. The first of them consists in proving that the conjugation of a pseudodifferential operator by a Fourier integral operator yields another pseudodifferential operator (an extension of a theorem of Egorov), which allows to reduce these operators to certain "canonical forms". As a second application, one shows that the solutions of certain evolution equations can be represented using some Fourier integral operators, which is important in partial differential equations (the Cauchy problem for hyperbolic operators), as well as in the spectral theory of partial differential operators (the asymptotic behaviour of the spectral function of an elliptic operator).

Bibliography:

1.L. Hörmander , The Analysis of Linear Partial Differential Operators, vol. III-IV, Springer, 1985.
2.J.-M. Bony, Calcul Weyl, curs DEA la École Polytechnique Paris, 1996.
3.J.-M. Bony si J.-Y. Chemin, Espaces fonctionnels associés au calcul de Weyl- Hörmander, Bull. Soc. Math. France 122(1994), 77-118.
4. J.-M. Bony, Weyl quantization and Fourier integral operators, Partial differential equations and mathematical physics, Birkhauser, 1995, 45-57.

AUTHOR'S BEST 5 PAPERS:

1.E.Croc, Y. Dermenjian, V. Iftimie, Une classe d'operateurs pseudo-différentiels partiellement hyperelliptique-analytiques
I J. Math. Pures Appl. 57, no. 3 (1978), 255-274.
II Proc. Conf.Saint-Jean-de -Monts, Lecture Notes in Math. 660, Springer, 1978, 59-65.
2.V. Iftimie, Opérateurs différentiels magnétiques: stabilité des trous dans le spectre, invariance du spectre essentiel et applications, Comm. Partial Differential Equations 18, no. 3-4 (1993), 651-686.
3.V. Iftimie, Décroissance exponnentielle des fonctions propres des opérateurs de Schrodinger avec des champs magnétiques, Bull. Sci. Math. (France), 120, no. 5(1996), 445-471.
4.E. Croc, V. Iftimie, Wave operators in a multistratified strip, Integral Equations Operator Theory 33, no. 4(1999), 389-405
5.Y. Dermenjian, V. Iftimie, Méthodes à N corps pour un problème de milieut pluristratifiés perturbés, Publ. Res. Inst. Math. Sci. Kyoto, 35. no. 4(1999), 679-709.

**5. Cezar Joita (IMAR): "Introduction to Several Complex Variables"**

This is an one semester introductory course into the Theory of Holomorphic Functions of Several Complex Variables. Roughly speaking, forty hours will be used for lecture and twelve for recitation.

Prerequisites: A course in One Complex Variable, Measure Theory
and rudiments of Functional Analysis and Commutative Algebra.

The course will cover the following topics:

A) Holomorphic functions of one complex variable:
$\overline\partial$-equation with compact support, Runge Theorem,
every domain in $\C$ is a domain of holomorphy.
B) Holomorphic functions of several complex variables: definition,
Cauchy integral formula and consequences.
C) Reinhardt domains, logarithmically convex domains.
D) Hartogs figures, $\overline\partial$-equation with compact support,
Hartogs Kugelsatz.
E) Domains of holomorphy and holomorphic convexity.
F) Subharmonic and plurisubharmonic functions. Pseudoconvexity.
G) Analytic sets. The ring of germs of holomorphic functions. Weierstrass
preparation and division theorems. Local structure of analytic sets. Dimension.
H) Complex manifolds.
I) Projective manifolds. Chow's theorem.
J) Stein manifolds. The Imbedding Theorem for Stein manifolds.
K) Riemann domains, envelopes of holomorphy.

MAIN REFERENCES:
J.P. Demailly: Complex Analytic and Algebraic Geometry
K. Fritzsche, H. Grauert: From Holomorphic Functions to Complex Manifolds
R. Gunning, H. Rossi: Analytic Functions of Several Complex Variables
L. H\"ormander: An Introduction to Complex Analysis in Several Variables

AUTHOR'S BEST 5 PAPERS:
1. "On the Projection of Pseudoconvex Domains" -
Mathematische Zeitschrift 233(2000), 625-631
2. "Traces of convex domains" -
Proceedings of AMS (2003) No. 9, 2721-2725
3. "On the n-concavity of Covering Spaces with Parameters" -
Mathematische Zeitschrift 245 (2003), 221-231
4. "The third Cauchy-Fantappie formula of Leray", with Finnur
Larusson, Michigan Mathematical Journal 51 (2003), No. 2,
339-350
5. "Chaotic dynamics of a rational map", with C. Georgescu, W.
Nowell, si P. Stanica - will appear in
Discrete and Continuous Dynamical Systems, Series A.

**6. Mosche Marcus (Technion - Israel Institute of Technology), Petru Mironescu (Univ. Paris 11)**
**"Semilinear elliptic equations. An introduction"**
[part of the program in nonlinear elliptic equations theory and variational problems]

Prerequisites : basic functional analysis

Short description
In the first part, we provide the most frequently used properties of Sobolev spaces and also discuss some fine properties of functions. In the remaining chapters, we describe the basic techniques used in the study of semilinear elliptic PDEs. The subjects marked with * will be discussed if enough time is available.

Plan of the course
I. Sobolev spaces
I1. Density of smooth maps
I2. Embedings
I3. Compact embeddings
I4. Poincaré, Wirtinger and Gagliardo-Nirenberg inequalities
I5. Traces (direct and inverse)

I6. Superposition (Nemytskij) operators
I7. Capacity
I8.* Fractional Sobolev spaces

II. Variational methods
II1. The Lax-Milgram lemma
II2. The direct method
II3. * Aubin's trick
II4. Mountain pass solutions and the Palais-Smale condition
II5. Monotonicity methods : sub and supersolutions

I. Implicit function methods
III1. Continuation methods
III2. Linearization
III3. Stability analysis
III4. (Crandall-Rabinowitz) Bifurcation

II. Existence, nonexistence and symmetry
IV1. Moving planes
IV2. Pohozaev's trick

LIST OF 5 BEST PUBLICATIONS OF Moshe Marcus:
(1) Transformations of domains in the plane and applications in the theory of functions, Pac.J.Math., Vol.14 (1964), 613-626.
(2) Every superposition operator mapping one Sobolev space into another is continuous, J.Funct.Anal., Vol.33 (1979), 271-229, (with V.Mizel).
(3) 'Large' solutions of semi-linear elliptic equations: existence, uniqueness and asymptotic behaviour, J. d'Analyse, 58, (1992), p.9-24 (with C. Bandle).
(4) Uniqueness and asymptotic behavior of solutions with blowup at the boundary for a class of nonlinear elliptic equations, Ann. Inst. Poincare, Anal. non lineaire, Vol.14, (1997), p.237-274 (with L.Veron).
(5) The boundary trace and generalized B.V.P. for semilinear elliptic equations with coercive absorption, Comm. Pure Appl. Math., Vol.56, (2003) p.689-731 (with L. Veron).

BEST 5 PAPERS OF P. Mironescu:
1. M. Comte, P. Mironescu, The behavior of a Ginzburg- Landau minimizer near its zeroes, Calc. Variations PDE 4 (1996), 323 -340.
2. P. Mironescu, Les minimiseurs locaux pour l'équation de Ginzburg- Landau sont à symétrie radiale, C. R. Acad. Sci. Paris 323 (1996), 593-598.
3. J. Bourgain, H. Brezis, P. Mironescu, Lifting in Sobolev spaces, Journal d'Analyse 80 (2000), 37-86.
4. J. Bourgain, H. Brezis, P. Mironescu, Another look at Sobolev spaces, in Optimal Control and Partial Differential Equations, In honour of Professor Alain Bensoussan's 60th Birthday, J. L. Menaldi, E. Rofman, A. Sulem (eds), IOS Press, Amsterdam, 2001, 439-455.
5. J. Bourgain, H. Brezis, P. Mironescu, H1/2 maps with values into the circle: minimal connections, lifting, and the Ginzburg-Landau equation, submitted to Annales IHES.

**6. Laurent Véron (Universite de Tours): "Regularity theory for elliptic equations"**
[part of the program in nonlinear elliptic equations theory and variational problems]

The aim of the course is to present classical results on linear second order elliptic equations with the view of treating a few questions associated to the nonlinear problems.

1 Harmonic functions and Laplace equations
1-1 Mean values formula and applications
1-2 Maximum principles
1-3 The Green and the Poisson kernels

1-4 Subharmonic functions and Perron's construction

2 Regularity theory for linear equations
2-1 The L2 regularity
2-2 The Schauder estimates
2-3 Element of Lp regularity

3 Elliptic equations with measurable coefficients
3-1 Uniform estimates
3-2 Harnack inequalities
3-3 The De Giorgi-Nash-Moser theorem

4 Applications
4-1 Regularity theory in 2-dim
4-2 Regularity of extremum of variational problems

BEST 5 PAPERS OF L. Veron:
1. Singular solutions of some nonlinear elliptic equations, Nonlinear Anal. T. M. & A. 5, 225-242 (1981)
2. Singular solutions of the p- Laplace equation (coll. S. Kichenassamy), Math. Annalen 275, 599-615 (1986)
3. Boundary singularities of solutions of nonlinear elliptic equations (coll. A. Gmira), Duke J. Math., 64, 271-324 (1991)
4. The boundary trace of positive solutions of semilinear elliptic equations: the subcritical case (call. M. Marcus), Arch. Rat. Mech. An. 144, 201-231 (1998)
5. Removable singularities and boundary traces (coll. M. Marcus), J. Math. Pures Appl. 80, 879-900 (2001)

**7. Eugen Mihailescu (IMAR): "Complex dynamics and ergodic theory"**

Description: "This course will be an introduction to dynamical systems with emphasis on Complex Dynamics.
Complex Dynamics is a relatively recent and flourishing field of Analysis, standing at the crossroads of Complex Analysis, Dynamical Systems, Global Analysis, Ergodic Theory.
The prerequisite for the course is some knowledge of Real and Complex Analysis, Differentiable Topology, etc. Notions will be recalled as needed. We will cover tentatively the following chapters:
--Hyperbolic dynamics, stable/unstable manifolds.
--Complex dynamics in one variable: Fatou and Julia sets, classification of Fatou components; Mandelbrot set, fractals.
--Complex dynamics in several variables: basic several complex variables theory, currents, Fatou sets in higher dimension, etc.
--Henon automorphisms and holomorphic maps on projective spaces.
--Ergodic theory: entropy, topological pressure, equilibrium states, inverse entropy/pressure, etc.
--Applications to estimates of Hausdorff dimension of fractal sets."

AUTHOR'S BEST 5 PAPERS:
1. Periodic points for actions of tori in Stein manifolds, Mathematische Annalen 314, 1999, no 1, 39-52
2. Inverse topological preasure with applications to holomorphic dynamics in several variables, joint with Mariusz Urbanski, accepted Comm. Contemp. Math., 2003
3. Holomorphic maps for wich the unstable manifolds depends on prehistories, joint with M. Urbanski, Discrete and Continuous Dynamical Systems, vol.9, no.2, 2003
4. The set K- for hyperbolic non-invertible maps, Ergodic Theory and Dynamical Systems, June 2002, 3, 873-888
5. Applications of thermodynamic formalism in complex dynamics on P^2, Discrete and Continuous Dynamical Systems, vol. 7, 4, October 2001, 821-836.

**8. Sergiu Moroianu, IMAR: "K-Theory and differential operators"**

This course aims to give an introduction to the theory of elliptic operators on compact manifolds. It is intended for fourth year students with previous exposure to differentiable manifolds and functional analysis.

Syllabus:
- Review of basic differential geometry. Vector bundles, Serre-Swan theorem. The group $K^0$. K-theory with compact support. $K^{-1}$ and the long exact sequence in topological K-theory.
- Elliptic differential operators. Pseudo-differential operators. Fredholm operators. Hodge theory.
- The Cauchy-Riemann operator on holomorphic vector bundles over $CP^1$. Families of differential operators. The index bundle. Atiyah's proof of Bott periodicity.
- Chern character. Push-forward in K-theory. The Atiyah-Singer index theorem.

BEST 5 PAPERS OF S. Moroianu (see also alum.mit.edu/www/moroianu):
1) Weyl laws on open manifolds, math.DG/0310075.
2) Adiabatic limits of eta and zeta functions of elliptic operators, Math. Z. 246 (2004), 441-471.
3) K-Theory of suspended pseudo-differential operators, K-Theory 28 (2003), 167-181.
4) Homology of pseudo-differential operators on manifolds with fibered boundaries (with Robert Lauter), J. Reine Angew. Math. 547 (2002), 207-234.
5) The index of cusp operators on manifolds with corners (with Robert Lauter), Ann. Global Anal. Geom. 21 no. 1 (2002), 31-49.

**9. Nicolae Popa (Univ. Bucharest)**
**"DYADIC HARDY SPACES GENERATED BY REARRANGEMENT INVARIANT SPACES; SOME OF ITS ISOMORPHISM-INVARIANT PROPERTIES"**

Content: 1. PRELIMINARIES; Rearrangement invariant function spaces, extensions of Doob's maximal inequality of rearrangement invariant spaces with nontrivial Boyd indices, Burkholder-Gundy-Davis inequality for rearrangement invariant functions spaces.

2. DYADIC HARDY SPACE $H_{X}(d)$ AND ITS DUAL;
Equivalent definitions of the dyadic Hardy space geerated by arearrangement invariant space $X$, extension of Fefferman's inequality for $H_{X}(d)$ with a $q$-concave $X$ , $1\leq q<2$.

3. DYADIC HARDY-ORLICZ SPACES;
Isomorphism theorem for dyadic Hardy-Orlicz spaces with Orlicz indices less than 2.

4. ISOMORPHISM THEOREMS FOR DYADIC HARDY SPACES $H_{X}(d)$.
Extension of Bourgain method to spaces $H_{X}(d)$ with $p_{X}=1$ and $X$ a $q$-concave rearrangement invariant space for $1<q<2$.

5.COMPLEMENTED DYADIC HARDY SUBSPACES OF A DYADIC HARDY SPACE;
It is a generalization of some interesting results for complemented subspaces of rearrangement invariant spaces, given by Maurey, Schechtman, Tzafriri in 1979.

SELECTED PAPERS
1. Basic sequences and subspaces in Lorentz sequence spaces without local-convexity - Trans. Amer. Math. Soc., 263, p. 431-456, 1981. MR82f

#46012, p. 2499, ref. Bor Luh-Lin.
2. Dual spaces of dyadic Hardy spaces generated by a rearrangement invariant space X on [0,1], Ark. Mat., 36 (1998), 163-175.
3. Unicity of the representation of dyadic Hardy spaces generated by a rearrangement invariant space X on [0,1], Function space (Poznan 1998), pp.445-458, Lecture Notes in Pure and Applied Mathematics, 213, Dekker, New-York, 2000.
4. Non-commutative BMO space, Archiv der Math., 74(2000),111-114.
5. A matriceal analogue of Fejer's theory. (co-authors: Sorina Barza and Lars-Erik Persson), Math. Nachr., 260, pp.14-20 (2003).

**10. Angela SUTAN (Univ. Strasbourg 1) : "Game theory: applied mathematics to decision making"**

This course describes highly applicable mathematics to social sciences and to decision problems.The choice of topics is based on a desire to present those facets of mathematics which will be useful to mathematicians when they want to examine economics and social/behavioral sciences.

Game theory is a bag of analytical tools designed to help us understand the phenomena that we observe when decision-makers interact. The basic assumptions that underlie the theory are that decision-makers pursue well-defined exogenous objectives (they are rational) and take into account their knowledge or expectations of other decision-makers' behavior (they reason strategically).

The models of game theory are highly abstract representations of classes of real-life situations. Their abstractness allows them to be used to study a wide range of phenomena. For example, the theory of Nash equilibrium has been used to study oligopolistic and political competition. The theory of mixed strategy equilibrium has been used to explain the distributions of tongue length in bees and tube length in flowers. The theory of repeated games has been used to illuminate social phenomena like threats and promises. The theory of the core reveals a sense in which the outcome of trading under a price system is stable in an economy that contains many agents.

Game theory uses mathematics to express its ideas formally. A mathematical formulation makes it easy to define concepts precisely, to verify the consistency of ideas, and to explore the implications of assumptions. Consequently the style is formal: the course state definitions and results precisely, interspersing them with motivations and interpretations of the concepts. The use of mathematical models creates independent mathematical interest.

A game is a description of strategic interaction that includes the constraints on the actions that the players can take and the players' interests, but does not specify the actions that the players do take. A solution is a systematic description of the outcomes that may emerge in a family of games. Game theory suggests reasonable solutions for classes of games and examines their properties.

We study four groups of game theoretic models : strategic games (Part I), extensive games with and without perfect information (Parts II and III), and coalitional games (Part IV).
In all game theoretic models the basic entity is a player. A player may be interpreted as an individual or as a group of individuals making a decision. Once we define the set of players, we may distinguish between two types of models: those in which the sets of possible actions of individual players are primitives

(Parts I, II, and III) and those in which the sets of possible joint actions of groups of players are primitives (Part IV). Sometimes models of the first type are referred to as "noncooperative", while those of the second type are referred to as "cooperative" (though these terms do not express well the differences between the models).

Strategic Games and Extensive Games
In Part I we discuss the concept of a strategic game and in Parts II and III the concept of an extensive game. A strategic game is a model of a situation in which each player chooses his plan of action once and for all, and all players' decisions are made simultaneously (that is, when choosing a plan of action each player is not informed of the plan of action chosen by any other player). By contrast, the model of an extensive game specifies the possible orders of events; each player can consider his plan of action not only at the beginning of the game but also whenever he has to make a decision.

Games with Perfect and Imperfect Information
The third distinction that we make is between the models in Parts II and III. In the models in Part II the participants are fully informed about each others' moves, while in the models in Part III they may be imperfectly informed. The former models have firmer foundations. The latter were developed intensively only in the 1980s; we put less emphasis on them not because they are less realistic or important but because they are less mature.

Game Theory and the Theory of Competitive Equilibrium
To clarify further the nature of game theory, we now contrast it with the theory of competitive equilibrium that is used in economics. Game theoretic reasoning takes into account the attempts by each decision-maker to obtain, prior to making his decision, information about the other players' behavior, while competitive reasoning assumes that each agent is interested only in some environmental parameters (such as prices), even though these parameters are determined by the actions of all agents.

To illustrate the difference between the theories, consider an environment in which the level of some activity (like fishing) of each agent depends on the level of pollution, which in turn depends on the levels of the agents' activities. In a competitive analysis of this situation we look for a level of pollution consistent with the actions that the agents take when each of them regards this level as given. By contrast, in a game theoretic analysis of the situation we require that each agent's action be optimal given the agent's expectation of the pollution created by the combination of his action and all the other agents' actions.

The course presents the main ideas of game theory at a suitable level for graduate students and advanced undergraduates.
It emphasizes the theory's foundations and interpretations of its basic concepts.

Reference books :
Osborne, A. Rubinstein     A course in Game Theory, MIT Press, 1994
G. Owen     Discrete Mathematics and Game theory, Kluwer Academic Publishers, Boston, 1999

SCIENTIFIC PAPERS (SELECTED):
1. "Coordination in cobweb experiments with(out) elicited beliefs" (with Marc WILLINGER) European Economic Science Association Meeting, Erfurt, September 2003 CeNDEF lustrum symposium, Amsterdam, November 2003 (presented by M. Willinger) Junior research seminar, March 2004, Montpellier in Working Papers Series, BETA,2003

2. "Price forecasts and coordination by beliefs", (with Marc WILLINGER)
Journée de l'Ecole Doctorale "Augustin Cournot", Illkirch, June 2003
20èmesJournées de Microéconomie Appliquée, JMA, Montpellier, May 2003
ESNIE (European School on New Institutional Economics), Cargèse, march 2003
ENDEAR Workshop (European Network for the Development of Experimental Economics and its Application to Research on Institutions and Individual Decision Making), poster session, Amsterdam, february 2003
WEHIA (Workshop on Economics with Heterogeneous Interacting Agents)
Kiel, mai 2003
in Integrare europeana in contextul globarizarii economice, vol. I, Editions AGIR, 2003, pp.43-76
3. "Coordination of beliefs, eductive learning and the cobweb model", (avec Marc WILLINGER) Summer School of Experimental Economics, poster session, Jena, July 2002
4. "The evolution of convention with(out) common knowledge", (avec G. Graeffe, W.Guth et alii) Summer School of Experimental Economics, Jena, July 2002
5. "Le taux de change et les courbes de taux : l'Euro ne répond plus aux variations des taux d'intérêt", (avec Yann TAMPEREAU), in Flash, Caisse des Dépôts et Consignations, n°147, 23 août 2000

## 2004 – 2005 Master courses proposals

### Master in Algebra-Algebraic Geometry at SNSB

**1. Barbu Berceanu (Institute of Mathematics of the Romanian Academy): Topics in Combinatorial and Geometric Group Theory**
**2. Vasile Brinzanescu (Institute of Mathematics of the Romanian Academy): Moduli Spaces of Vector Bundles**
**3. Dan Burghelea (Ohio State Univ.) : Introduction to Morse Theory**
**4. Cristodor Ionescu (Institute of Mathematics of the Romanian Academy): Homological Methods in Commutative Algebra**
**5. Paltin Ionescu (University of Bucharest): Abstract versus Embedded Classification of Complex Projective Manifolds**
**6. Razvan Litcanu (University of Iasi): Introduction in Arithmetic Geometry**

**1. Barbu Berceanu (Institute of Mathematics of the Romanian Academy): Topics in Combinatorial and Geometric Group Theory**

1) free grps, free products, and amalgams;
2) finitely generated grps as metric spaces;
3) growth functions and growth series of grps;
4) cohomology and ends;
5) automatic grps.
and classical examples: Euclidean grps, planar discontinuous grps, knot grps, modular grp, arithmetic grps, Coxeter and Artin grps.

Author's best papers:
The last submitted, "Multiplicative models for configuration spaces of algebraic varieties", with M. Makl and St. Papadima, (see arXiv.org/abs/math. AT/0308243), could be my best.

**2. Vasile Brinzanescu (Institute of Mathematics of the Romanian Academy): Moduli Spaces of Vector Bundles**

The notion of stability for vector bundles was introduced by Mumford and Takemoto for vector bundles on curves. Later it was generalized in many ways and the study of stable vector bundles is a very important object in geometry with intersting applications in other domains, esspecially in string theory. In the lecture courses, the notions of stability will be described, the construction of the moduli spaces will be given and some applications will be presented (some information on Kobayashi-Hitchin correspondence between stable vector bundles and Hermite-Einstein connections will be disscused).

Author's selected papers:
1. V. Brinzanescu - P. Flondor; "Holomorphic 2-vector bundles on

nonalgebraic 2-tori", J. Reine Angew. Math. (Crelle Journal) 363 (1985), 47-58.
2. V. Brinzanescu; "The Picard group of a primary Kodaira surface", Math. Ann. 296 (1993), no.4, 725-738.
3. V. Brinzanescu; "Holomorphic vector bundles over compact complex surfaces" (research monograph, 180 pages), Lect. Notes Math. 1624, Springer 1996.
4. M. Aprodu - V. Brinzanescu; "Moduli of vector bundles over ruled surfaces", Nagoya Math. J. 154 (1999), 111-122.
5. M. Aprodu - V. Brinzanescu - M. Toma; "Holomorphic vector bundles on primary Kodaira surfaces", Math. Z. 242 (2002), no.1, 63-73.

**3. Dan Burghelea (Ohio State University): Introduction to Morse Theory:**

Morse Theory begins with the modest task of understanding the local maxima, minima and saddle points, of a smooth function in relationship with the topology of the "space" the function is defined on.It led to (or it was crucial in the proof of) some of the deepest mathematical results in:

- differential algebraic and infinite dimensional topology
- dynamics,
- Riemannian and symplectic geometry, gauge theory, algebraic geometry.

New aspects of the theory raise questions attractive by the simplicity of their formulation and promising for application. The course will cover only basics of elementary Morse theory but a number of lectures about the new aspects of Morse theory will be offered to a more expert audience

References

a. Milnor, Morse theory, J. Milnor,Princeton University Press, 1963
b. Morse Homology , M.Schwartz, Birkhauser Verlag, Basel,1993,
c. Introducere in Topologia diferentiala, D Burghelea, Th Hangan, H.Moscovici, A Verona, Editura StiintificaBucuresti, 1973 in differential topology,
d. Chapter 1 in the book in preparation ( Witten Helffer Sj\"ostrand theory.)
Chapter one (Elementary Morse theory) is written and will be distributed to students and other participants.
In addition a number of papers will be suggested as reading.

Author's best 5 papers:

1. Hilbert Manifolds, Annals of Math, Vol 90, 1969 pp 379-417 (with N Kuiper)
2. Stability for concordances and suspension homeomorphisms, Annals of Math. Vol 105, 1977, pp 449-472 (with R.Lashof)
3. Cyclic homology of group rings, Comm.Math. Helv, Vol 60, 1985, pp 354-365
4. Meyer Vietoris Type formula for determinants of Elliptic opertors, Journal of Funct.Anal., Vol 107,1992, pp 34-65.(with L.Friedlander, T.Kappeler).
5. Analytic and Reidemeister torsion for representations in finite type Hilbert modules, Geom.Funct.Anal. Vol 6,1996, 751-859 (with L.Friedlander, T.Kappeler, P.McDonald)

**4. Cristodor Ionescu (Institute of Mathematics of the Romanian Academy): Homological Methods in Commutative Algebra**

Abstract: The aim of the course is to present recent directions of the development of Commutative Algebra using methods and tools of Homological Algebra. There are some very actual directions such as: characterizing classes of noeherian rings with the help of (co)-homological theories(Hochschild, homology, cyclic homology etc.), extensions of classical results about projective dimension and finite resolutions over regular local rings to more general classes of rings and infinite resolutions, as well as(depending on the time), other domains.

Author's selected papers:

1)Hochschild homology of topological algebras and formal

smoothness-Communications in Algebra,22,1994,4801-4805.
2)Reduced morphisms and Nagata rings,Arch. Math.,60,1993,334-338.
3)q-torsion freeness and symmetric
powers,Rend.Circ.Mat.Palermo,46,1997,329-345.
4)A note on derivations in positive characteristic,Revue Roumaine
Math.Pures Appl.,XLV,2000,931-937.
5)Torsion in tensor powers and flatness,in Commutative
Algebra,Singularities and Computer Algebra,J.Herzog and V.
Vuletescu(eds.),Proc.NATO Workshop,Kluwer,2003,191-196.

**5. Paltin Ionescu (University of Bucharest): Abstract versus Embedded Classification of Complex Projective Manifolds**

Following a request by several students that already have a background in Algebraic Geometry, I propose the following course for the Master Program at SNSB.
"Abstract versus Embedded Classification of Complex Projective Manifolds"

(i) Elements of Mori Theory (deformations of rational curves, cone theorem, contraction theorem, case of surfaces).
(ii) Generalized adjoint systems, rationality properties.
(iii) Applications of general adjunction (hyperplane sections, classification of polarized pairs).
(iv) Reider's theorem.
(v) Classical adjunction-the two main theorems.
(vi) Classification of manifolds of small invariants (sectional genus, delta-genus, degree).
(vii) Manifolds of small degree,I (quantitative approach).
(viii) Manifolds of small degree, II (qualitative approach).

Author's selected papers:
1. Generalized adjunction and applications, Math. Proc. Cambridge Phil. Soc. 99, 1986, p.457-472.
2. Embedded projective varieties of small invariants I, Springer Lecture Notes Math., 1056, 1984, p.142-186.
3. On varieties whose degree is small with respect to codimension, Math. Annalen, 271, 1985, p.339-348.
4. On very ample vector bundles on curves, Int. Journal. Math., 8(1997), p.633-643 (cu M.Toma).
5. Models of rationally connected manifolds, J. Math. Soc. Japan, 55 (2003), p. 143-164 (cu C.Voica).
6. On manifolds of small degree, Preprint 2000, 10p.

**6. Razvan Litcanu (University of Iasi): Introduction in Arithmetic Geometry**

The aim of this course is the presentation of some techniques and important results in arithmetic geometry.

The main part of the course concerns the notion of height, an invariant that is associated to a rational point of an arithmetic variety. We shall explain in particular how this invariant can be interpreted as an intersection number, fact that suggests the definition of the height for a subvariety of higher dimension. This will suppose the presentation of some important objects in modern algebraic geometry, as algebraic schemes and abelian varieties, among others. This study will have as a goal (or rather as a "pretext") the explanation of the main ideas of the proof of Bogomolov's conjecture on small points on a curve of genus bigger than 1, defined over a number field. This result leads to an alternative possibility to define the height of such a curve, as an essential lower bound for the height of its rational points.

In the last part of the course we shall define the notions of field of definition and field of moduli of a curve, morphism, etc. and we shall present Belyi's theorem, which characterizes the curves defined over the algebraic closure of Q. We shall explain how this result could lead, eventually, to a third alternative approach to a height for such a curve. Some applications will also be presented.

Preliminary bibliography :
Abbes, A. : Hauteur et discrétude, Séminaire Bourbaki 825, 1996
Cornell, G. ; Silverman, J. (ed.) : Arithmetic Geometry, Springer, 1986
Hartshorne, R. : Algebraic Geometry, Springer, 1977
Lang, S. : Fundamentals of Diophantic Geometry, Springer, 1983
Litcanu, R. : Intersections arithmétiques, petits points et morphismes de Belyi, Università degli Studi di Padova, 2001 (versiune prescurtata trimisa spre publicare la Expositiones Mathematicae)
Schneps, L. (ed.) : The Grothendieck Theory of Dessins d'Enfants, Cambridge Univ. Press, 1994

Serre, J.-P. : Lectures on Mordell-Weil Theorem, Vieweg, 1989
Szpiro, L. (ed.) : Séminaire sur le pinceaux de courbes de genre au moins 2, Astérisque 86, 1981
Szpiro, L : Small Points and Torsion Points, Contemporary Math. 58 (1986), 251-260
Ullmo, E. : Points entiers, points de torsion et amplitude arithmétique, Amer. J. of Math. 117 (1986), 1039-1056

Author's selected papers:
1. Etude du degré des morphismes de Belyi, Monatshefte für Mathematik, 2004, DOI 10.1007/s00605-003-0142-2
2. Counting Lamé differential operators, Rend. Sem. Mat. Univ. Padova 107 (2002), 191-208
3. Lamé operators with finite monodromy - a combinatorial approach, sent to Journal of Diff. Equations (in the revision stage) ; preprint at the Institut de Recherche Mathématique de Rennes, 2003, " Lamé operators with finite monodromy "
4. Intersections, petits points et fonctions de Belyi - quelques remarques sur la construction des hauteurs, sent to Expositiones Mathematicae ; preprint Università degli Studi di Padova, 2001, " Intersections arithmétiques, petits points et morphismes de Belyi "
5. Some remarks on a conjecture of Dwork, sent to "Proceedings of the Second Italian Conference on Number Theory, Parma, Nov. 2003", will appear in Rivista di Matem. Univ. Parma

## 2005 – 2006 Introductory courses

**1. Radu Gologan (IMAR si "Politehnica" Univ. Bucharest), Calin Popescu (IMAR): Nineteenth Century Mathematics-Selected Topics. About numbers and pictures**
**2. Nicolae Popa (University of Bucharest): Introduction in Mathematical Analysis:The evolution of important notions from the beginnings to our times.**

### 1. Radu Gologan (IMAR si "Politehnica" Univ. Bucharest), Calin Popescu (IMAR): Nineteenth Century Mathematics-Selected Topics. About numbers and pictures

The lectures will be devoted mainly to very classical facts for solving combinatorial problems: groups, invariants, graphs, analytical methods including generating functions.
The first part will concentrate on the applications of the main theorems for finite groups in characterizing the groups of symetries of regular polyedra.
The second part will be a brief introduction to graph theory and applications.
The third part will contain results on combiatorial geometry.
Depending on students interest some more topics will be disscused.

Selected papers:
1. Gologan, R. N.: Ergodic theorems in sigma-lattice cones, Rend. Circ. Mat. Palermo, II, 14(1987), 439-446.
2. Gologan, R. N.: A perturbed ergodic theorem, Proc. Amer. Math. Soc., 5, 128(2000), 1377-1380.
3. Boca, F. P.; Gologan, R. N.; Zaharescu, A. The average length of a trajectory in a certain billiard in a flat two-torus. New York J. Math. 9 (2003), 303--330
4. Boca, Florin P.; Gologan, Radu N.; Zaharescu, Alexandru The statistics of the trajectory of a certain billiard in a flat two-torus. Comm. Math. Phys. 240 (2003), no. 1-2, 53--73.

5. Popescu, Calin Characteristic zero loop space homology of two-cones. Bull. London Math. Soc. 32 (2000), no. 5, 600--608.
6. Popescu, Calin Characteristic zero loop space homology for certain two-cones. Comment. Math. Univ. Carolin. 40 (1999), no. 3

### 2. Nicolae Popa (University of Bucharest): Introduction in Mathematical Analysis:The evolution of important notions from the beginnings to our times.

Content:
A history of the notions of limit, series, function. Their evolution in the past (17th, 18th, 19th centuries). The new branches of analysis:

theory of analytic functions, measure theory, harmonic analysis and partial differential equations and functional analysis at the end of 19th century and at the beginning of 20th century. The development of harmonic analysis and partial differential equations in 20th century. The ramifications of functional analysis in this century from Banach spaces to operator spaces. Applications of analysis in other branches of mathematics like analytic number theory or geometric theory of measure, etc.

Selected papers:
1. Basic sequences and subspaces in Lorentz sequence spaces without local-convexity - Trans. Amer. Math. Soc., 263, p. 431-456, 1981. MR82f #46012, p. 2499, ref. Bor Luh-Lin.
2. Dual spaces of dyadic Hardy spaces generated by a rearrangement invariant space X on [0,1], Ark. Mat., 36 (1998), 163-175.
3. Unicity of the representation of dyadic Hardy spaces generated by a rearrangement invariant space X on [0,1], Function space (Poznan 1998), pp.445-458, Lecture Notes in Pure and Applied Mathematics, 213, Dekker, New-York, 2000.
4. Non-commutative BMO space, Archiv der Math., 74(2000),111-114.
5. A matriceal analogue of Fejer's theory. (co-authors: Sorina Barza and Lars-Erik Persson), Math. Nachr., 260, pp.14-20 (2003).
6. Approximation of infinite matrices by matricial Haar polynomials, (co-authors: Sorina Barza and Victor Lie), to appear in Ark. Mat. 2005.
7. Matricial Lebesgue spaces and Hoelder inequality, (co-authors: Sorina Barza and Dimitris Kravvaritis), to appear in Journal of Function Spaces and Applications, 2005.

## 2005 – 2006 Preliminary cycle

**1. Alexandru Gica (University oh Bucharest): Rational points on Elliptic Curves.**
**2. Andrei Halanay (University of Bucharest): Operator Theory and Retarded Functional Differential Equations**
**3. Cristodor Ionescu (IMAR): Homolgical algebra and applications I+II**
**4. Nicolae Manolache (IMAR): Representation Theory**
**5. Nicolae Manolache (IMAR): Elliptic Curves**
**6. Nicolae Manolache (IMAR): Abelian Varieties**
**7. Nicolae Manolache (IMAR): Complements of Algebraic Geometry (or Algebraic Geometry II)**
**8. Eugen Mihailescu (IMAR): Introduction to Dynamical Systems.**
**9. Serban Stratila (University of Bucharest): K-theory for C*-algebras**

**1. Alexandru Gica (University oh Bucharest): Rational points on Elliptic Curves.**
Short description of the course:

An elliptic curve is the set of zeros of a cubic polynomial in two variables. We study polynomials with rational coordinates and the rational solutions of these polynomials.

Presenting the basic facts about elliptic curves, we will use the informal style of Silverman&Tate but also we will provide accurate proofs of these basic facts.

Topics:
1) The group structure of the elliptic curves.
2) The Nagell-Lutz theorem describing the points of finite order in the group associated with the elliptic curve.
3) The Mordell-Weil theorem on the finite generation of the group of the rational points. Even there is not a standard technique, we will show how to compute the rank of an elliptic curve in particular cases.
4) The Thue-Siegel theorem on the finiteness of the set of integer points of an elliptic curve. We will present also some results of effectivity,

i.e. the upper bound of the largest solution (following Baker&Coates, 1970).

Applications in Cryptography:
5) How to find large prime numbers with the aid of elliptic curves.
6) Elliptic curves cryptosystems (developed since 1985 by N. Koblitz and V. Miller).
7) Elliptic curve factorization (Lenstra's algorithm to factor large integers).

The list of my best papers:
1) The proof of a conjecture of additive number theory, Journal of Number Theory, 94(2002), 80-89.
2) On Oblath's problem, together with L. Panaitopol, Journal of Integer Sequences, 6(2003), Article 03.3.5 (12 pages)
3) On a problem of Brocard, together with L. Panaitopol, Bulletin of London Mathematical Society, 37(2005), no.4, 502-506.
4) Quadratic residues of certain types, will appear in Rocky Mountain Journal of Mathematics.
5) The diophantine equation (n)_k=P(m), Rev. Roumaine Math. Pures Appl. 50(2005), no.3, 277-282.

**2. Andrei Halanay (University of Bucharest): Operator Theory and Retarded Functional Differential Equations**

Banach spaces ;basic examples. Closed linear operators and bounded linear operators in Banach spaces. Compact operators. Spectral theory. Continuous semigroups of operators in Banach spaces. The infinitesimal generator and the Hille- Yosida Theorem.
Basic elements of Laplace transform.
Retarded functional differential equations :problems that lead to such equations and examples. Existence,uniqueness and continuous dependence. Stability theory ; Lyapunov functionals. Linear autonomous systems :the semigroup and its infinitesimal generator. Perturbed linear systems. Stability analysis for linear systems and perturbed linear systems in autonomous case.

5 selected papers :
1. M.Adimy, F.Crauste, A.Halanay, M.Neamtu, D.Opris,(2005) Stability of limit cycles in pluripotent stem cell dynamics model, Chaos,Solitons and Fractals, in press.
2. A.Halanay,C.A.Safta(2005),Stabilization of some nonlinear controlled electrohydraulic servosystems,Applied Mathematics Letters,18(2005),911-915.
3. A.Halanay (2004),Controlled factorization for some commuting pairs of contractions with thin spectrum,Revue Roum.de Math.Pures et Appl.49,no.4, p.323-354.
4. A.Halanay,C.A.Safta(2000),Existence and stability of normal motions in loaded hydraulic copying systems with periodic and composed inputs,Z.Angew. Math.Mech.,80,no.2,93-101.
5. A.Halanay (1996),Subspaces of H^infty and the study of contractions with spectral radius one,Revue Roumaine de Math.Pures et Appl.41,no.1-2,p.51-82.

**3. Cristodor Ionescu (IMAR): Homolgical algebra and applications I+II**

Description: The course will contain 2 parts divided into 2 semesters:
1)Basics of homological algebra: complexes, resolutuions, derived functors, Tor and Ext, characterization of projectives, injectives and flat modules with Tor and Ext, homological dimensions.
2) Special (co)-homolgy theories with applications: depending on the time and on the students, it can contain: Koszul complexes, local cohomology, Andre-Quillen homology, Hochschild homology etc. all of them with significant applications.

List of papers:
a)Hochschild homology of a topological algebra and formal smoothness, Communications in Alg., 22, 1994, 4801-4805
b)Reduced morphisms and Nagata rings, Arch. Math., 60, 1993, 334-338
c)Torsion in tensor powers and flatness,in Commutative Algebra,Singularities and Computer Algebra,J. Herzog, V. Vuletescu(eds.),Proc. NATO Adv. Res.Workshop,Sinaia,17-22 september 2002,NATO Science Series:II-Mathematics,Physics and Chemistry,115,2003,191-196.
d)q-torsion freeness of symmetric powers, Rend. Circ. Mat. Palermo, 46, 1997, 329-346 (with G. Restuccia).
e)A note on derivations in rings of positive characteristic, Revue Roumaine Math. Pures Appl.,XLV,2000,931-937(with M. Crupi).

**4. Nicolae Manolache (IMAR): Representation Theory**

I mean mainly linear representations of groups (general theory, finite groups, classical groups), but also some elements of quivers representations.
[I do not want to fix the content of the proposal, because it depends upon the students' background. In principle I intend to cover as much material as possible, in as many directions as possible]

Some papers:
1. (joint paper with Serban Barcanescu): Nombre de Betti d'une singularit\'e de Segre-Veronese, C.R. Acad. Sci. Paris, t. 288 (29 janvier 1979)
1'.(joint paper with Serban Barcanescu) : Betti Numbers of Segre-Veronese Singularities, Rev. Roum. Math. Pures et Appl., t. 26, No 4, 549-565, 1981
2. Rank 2 stable vector bundles on ${\Bbb P}^3$ with Chern classes $c_1 = -1$, $c_2 = 2$}, Rev. Roum. Math. Pures et Appl., t 26, No 9, 1203-1209, 1981
3. (joint paper with Constantin Banica: Rank 2 stable vector bundles on ${\Bbb P}^3({\bf C})$ with Chern classes $c_1= -1$, $c_2 = 4$, Math. Z. 190, 315-339, 1985
3'. (joint work with Constantin Banica: Remarks on rank 2 stable vector bundles on ${\Bbb P}^3$ with Chern classes $c_1=-1$, $c_2=4$, Preprint INCREST 104, 1981 \\
3''. (joint paper with Constantin Banica): Moduli space $M(-1,4)$: Minimal spectrum, preprint INCREST 19, 1983 \\
4. On the normal bundle to abelian surfaces embedded in ${\Bbb P}^4({\bf C})$, Manuscripta Math. 56, 111-119, 1986 \\
5. Cohen-Macaulay nilpotent structures, Rev. Roum. Math. Pures et Appl., t. 31, No 6, 563-575, 1986 (dedicated to professor Gh. Galbura)\\
6. Syzygies of abelian surfaces embedded in ${\Bbb P}^4({\Bbb C})$, J. reine und angew. Math., 384, 180-191, 1988 \\
6'. The equations of the abelian surfaces embedded in ${\Bbb P}^4({\bf C})$, J. reine und angew. Math., 394, 196-202, 1989
7. (joint paper with W. Decker and F.-O. Schreyer): Geometry of the Horrocks bundle on ${\Bbb P}^5$, (Proc. of NAVF Conf. in Alg. Geom., Bergen 1989) London Math. Soc. Lecture Notes 179, Complex Geometry 1992, Cambridge University Press
8. Multiple structures on smooth support, Math. Nachr. 167, 157-202, 1994
9. (joint paper with F.-O. Schreyer): Moduli of abelian surfaces with polarization of type (1,7) embedded in ${\Bbb P}^6$, Math. Nachr. 226 (2001), 177-203

**5. Nicolae Manolache (IMAR): Elliptic Curves**

According to what the students already know, this thema can be treated at an introductory level, or at a "more advanced" level. In any case I would begin with classical XIX century mathematics.
[I do not want to fix the content of the proposal, because it depends upon the

students' background. In principle I intend to cover as much material as possible, in as many directions as possible]

**6. Nicolae Manolache (IMAR): Abelian Varieties**

This thema can be properly treated for students who already had a course in Algebraic Geometry. I would begin also with classical XIX century mathematics. [I do not want to fix the content of the proposal, because it depends upon the students' background. In principle I intend to cover as much material as possible, in as many directions as possible]

**7. Nicolae Manolache (IMAR): Complements of Algebraic Geometry (or Algebraic Geometry II)**

I mean "swimming deeply in Grothendieck's Philosophy", as far and as deep as the students' level would permit (Hilbert scheme, Picard scheme, Grothendieck Theory of Chern classes, Riemann-Roch-Grothendieck Theorem, etc.).
[I do not want to fix the content of the proposal, because it depends upon the students' background. In principle I intend to cover as much material as possible, in as many directions as possible]

**8. Eugen Mihailescu (IMAR): Introduction to Dynamical Systems.**

The course is suited for mathematics students with a fairly good knowledge of real analysis and measure theory (at the level of first or second univ. year); knowledge of complex analysis helps, but is not mandatory.
We start with basic notions, like topological conjugacy (and semi-conjugacy) for discrete systems, non-wandering sets, transitivity, symbolic dynamics and coding. Also in this part several topological invariants will be introduced, important notions like: topological entropy, measure-theoretic entropy, topological pressure; the Variational Principle provides the connection between measure related concepts and topological ones. Then the second part of the course will study dynamical systems with hyperbolic behaviour: stable and unstable manifolds, invariant cone fields, Smale's horseshoes, the solenoid, structural stability of hyperbolic sets, local product structure. If time permits we will talk also about metric structures of hyperbolic sets, Holder continuity of the stable/unstable distributions, etc.
Finally in the third part of the course, complex dynamical systems will be introduced and studied. We begin with one dimensional systems, define the Fatou and Julia sets, give the crucial Sullivan's Classification Theorem for the classes of conjugation of Fatou components for a rational map, etc. If time permits, also the multidimensional complex systems will be defined, and some properties will be explained.
All necessary prerequisites will be done in class.

Some papers:

1) Periodic points for actions of tori in Stein manifolds, Mathematische Annalen 314, 1999, no 1, 39-52

2) The set K- for hyperbolic non-invertible maps, Ergodic Theory and Dynamical Systems, June 2002, 3,

873-888
3) Applications of thermodynamic formalism in complex dynamics on P2, Discrete and Continuous Dynamical Systems, vol. 7, 4, October 2001, 821-836
4) Inverse topological pressure with applications to holomorphic dynamics in several variables, joint with Mariusz Urbanski, Commun. Contemp. Math., vol.6, no.4, 2003, 653-682.
5) PH.D Thesis, Hyperbolicity and periodicity in higher dimensional complex dynamical systems, Univ. of Michigan Press 1999.
6) Estimates for the stable dimension for holomorphic maps, joint with M. Urbanski, Houston J. Math., 31(2), 2005, 367-391.

**9. Serban Stratila (University of Bucharest): K-theory for C*-algebras**

PREREQUISITES : a general course on Functional Analysis

MOTIVATION :
1) This is not a special course in operator algebras. Since over 20 years the operator algebras became a frame for several other domains in mathematics. Specifically, this course presents an invariant for "non-commutative locally compact topological spaces" (= C*-algebras) which, in the commutative case, coincides with the topological K-theory. The functor K(zero) is also the same as in the algebraic K-theory. The construction of the theory in the general case is simpler than in the classical topological case and the functor K(one) has a direct description in adequate terms from the very beginning.

2) The Course adresses to a group of four students at SNSB plus two of their colleagues at the University of Bucharest. All six were my students for two courses at the University of Bucharest, namely "Real functions and measure theory - one year course" and "Analysis on manifolds" (that is an introduction to differential topology} - one semester course, both courses in the frame of the "Advanced Studies Group". These students asked me a Course on Operator Algebras of a broader interest than within the theory itself. Two of these students (Liviu Paunescu and Mihaela Ifrim) want to ellaborate their Diploma Work at the University of Bucharest under my supervision with a subject connected to Operator Algebras. Also Cezar Condeescu (currently junior research worker at the Institute of Mathematics) expressed his interest in attending this course (he already attended last year my course on "Operator Algebras" for the Master Programm at the University and - let me say it - his presence was my only motivation for giving indeed a comprehensive course on the theory of operator algebras)

PLAN OF THE COURSE :
- Basics of C*-algebras : Spectral theory, Adjoinig a unit
- Construction of the K-theory for unital C*-algebras (corresponds to the compact topological case)
- Construction of the K-theory in the general case
- The short exact sequence
- Homotopy invariance. Direct sum. Stability : K*(A) = K*(Mat(A))
- Bott periodicity
- The exact hexagone
- Mayer-Vietoris
- Examples of computation for several topological spaces
- K-theory of von Neumann factors is trivial
- K-theory of UHF-algebras; consequence : the Theorem of Glimm
- K-theory of AF-algebras (George Elliott - "avant la lettre")
- K-theory for Cuntz and Cuntz-Krieger algebras (Joachim Cuntz)
- Properly infinite simple C*-algebras

- K-theory of the global and of the reduced C*-algebras of free groups
  (Mihai Pimsner and Dan Voiculescu). Consequence : the non-isomorfism of
  C*(F(n))(reduced). We use a device due to Simon Wassermann [NB. At the
  level of the free group factors L(F(n)) the problem is still open and led
  Dan Voiculescu to his theory of free random variables]
- K-theory of the Rieffel A(theta) algebras (Mihai Pimsner and Dan
  Voiculescu) [i.e. K-theory for crossed products by actions of Z]
- The Thom-isomorphism theorem of Alain Connes [i.e. K-theory for crossed
  products by actions of R]
- Short description of the Kasparov bifunctor KK(A,B)
- Short description of the result due (independently) to Eberhard Kirchberg
  and Chris Phillips concerning the classification of simple nuclear properly
  infinite C*-algebras
- [if time permits] Some other topological invariants for C*-algebras (real
  rank. topological stable rank, etc)

REFERENCES

1) S.Stratila : Lecture Notes - manuscript [the completion of these notes is
considered in collaboration with Florin Boca]

2) N.E. Wegge-Olsen : K-theory and C*-algebras, Oxford Science Publications,
1997 (?)

3) M.Rordam, F.Larsen, N.J.Laustsen : An introduction to K-theory for
C*-algebras, London Mathematical Society, Student Texts 49, 2000

4) K.K. Jensen , K. Thomsen - Elements of KK-Theory, Bikhauser, 1991

5) S.Wassermann : Exact C*-algebras and related topics, Lecture Notes, South
Coreea, 1995 (?)

6) S.Stratila, L.Zsido : Operator Algebras ; a Banach algebra approach, Theta,
2006 (to appear), cca 500p [the preprint is available]

From my LIST OF PUBLICATIONS :

- An algebraic reduction theory for C*-algebras (+ L.Zsido), Journal of
  Functional Analysis, 1973
- Representations of AF-algebras and of the unitary group U(infinity)
  (+ D.Voiculescu), LNM, Springer Verlag, 1975, 186 pp
- The commutation theorem for tensor products over subalgebras (+ L.Zsido),
  Journal of Functonal Analysis, vol.165(2000), 293-346
- Homotopy classes of parial isometries in von Neumann algebras (+M. Mbekhta),
  Acta Sci Math (Szeged), 68(2002), 271-277
- Lectures on von Neumann Algebras (+ L.Zsido), Abacus Press & Editura
  Academiei, 1979
- Modular Theory in Operator Algebras, Abacus Press & Editura Academiei, 1981

## 2005 – 2006 Master courses

### MASTER IN GEOMETRY AND TOPOLOGY

**1. Marian Aprodu (IMAR): Geometry of Toric Varieties**

**2. Liviu Ornea (University of Bucharest): Introduction to symplectic geometry**

### MASTER IN MATHEMATICAL PHYSICS AND SPECTRAL THEORY OF QUANTUM HAMILTONIANS

**1. Radu Purice (IMAR): Quantum Hamiltonians: spectral analysis and asymptotics for the evolution**

**2. Vincentiu Radulescu (University of Craiova): Nonlinear Analysis and Applications in Mathematical Physics**

**1. Marian Aprodu (IMAR): Geometry of Toric Varieties**

DESCRIPTION:

A classical mathematical problem is to determine
the number of integer points contained in a region
in the space. A first good approximation of the
number Pi was obtained in this way. If the given

region is a polytope, this question leads us in a suprising way to the algebraic geometry, specifically to the geometry of toric varieties. We aim to present an introduction to this beautiful part of algebraic geometry, with many applications in algebra, geometry, number theory, optimisation etc. The toric geometry is rapidly developing in the last period, as toric varieties provide test examples for many conjectures.

BACKGROUND:
The course would be somewhat self-contained, being thought of as an introductory course in algebraic geometry and applications. An one-semester course in algebraic geometry would be nevertheless useful. Being familiar with varieties, projective and affine, divisors, line bundles, cohomology, Hilbert polynomial would be of much help. However, during the lecture course, these notions would be dully recalled and reinterpreted in the toric context.

LIST OF RECENT PAPERS:
1. Remarks on syzygies of d-gonal curves, Math. Res. Letters 12 (2005) 387-400.
2. Green-Lazarsfeld gonality conjecture for a generic curve of odd genus, Int. Math. Res. Notices 63 (2004) 3409-3416.
3. A lefschetz type result for Koszul cohomology, Manuscripta Math. 114 (2004) 423-430 (w/ J. Nagel).
4. Green-Lazarsfeld's conjecture for generic curves of large gonality, C. R. Acad. Sci. Paris 336 (2003) 335-339 (w/ C. Voisin.)
5. On the vanishing of higher syzygies of curves, Math. Zeit. 241 (2002) 1-15.

**2. Liviu Ornea (University of Bucharest): Introduction to symplectic geometry**

Aim: Make students familiar with the main topics of symplectic geometry: local description, symplectic actions and the reduction technique, toric manifolds, special features of related structures (contact, Kaehler, hyperkaehler).

Contents: Motivation, examples, Lie group actions (coadjoint orbits), Darboux-Weinstein and Moser theorems, Noether theorem, symplectic and hamiltonian actions, classical reduction and momentum maps, convexity of toric momentum maps, related structures (Kaehler and hyperkaehler manifolds, contact structures).

Basic bibliography: Robert Bryant's "Introduction to Lie groups and symplectic geometry"; Dusa McDuff & Dietmar Salamon's "Symplectic topology".

Address: The subject may well suit students at all levels. More or less topics can be treated depending on the background.

List of 5 published best papers:
1. Locally conformal Kähler structures in quaternionic geometry, Transactions of the American Mathematical Society, 349 (1997), 641-655, (in collaboration with P. Piccinni). MR 97e:53091.

2. Locally conformal Kähler metrics on Hopf surfaces, Annales de l'Institut Fourier, 48 (1998), 1107-1127 (in collaboration with P. Gauduchon) MR 2000g:53088
3. Structure theorem for compact Vaisman manifolds, Mathematical Research Letters, 10 (2003), 799-805 (in collaboration with M. Verbitsky).
4. An immersion theorem for Vaisman manifolds (in collaboration with M. Verbitsky), Mathematische Annalen 332 (2005), 121-143.
5. Locally conformal K\"ahler reduction (in collaboration with R. Gini and M. Parton). Crelle Journal fuer die Reine und Angewandte Mathematik 581 (2005), 1-21.

**1. Radu Purice (IMAR): Quantum Hamiltonians: spectral analysis and asymptotics for the evolution**

Motivation:
The mathematical description of quantum systems, having its origin in the work of John Von Neumann, has been a very active field of research during the second part of the 20-th century, developping towards a coherent, well defined domain at the intersection of functional analysis and mathematical physics (see for example the basic monographies:
Varadarajan, V. S.: "Geometry of quantum theory", 1985 (2-nd ed); M. Reed, B. Simon: "Methods of modern mathematical physics" (4 vol.); Cycon H. L., Froese R. G., Kirsch W., Simon B.: "Schrodinger operators with application to quantum mechanics and global eometry", 1987; Glimm J., Jaffe, A.: "Quantum physics. A functional integral point of view", 1987 (2-nd ed); Bratteli O., Robinson D.W.: "Operator algebras and quantum statistical mechanics" (2 vol., 2-nd ed)).
A central object associated to any quantum system is its Hamiltonian operator, a self-adjoint (usually unbounded) operator in a Hilbert space. This operator is the generator of the 1-parameter group describing the time evolution of the system and also defines the equilibrium steady states of a statistical ensamble. The spectral analysis of these Hamiltonian operators (from abstract general qualitative features up to exact soluble models and perturbative expansions) provides the main information necessary for the mathematical study of the given quantum systems.

Abstract:
The course is intended to present some of the most important mathematical developments involved during the last 15 years in the spectral analysis of quantum Hamiltonians and the large time asymptotics of the evolution they generate: Weyl quantization and noncommutative functional calculus; spectral theory for pseudodifferential operators; crossed-product C*-algebras; the conjugate operator method.
The course (14 lectures of 4 hours each) is divided into 4 chapters with the following structure:

I. Introduction:
1. Recall of classical mechanics;
2. Motivation and basic framework for description of quantum systems;
3. Recall of Hilbert space geometry, topology and the algebra of bounded linear operators;
4. Recall of Duality in convex linear topological spaces, Distributions and Fourier transform;

II. Self-adjoint operators and Functional calculus:
1. Closed operators and sesquilinear forms in Hilbert spcaes; Self-adjointness;
2. Rezolvents; Self-adjointness criteria; Dunford calculus; Self-adjoint extensions;

3. Borelian functional calculus for normal operators
4. Structure of the spectrum of self-adjoint operators; Spectra of compact operators;
5. Functional calculus with C_0 groups; Evolution group;
6. Operator algebras, affiliation;

III. Spectral analysis for self-adjoint operators:
1. Weyl quantization; Pseudodifferential calculus; Crossed-products;
2. Relative compactness; Computing the essential spectrum; generalized HWZ theorems;
3. Spectral multiplicity;
4. Scattering theory for pairs of Hamiltonians; Limiting absorption principle;
5. The conjugate operator method;

IV. Schroedinger Hamiltonians:
1. The short -range 2-body system;
2. Periodic potentials;
3. Systems in a magnetic field;
4. Perturbation of isolated eigenvalues;
5. Resonances and spectral deformations;
6. Adiabatic theorem, effective Hamiltonians.

Main Refferences:
1. M. Reed, B. Simon: "Methods of modern mathematical physics" (4 vol.);
2. Cycon H. L., Froese R. G., Kirsch W., Simon B.: "Schr&#65533;dinger operators with application to quantum mechanics and global geometry", 1987;
3. J. Derezinski, Ch. Gerard: "Scattering theory of classical and quantum N-particle systems", 1997;
4. W.O. Amrein, A. Boutet de Monvel, V. Georgescu: "C_0 groups, commutator methods and spectral theory of N-body Hamiltonians", 1996;
5. G.B. Folland: "Harmonic analysis in phase space", 1989;
6. Gerard Ch., Nier F.: The Mourre theory for analytically fibered operators. J. Funct. Anal. 152 (1998), no. 1, 202--219.
7. Gerard Ch., Nier F.: Scattering theory for the perturbations of periodic Schr&#65533;dinger operators. J. Math. Kyoto Univ. 38 (1998), no. 4, 595--634.
8. Georgescu V., Iftimovici A.: C*-algebras of quantum Hamiltonians. Operator algebras and mathematical physics (Constanta, 2001), 123--167, Theta, Bucharest, 2003.
9. Amrein W. O., Mantoiu M., Purice R.: Propagation properties for Schr&#65533;dinger operators affiliated with certain C*-algebras. Ann. Henri Poincare 3 (2002), no. 6, 1215--1232.
10. Boutet de Monvel A., Purice R.: The conjugate operator method: application to Dirac operators and to stratified media. Evolution equations, Feshbach resonances, singular Hodge theory, 243--286, Math. Top., 16, Wiley-VCH, Berlin, 1999.
11. Nenciu G.: On asymptotic perturbation theory for Quantum Mechanics: Almost invariant subspaces and gauge invariant magnetic perturbation theory, J. Math. Phys. 43 (2002), no. 3, 1273--1298.

5 Lucrari proprii semnificative in domeniu:
1. Mantoiu, Marius; Purice, Radu: Strict deformation quantization for a particle in a magnetic field. J. Math. Phys. 46 (2005), no. 5, 052105 (15 p).
2. Mantoiu, Marius; Purice, Radu: The magnetic Weyl calculus. J. Math. Phys. 45 (2004), no. 4, 1394--1417.
3. Amrein, W. O.; Mantoiu, M.; Purice, R.: Propagation properties for Schrodinger operators

affiliated with certain C*-algebras. Ann. Henri Poincare 3 (2002), no. 6, 1215--1232.
4. Boutet de Monvel, Anne; Purice, Radu: The conjugate operator method: application to Dirac operators and to stratified media. Evolution equations, Feshbach resonances, singular Hodge theory, 243--286, Math. Top., 16, Wiley-VCH, Berlin, 1999.
5. Mantoiu, Marius; Purice, Radu: Some propagation properties of the Iwatsuka model. Comm. Math. Phys. 188 (1997), no. 3, 691--708.

**2. Vincentiu Radulescu (University of Craiova): Nonlinear Analysis and Applications in Mathematical Physics**

Abstract. This course is strictly related to my research field and the topics are inspired by the course given in 1992 and 1996 by Professor Haim Brezis at the Paris 6 University. The main directions of the course include:
- monotonicity methods (sub- and super-solutions, comparison principles, the Brezis-Oswald and Krasnoselkii uniqueness criterions etc.);
- bifurcation problems (the implicit function theorem, Amann's theorem, stability of the minimal solution, applications to various classes of nonlinearities);
- critical point theory (the mountain pass lemma, the saddle point theorem, variational methods);
- singular nonlinear elliptic problems (blow-up boundary equations, the role of the Benilan-Brezis-Crandall condition, problems with a convection term).
The applications include the qualitative study of several classes of boundary value problems arising in Mathematical Physics. We strongly intend to encourage the students to competitive mathematical research and to propose several problems to study.

Main 5 research papers:
1. C. Lefter and V. Radulescu, On the Ginzburg-Landau energy with weight, Ann. Inst. H. Poincaré, Analyse Non Linéaire 13 (1996), 171-184.
2. M. Degiovanni, M. Marzocchi and V. radulescu, Multiple solutions of hemivariational inequalities with area-type term, Calculus of Variations and PDE 10 (2000), 355-387.
3. F. Cîrstea and V. Radulescu, Existence and uniqueness of blow-up solutions for a class of logistic equations, Commun. Contemp. Math. 4 (2002), 559-586.
4. D. Smets, V. Radulescu and M. Willem, Hardy-Sobolev inequalities with remainder terms, Topol. Meth. Nonlin. Anal. 20 (2002), 145-149.
5. F. Cîrstea, M. Ghergu and V. Radulescu, Combined effects of asymptotically linear and singular nonlinearities in bifurcation problems of Lane-Emden-Fowler type, J. Math. Pures Appliquées (Journal de Liouville) 84 (2005), 493-508.
Full details on my research activity may be found on my web page at http://inf.ucv.ro/~radulescu

## 2006 – 2007 Introductory courses

**1) Nicolae Popa (Bucharest) "Introduction in Mathematical Analysis: The evolution of important notions from the beginnings to our times"**
**2) Radu Gologan and Calin Popescu (Bucharest): "19th Century Mathematics- Selected Topics. About numbers and pictures"**

**1) Nicolae Popa (Bucharest) "Introduction in Mathematical Analysis: The evolution of important notions from the beginnings to our times"**
Content:
A history of the notions of limit, series, function. Their evolution in

the past (17th, 18th, 19th centuries). The new branches of analysis: theory of analytic functions, measure theory, harmonic analysis and partial differential equations and functional analysis at the end of 19th century and at the beginning of 20th century. The development of harmonic analysis and partial differential equations in 20th century. The ramifications of functional analysis in this century from Banach spaces to operator spaces. Applications of analysis in other branches of mathematics like analytic number theory or geometric theory of measure, etc.

publications;
[1] (co-authors: Barza, Sorina; Kravvaritis, Dimitri)
Matriceal Lebesgue spaces and Hoelder inequality, J. Funct. Spaces Appl. 3 (2005), no. 3, 239--249.
[2] (co-authors: Barza, Sorina; Lie, Victor) Approximation of infinite matrices by matricial Haar polynomials, Ark. Mat. 43 (2005), no. 2, 251--269.
[3] (with Barza, Sorina and Persson, Lars-Erik)
A matriceal analogue of Fejer's theory. Math. Nachr. 260 (2003), 14--20.
[4] Unicity of the representation of dyadic Hardy spaces generated by a rearrangement invariant space $X$ on $[0,1]$.
Function spaces (Pozna\'n, 1998), 445--458, Lecture Notes in Pure and Appl. Math., 213, Dekker, New York, 2000.
[5] Non-commutative BMO space. Arch. Math. (Basel) 74 (2000), 111--114.

**2) Radu Gologan and Calin Popescu (Bucharest): "19th Century Mathematics- Selected Topics. About numbers and pictures"**

The aim of the course is a self-contained introduction to general and algebraic (with emphasis on combinatorial) topology. Basic notions such as topology, convergence, continuity, separation axiomss, connectedness and compactness are first considered with a special emphasis on the metric case. We then move to the deep problems of embedding, metrization and compactification. We could also takle some basic topological dimension theory. Finally, we introduce the fundamental group of a space and consider related combinatorial facts.

Prerequisites: a good wealth of common sense.

papers
Calin Popescu:
1. Calin Popescu, Characteristic Zero Loop Space Homology of Two-Cones, Bull. London Math. Soc., 32 (2000), pp. 600-608.
2. Calin Popescu, On UHL and HUL, Bull. Belgian Math. Soc., 6 (1999), 219-235.

Radu Gologan:
[1] F.Boca, R.N. Gologan, A. Zaharescu: On the index of Farey sequences, Quart. J. Math, Oxford University Press, 53(2002), 377-391)
[2] F.Boca, R.N. Gologan, A. Zaharescu: The statistics of the trajectories of a certain billiard in a flat two-dimensional torus, Communications in Mathematical Physics, 240, 53-73,2003
[3] coauthor for "Romanian Mathematical Contests", vol. 2001-2005, SSMR

Radu Gologan: "I must say that Calin Popescu was completely involved in the course this year, presenting in an excitig way facts from elementary topology and some flavor of non-trivial results. The audience was all the time in an unexpected number and as a fact the course continues unofficially this semester too. A text will be also possible in a short time."

## 2006 – 2007 Preliminary cycle

**1) Serban Barcanescu (Bucharest) "Algebraic Combinatorics (an introduction)"**
**2) Alexandru Gica (Bucharest) "Quadratic forms according to Gauss"**
**3) Alexandru Gica (Bucharest) "Transcendental Number Theory."**
**4) Atle Hahn (Bonn) "Lie Groups and Quantum Physics"**
**5) Daniel Matei (Bucharest) "Geometric Group Theory"**
**6) Daniel Matei (Bucharest) "Topology of Algebraic Plane Curves"**
**7) Daniel Matei (Bucharest) "Knots and Primes"**
**8) Vicentiu Radulescu (Craiova) "Functional Analysis and Applications"**
**9) Jean-Marc Schlenker (Toulouse) and Sergiu Moroianu (Bucharest): "Hyperbolic manifolds in dimensions 2 and 3"**

**1) Serban Barcanescu (Bucharest) "Algebraic Combinatorics (an introduction)"**

1. Simplicial complexes and convex polytopes (Definitions,basic properties, examples).
2. The Kruskal -Katona theorem for the f-vectors of simplicial complexes.
3. The Kruskal-Katona theorem (applications).
4. Hilbert functions over homogeneous rings.
5. Macaulay's theorem on Hilbert functions.
6. Macaulay's theorem on Hilbert functions (further results).
7. O-sequences and Cohen-Macaulay rings.
8. Stanley-Reisner rings (fundamental results).
9. The Upper Bound Conjecture and related results.
10. Erhardt polynomials.
11. Erhart's law of reciprocity.
12. Rational Convex Polyhedral Cones. Semigroup algebras .
13. Semigroup rings and invariant theory ( an introduction )
14. Algebras with straightening law. Hodge Algebras and determinantal rings.

The Seminars will be based on examples and disscusion of the main results in the Course.

**2) Alexandru Gica (Bucharest) "Quadratic forms according to Gauss"**

The purpose of this course is to speak about a subject "which belongs to one of the most beautiful theories in mathematics" (quotation from E. Landau).

1) Primitive, positive definite, reduced forms.
The proper equivalence relation between binary quadratic forms.
The number of classes of primitive positive definite forms.
2) Genus Theory. Convenient numbers.
The presentation of these two chapters will follow the celebrated book of Gauss "Disquisitiones Arithmeticae" (Gauss treatment of quadratic forms occupies the fifth and longest section of the book) and the book of Landau "Vorlesung uber Zahlentheorie", Erster Band, "Aus der elementaren und additiven Zahlentheorie"(the fourth section of the book).
3) Numbers which are sum of 2,3 or 4 squares. How many representation they are?
4) The formula for the class number. As special cases:
a)If p is a prime, p=8k+7, then the
class number for the discriminant -p equals the difference between the quadratic residues and nonquadratic residues which lies between 1 and (p-1)/2.
b)If p is a prime, p=8k+3, then the class number for discriminant -p equals one third of the above difference.
5)They are only nine imaginary quadratic forms with a principal ring of the integers. This famous result was conjectured by Gauss and proved by Baker and Stark in 1966-1967.
6. The growth of the class number. The formula of Siegel.

The list of my "best" 5 papers:
1. "The Proof of a Conjecture of Additive Number Theory", Journal of Number Theory 94, (2002), 80-89.
2. "On a problem of Brocard", together with L.Panaitopol, Bull. London Math. Soc. 37(2005), no. 4, 502-506.
3. "Quadratic residues of certain types", will appear in the Rocky Mountain Journal of Mathematics(accepted for publication in 2004).
4. "On Oblath's problem", together with L.Panaitopol, Journal of Integer Sequences, volume 6, 2003, Issue 3, Article 03.3.5 (12 pages).
5. "A statement equivalent to a theorem of Gauss", Rev. Roumaine Math. Pures Appl. 49(2004), no. 2, 135-139.

**3) Alexandru Gica (Bucharest) "Transcendental Number Theory."**

The purpose of this course is to speak about a powerfull tool (linear forms in logarithms) discovered by Alan Baker in the 60's and its various applications in Number Theory. Alan Baker was awarded with the Fields medal in 1970 for his work. The title of this course borrows the title from Alan Baker's celebrated book "Transcendental Number Theory" (Cambridge University Press, 1975).
Besides this book we will use also the book of Tijdeman and Shorey "Exponential diophantine equations" (Cambridge University Press, 1986) and Mordell's book "Diophantine equations" (Academic Press, 1969).

1) Linear forms in logarithms.
2) The Thue equation. Effectivity results.
3) The Siegel theorem (there are only a finite number of integer points on a nonsingular elliptic curve). Effectivity results.
4) Class numbers of imaginary quadratic fields.
a)there are only nine quadratic imaginary fields with a principal ring of integers.
b) the class number 2 problem.
5) Tijdeman theorem: the Catalan equation has a finite number of solutions (recently, Preda Mihailescu proved that the Catalan equation has only one solution $3^2-2^3=1$).

The list of my "best" 5 papers:
1. "The Proof of a Conjecture of Additive Number Theory", Journal of Number Theory 94, (2002), 80-89.
2. "On a problem of Brocard", together with L.Panaitopol, Bull. London Math. Soc. 37(2005), no. 4, 502-506.
3. "Quadratic residues of certain types", will appear in the Rocky Mountain Journal of Mathematics(accepted for publication in 2004).
4. "On Oblath's problem", together with L.Panaitopol, Journal of Integer Sequences, volume 6, 2003, Issue 3, Article 03.3.5 (12 pages).
5. "A statement equivalent to a theorem of Gauss", Rev. Roumaine Math. Pures Appl. 49(2004), no. 2, 135-139.

**4) Atle Hahn (Bonn) "Lie Groups and Quantum Physics"**
Course Outline
The course is an introduction to the structure and representation theory of Lie groups. Several interesting and important applications to Quantum Mechanics and Elementary Particle Physics are also discussed (style/level of the physics part will be adapted to the knowledge of the participants).

- Basic concepts + examples (matrix groups, Lie algebras, abstract Lie groups, theory of coverings, ...)
- Structure theory of compact connected Lie groups (maximal tori, Weyl groups, root systems, Dynkin diagrams, ...)
- Representation theory of compact Lie groups (characters, weights, Weyl's character formula, Racah formula, representations of the classical groups)
- Elements of the representation theory of the Poincare group.

· Applications in Mathematical Physics (Clebsch-Gordon coefficients, Quarks and the group SU (3), Dirac equation, ...)

Selected Publications by Atle Hahn


[1] Chern-Simons theory on R3 in axial gauge: a rigorous approach, J. Funct. Anal. 211(2): 483507 (2004)

[2] The Wilson loop observables of Chern-Simons theory on R3 in axial gauge, Commun. Math. Phys. 248(3): 467499 (2004)

[3] Chern-Simons models on S 2 × S 1 , torus gauge fixing, and link invariants I, J. Geom. Phys. 53(3): 275-314 (2005)

[4] White Noise Analysis, Quantum Field Theory, and Topology. In T. Hida, editor, Stochastic Analysis, Classical and Quantum. Perspectives of White Noise Theory, pages 1633. World Scientific, 2005.

[5] An analytic Approach to Turaev's Shadow invariant, arXiv-Preprint math-ph/0507040, 2005, submitted to J. Knot Th. Ram.


**5) Daniel Matei (Bucharest) "Geometric Group Theory"**

Description: This course is meant to be an introduction to the study of groups as geometric objects. The emphasis will be on infinite groups, investigated using techniques reminiscent of topology and Riemannian geometry.
Following ideas of M.Gromov, we will discuss the way in which large-scale geometric features of the Cayley graph associated to a finitely generated group reflect its algebraic structure.
The central goal of this approach is to classify finitely generated groups with their word metric up to quasi-isometry. The course will survey properties of a group that are invariant under quasi-isometry such as growth rate, isoperimetric function, hyperbolicity, and it will culminate with Gromov's polynomial growth theorem.
Many examples will be discussed including infinite groups such as: braid groups, Artin groups, mapping class groups, automorphism groups of free groups and Thompson's groups.

papers:


[1] Matei, Daniel; Suciu, Alexander I. Counting homomorphisms onto finite solvable groups. J. Algebra 286 (2005), no. 1, 161--186.

[2] Matei, Daniel; Suciu, Alexander I. Hall invariants, homology of subgroups, and characteristic varieties. Int. Math. Res. Not. 2002, no. 9, 465--503.

[3] Matei, Daniel; Suciu, Alexander I. Cohomology rings and nilpotent quotients of real and complex arrangements. Arrangements---Tokyo 1998, 185--215, Adv. Stud. Pure Math., 27, Kinokuniya, Tokyo, 2000.

[4] Matei, Daniel; Suciu, Alexander I. Homotopy types of complements of $2$-arrangements in $R\sp 4$. Topology 39 (2000), no. 1, 61--88.


**6) Daniel Matei (Bucharest) "Topology of Algebraic Plane Curves"**

Description: The study of algebraic curves in the complex plane (affine or projective) has a long history. In this course we will focus on the topological aspects, and on their interaction with the algebraic geometric and combinatoric ones. We start with the local situation by discussing tangents, singular points, local branches, Puiseux series, Newton polyogons,

Bezout's theorem, and intersection multiplicity.
We then move towards global issues with
Plucker's formula, various genus formulae,
and the Riemann-Hurwitz formula. We close
with a discussion of how the position of singularities
affect the topology of the complement to the curve,
and the topology
of the pair curve, ambient space.

papers:
[1] Matei, Daniel; Suciu, Alexander I. Counting homomorphisms onto finite solvable groups.
J. Algebra 286 (2005), no. 1, 161--186.
[2] Matei, Daniel; Suciu, Alexander I. Hall invariants,
homology of subgroups, and characteristic varieties.
Int. Math. Res. Not. 2002, no. 9, 465--503.
[3] Matei, Daniel; Suciu, Alexander I. Cohomology rings and
nilpotent quotients of real and complex arrangements.
Arrangements---Tokyo 1998, 185--215, Adv. Stud. Pure Math., 27,
Kinokuniya, Tokyo, 2000.
[4] Matei, Daniel; Suciu, Alexander I. Homotopy types of complements
of $2$-arrangements in $R\sp 4$. Topology 39 (2000), no. 1, 61--88.

**7) Daniel Matei (Bucharest) "Knots and Primes"**

Description: The course will discuss analogies between
number theory and knot theory which have their origins
in the work of Gauss.
The following issues will be covered in pairs:
quadratic residues and linking numbers, higher residue
symbols and Milnor's higher linking numbers, genus
theory for primes and knots,
Iwasawa and Alexander modules.

papers:
[1] Matei, Daniel; Suciu, Alexander I. Counting homomorphisms onto finite solvable groups.
J. Algebra 286 (2005), no. 1, 161--186.
[2] Matei, Daniel; Suciu, Alexander I. Hall invariants,
homology of subgroups, and characteristic varieties.
Int. Math. Res. Not. 2002, no. 9, 465--503.
[3] Matei, Daniel; Suciu, Alexander I. Cohomology rings and
nilpotent quotients of real and complex arrangements.
Arrangements---Tokyo 1998, 185--215, Adv. Stud. Pure Math., 27,
Kinokuniya, Tokyo, 2000.
[4] Matei, Daniel; Suciu, Alexander I. Homotopy types of complements
of $2$-arrangements in $R\sp 4$. Topology 39 (2000), no. 1, 61--88.

**8) Vicentiu Radulescu (Craiova) "Functional Analysis and Applications"**

II. Abstract and further details:
This course is addressed to students of 3rd or 4th year. It is aimed to
introduce some basic tools in functional analysis and to give several
applications in linear or nonlinear problems arising in Mathematical Physics.
We intend to study the following topics.
1. Hilbert spaces: the projection theorem, the dual of a Hilbert space and the
Riesz theorem, weak convergence in Hilbert spaces, Hilbert bases, Stampacchia
and Lax-Milgram theorems, compact operators on Hilbert spaces, the
Riesz-Fredholm theory, spectral theory for compact and selfadjoint operators.
2. Lebesgue and Sobolev spaces: definitions and main properties, density
theorems, the Brezis-Lieb lemma, Poincare's inequality, Sobolev inequalities,
weak solutions of boundary value problems, the Dirichlet principle, regularity
of solutions (Schauder and Holder), the maximum principle, eigenfunctions and

spectral decomposition, weak solutions of evolution problems (the heat problem and the wave problem).
3. Applications to nonlinear problems: ground state solutions, nonlinear eigenvalue problems, failure of symmetry, Hardy's inequality, degenerate and singular differential operators.
4. Rearrangements: polarisation, the Schwarz symmetrization, the isoperimetric inequality.

References:
H. Brezis, Analyse fonctionnelle, Masson, Paris, 1993. Romanian translation at: http://www.inf.ucv.ro/~radulescu/articles/BrezisAF.pdf
F. Hirsch, G. Lacombe, Elements of functional Analysis, Springer, New York, 1999.
E. Lieb, M. Loss, Analysis, Amer. Math. Soc., Graduate Studies in Mathematics, vol. 14, 1997.
M. Willem, Analyse fonctionnelle elementaire, Cassini, Paris, 2003.

III.
Main papers.
1. V. Radulescu, D. Smets, M. Willem, Hardy-Sobolev inequalities with remainder terms, Topol. Meth. Nonlin. Anal. 20 (2002), 145-149.
2. V. Radulescu and M. Willem, Elliptic systems involving finite Radon measures, Differential and Integral Equations 16 (2003), 221-229.
3. M. Ghergu, V. Radulescu, Sublinear singular elliptic problems with two parameters, J. Differential Equations 195 (2003), 520-536.
4. F. Cirstea, M. Ghergu, V. Radulescu, Combined effects of asymptotically linear and singular nonlinearities in bifurcation problems of Lane-Emden-Fowler type, J. Math. Pures Appliquées (Journal de Liouville) 84 (2005), 493-508.
5. V. Radulescu, Singular phenomena in nonlinear elliptic problems. From blow-up boundary solutions to equations with singular nonlinearities, in Handbook of Differential Equations: Stationary Partial Differential Equations, 3 (Michel Chipot, Pavol Quittner, Editors), 2006, sub tipar.
The complete list of my papers may be found on my web page at: http://www.inf.ucv.ro/~radulescu/publications.html

**9) Jean-Marc Schlenker (Toulouse) and Sergiu Moroianu (Bucharest): "Hyperbolic manifolds in dimensions 2 and 3"**

Description: We aim to provide an introduction to hyperbolic geometry and Teichmueller theory, with an emphasis on the smooth case. If time permits, we may cover manifolds with conical singularities.

Prerequisites: basic familiarity with differential / Riemannian geometry.

1) Dimension 2: Teichmueller space
- review of Riemannian geometry
- the hyperbolic plane
- Pants decomposition of hyperbolic surfaces
- Hyperbolization of compact Riemann surfaces (analytical argument)
- Tangent space to Teichmueller space (description in terms of parallel sections in the flat bundle of infinitesimal Killing fields)
... and also
- Surfaces with conical singularities
- Hyperbolization of cone-surfaces.

2) Dimension 3
- Examples of hyperbolic manifolds (glueing polyhedra)
- Examples of hyperbolic manifolds (congruence groups)
- Calabi-Weil rigidity
- Convex co-compact hyperbolic manifolds
... and also
- Hyperbolic cone-manifolds

- Hodgson-Kerckhoff rigidity

papers: J.-M. Schlenker:
[1] Small deformations of polygons and polyhedra. To appear, Trans. A. M. S.
[2] Hyperbolic manifolds with convex boundary. Inventiones math. 163(2006):1, 109-169.
[3] Hyperideal circle patterns. Math. Res. Lett., 12 (2005):1, 85-112.
[4] Rhombic embeddings of planar quad-graphs. (with R. Kenyon) Trans. AMS., 357 (2005), 3443-3458.
[5] A rigidity criterion for non-convex polyhedra. Discrete and Computational Geometry, 33 (2005):2, 207-221.

S. Moroianu:
[1] An index formula on manifolds with fibered cusp ends, (with Robert Lauter), J. Geom. Analysis 15 (2005), 261-283.
[2] Cusp geometry and the cobordism invariance of the index, Adv. Math. 194 (2005), 504-519.
[3] On Carvalho's K-theoretic formulation of the cobordism invariance of the index, to appear in Proc. AMS.
[4] Gravitational and axial anomalies for generalized Euclidean Taub-NUT metrics (with Ion Cotaescu and Mihai Visinescu), J. Phys. A - Math. Gen. 38 (2005), 7005-7019.
[5] On the structure of quantum permutation groups (with Teodor Banica), to appear in Proc. AMS.

## 2006 – 2007 Master courses

**1) Marian Aprodu (Bucharest) " Homological methods in algebraic geometry"**
**2) Cristian Cobeli: Analytic Number Theory. Exponential sums and distribution of sequences**
**3) Gheorghe Dinca (Bucharest) "Topological degree and fixed point theorems"**
**4) Louis Funar (Grenoble) "Teichmueller spaces and mapping class groups"**
**5) Nicolae Manolache (Bucharest): "Abelian Varieties"**
**6) Eugen Mihailescu (Bucharest) "Ergodic theory with applications to dynamics"**
**7) Radu Clement Popescu (Bucharest) "Knots, topology and quantum invariants"**
**8) Dragos Stefan (Bucharest) "Algebras of small Hochschild dimension"**
**9) Tamas Szamuely (Budapest) "p-adic Numbers and Equations Over Finite Fields"**

### 1) Marian Aprodu (Bucharest) " Homological methods in algebraic geometry"

We propose an excursion on the realm of homological algebra with special emphasize on applications in algebraic geometry. Starting from the famous Hilbert Syzygy Theorem, people became aware of the importance of minimal free resolutions in the study of algebraic objects coming from algebraic geometry. In recent years, there has been a growing interest in the theory of minimal resolutions, justified by the strong interaction with intrinsic properties of special of varieties (curves, ruled varieties, abelian varieties, toric varieties etc). The lecture should provide an introduction in the techniques of the theory of syzygies. It is self-contained, presuming the students are familiar with basics of projective algebraic geometry. We review the Hilbert function of a projective variety, and introduce the graded Betti numbers. Then we relate them to the Koszul cohomology, as a basic tool for computations.
According to the level if students, one or two lectures are needed for a quick introduction to spectral sequences. One lecture should be also allowed for an informal presentation of modern computer algebra programms such as Macaulay2. The exercise sessions will generally compute explicitly graded

Betti numbers in several cases (points, curves etc).
At the end of the lecture series, the students will be presented a few open problems in this theory.

Basic references for the lecture course:
D. Eisenbud: Geometry of syzygies, Springer Verlag 2006.
M. Green: Koszul cohomology and geometry of projective varieties, J. Diff. Geom. 1984.

Some scientific publications in the last five years:
1. M. Aprodu: Remarks on syzygies of d-gonal curves. Mathematical Research Letters. 12, 387 - 400 (2005).
2. M. Aprodu: Green-Lazarsfeld gonality conjecture for a generic curve of odd genus. Int. Math. Res. Notices 63, 3409-3416 (2004).
3. M. Aprodu and J. Nagel: A Lefschetz type result for Koszul cohomology. Manuscr. Math. 114, No.4, 423-430 (2004).
4. M. Aprodu and C. Voisin: Green-Lazarsfeld's conjecture for generic curves of large gonality. C. R., Math., Acad. Sci. Paris 336, No.4, 335-339 (2003).
5. M. Aprodu: On the vanishing of higher syzygies of curves. Math. Z. 241, No.1, 1-15 (2002), II Math. Z. 243, No.4, 775-778 (2003).

**2) Cristian Cobeli: Analytic Number Theory. Exponential sums and distribution of sequences**

In this course, we will give an account of some classic exponential sums methods. Our purpose is to get bounds for exponential sums that arise in number-theoretic problems.
The results will be applied to obtain the distribution of some remarkable sequences.

The material is organized in four chapters.

1. Kloosterman sums. This chapter explores the results of Kloosterman, Esterman and Weil and uses them to reveal a few aspects of the distribution of inverses modulo a prime $p$.
2. Vinogradov Method. We prove the Mordel Theorem and outline the methods of Vinogradov and Karatsuba to estimate short exponential sums.
3. The Methods of Weyl and Van der Corput.
We present the Weyl method, the Van der Corput sets and the method of exponent pairs.
The bounds obtained will be applied to get estimates in the circle problem, the divisor problem, the order of the zeta function on the critical line and in the Piatetski-Shapiro prime number theorem.
1. Pair correlation and spacing distribution.} Examples of sequences in the whole range from order to randomness will be presented. Starting with simple examples, we will discuss the distribution of primes (Gallagher Theorem), the distribution of primitive roots modulo $p$, the distribution of Farey sequences in short intervals and the distribution of the zeros of the zeta function.

The seminar. Students will solve exercises and specific problems to get reflexes in handling the concepts acquired.
During the seminar hours the emphasis will be on manipulative techniques applied on basic examples.

Selected papers.
[1] Cobeli C., Ford K., Zaharescu A., The jumping champions of the Farey series, Acta Arith. 110 (2003), no. 3, 259--274.
[2] Boca F. P., Cobeli C., Zaharescu A., A conjecture of R. R. Hall on Farey points, J. Reine Angew. Math. 535 (2001), 207--236.

[3] Cobeli C., Zaharescu A., Generalization of a problem of Lehmer, Manuscripta Math. 104 (2001), no. 3, 301--307.
[4] Cobeli C., Gonek S. M., Zaharescu, A., On the distribution of small powers of a primitive root, J. Number Theory 88 (2001), no. 1, 49--58.
[5] Boca F. P., Cobeli C., Zaharescu A., Distribution of lattice points visible from the origin, Comm. Math. Phys. 213 (2000), no. 2, 433--470.

**3) Gheorghe Dinca (Bucharest) "Topological degree and fixed point theorems"**

Nonlinear analysis today is a remarkable mixture of topology (of different types), analysis (both "hard" and "soft") and applied mathematics.
The idea of the lecture is to illuminate the above mentioned interplay through one of the most powerful tool of nonlinear analysis: the topological degree for different classes of mappings. Some more or less classical fixed point theorems are derived as consequences of the fundamental properties of the degree.
The applications are chosen in such a manner to offer a good introduction to various branches of nonlinear analysis. Of course, the references cannot be exhaustive but constitute a good "covering" for our goal.

CONTENTS
I.Brouwer degree theory: the degree of continuous mappings in finite dimensional normed spaces
1.Preliminaries: Morse-Sard lemma and Dugundji extension theorem.
2.Definition of the Brouwer degree in the case open and bounded, , .
Extension to the case of any finite dimensional normed space.
3.Main properties of the Brouwer degree: normalization, existence theorem, additivity-excision lemma, invariance under homotopy.
4.The uniqueness of the degree as defined by the main properties.
5.Direct consequences of the main properties of the Brouwer degree:
5.1.continuity of the degree function with respect to and ;
5.2. is constant with respect to on components in ;
5.3. implies is a neighborhood of .
6.Odd mappings. Borsuk theorem and some consequences: the Borsuk-Ulam theorem; the Lusternik-Schnirelmann category.
7.Brouwer fixed point theorem:
7.1.Brouwer fixed point theorem as a consequence of the main properties of the degree;
7.2.equivalent forms: the K-K-M (Knaster-Kuratowski-Mazurkiewicz) theorem, the Ky-Fan min-max inequality, the Hartman-Stampacchia theorem for variational inequalities (Brezis proof), the non-retraction of the unit ball on its boundary, the Rothe fixed point theorem.
8.The Brouwer fixed point theorem as essential tool in proving significant results in nonlinear analysis:
8.1.Browder's result concerning the surjectivity of monotone, demicontinuous and coercive operators on reflexive Banach spaces. Consequence: the surjectivity of duality mappings on reflexive and smooth Banach spaces;
8.2.Ky-Fan's fixed point theorem for upper semicontinuous multivalued mappings with compact and convex values in normed spaces. Consequence: Nash's equilibrium theorem and the von Neumann's saddle point theorem.
8.3.Poincare's operator and the method of guiding functions (Krasnoselskii) in proving the existence of periodic solutions for first order differential systems.
8.4.Sufficient conditions for the injectiveness of the deformation in the theory of elasticity (Ciarlet's approach)
8.5.The Poincare index: opening to the Ghinzburg-Landau theory (the Bethuel-Brezis-Mironescu approach)
8.6.Existence results for homogeneous Navier-Stokes equations (Temam's approach)

8.7.Existence results for coercive and semicoercive hemivariational inequalities.
II. Leray-Schauder degree theory: the degree for compact perturbations of the identity in infinite dimensional Banach spaces
1.Preliminaries: Some properties of compact nonlinear operators in normed spaces. Schauder approximation of totally bounded sets in normed spaces (Schauder's projection theorem).
2.Definition of the Leray-Schauder degree, , in the case  is an infinite dimensional real Banach space,  open bounded,  compact such that  and  is the identity on .
3.Main properties of the Leray-Schauder degree: normalization, existence theorem, additivity-excision lemma, invariance under homotopy of compact transforms.
4.The uniqueness of the Leray-Schauder degree as defined by the main properties.
5.Borsuk theorem.
6.The Leray-Schauder degree as essential tool in proving significant results in nonlinear analysis:
6.1.Schauder's fixed point theorem and equivalent forms. Consequences:
a)Lemonosov's theorem (existence of nontrivial closed invariant subspaces for some classes of compact operators);
b)existence results of boundary value problems for uniformly elliptic operators: Schauder's estimates and regularity.
6.2. Extensions of Schauder's fixed point theorem: Tychonoff's theorem, Rothe's theorem, Krasnoselskii's theorem, Schaefer's theorem, Sadovski's theorem.
6.3.Topological properties of the fixed point set of compact operators: compactness and connectedness. The Krasnoselskii-Perov theorem. Consequence: the Kneser-Hukuhara theorem (the connectedness of the solution set of Cauchy-Peano problem)
6.4.Bifurcations: the main Krasnoselskii and Rabinowitz theorems
6.5.A Fredholm theory for nonlinear compact operators.
III.Short presentation and references concerning other (modern) concepts of topological degree: Brezis-Nirenberg, Mawhin, Browder, Berkovits-Mustonen
IV.Fixed points for nonexpansive operators.
1.Alspach's example: a fixed point free nonexpansive map.
2.Existence results due to Browder, Göhde, Kirk, Datson
3.Ergodic theorems of Baillon. Other iteration processes for nonexpansive operators (Mann-Toeplitz, Ishikawa, Reich, Gwinner)
4.On the structure of the fixed point set of compact nonexpansive operators (connectedness).

REFERENCES
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H. Brezis, L. Nirenberg, Degree theory and BMO;
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**4) Louis Funar (Grenoble) "Teichmueller spaces and mapping class groups"**

The aim of this course is to cover some classical topics in the geometry and topology of surfaces and their moduli. We would like to bring forth an approach that uses only a very little amount of advanced mathematics (no use of deep analysis a la Ahlfors and Bers, nor deep algebraic geometry) which lead us deep enough and yields information in a physicist-oriented manner.
The topics I would like to discuss on are, in order:

1. Fuchsian groups: the hyperbolic plane and its isometries,
discrete subgroups of isometries, arithmetic subgroups, Siegel's
theorem, the Poincare construction, Hurwitz theorem concerning the
order of the automorphism group of a Riemann surface.
2. Spaces of discrete subgroups: non-rigidity phenomena, Teichmueller space,
Thurston-Bonahon-Penner-Fock alias shearing coordinates on the Teichmueller space.
3. Mapping class groups: homotopy versus isotopy for curves and
homeomorphisms of surfaces, generating mapping class
group by Dehn twists, the Dehn-Nielsen-Kneser theorem, basic relations
(braid-type, lantern, 2-chain), the symplectic group,
the Torelli group and its generators, the Johnson homomorphism,
complexes of curves and arcs, Harer-Hatcher theorem about
the contractibility of the arc complex.
4. The interplay between mapping class groups and Teichmueller spaces:
proper discontinuity, stabilizers, Ptolemy groupoids,
explicit computations in terms of shearing coordinates, Belyi surfaces,
the symplectic structure.

Pre-requisites: rudiments of algebraic topology (homology,
fundamental group), surfaces, linear algebra, basic complex
analysis.
If needed, one might start with additional introductory topics
like basic differential topology, Riemann surfaces etc and drop
some of the subjects above.

Papers: http://www-fourier.ujf-grenoble.fr/~funar/publications.html

**5) Nicolae Manolache (Bucharest): "Abelian Varieties"**

This thema can be properly treated for students who already had a course
in Algebraic Geometry. I would begin also with classical XIX century
mathematics. [I do not want to fix the content of the proposal,
because it depends upon the students' background. In principle I intend
to cover as much material as possible, in as many directions as possible]

Some papers:
1. (with Serban Barcanescu): Nombre de Betti d'une
singularite de Segre-Veronese, C.R. Acad. Sci. Paris, t. 288 (29 janvier 1979)
1'. (with Serban Barcanescu) : Betti Numbers of
Segre-Veronese Singularities, Rev. Roum. Math. Pures et Appl., t. 26,
No 4, 549-565, 1981
2. Rank 2 stable vector bundles on P^3 with Chern classes c_1
=-1, c_2 = 2, Rev. Roum. Math. Pures et Appl., t 26, No 9, 1203-1209, 1981
3. (with Constantin Banica: Rank 2 stable vector bundles on P^3(C)
with Chern classes c_1= -1, c_2 = 4, Math. Zeitschr. 190, 315-339, 1985
4. On the normal bundle to abelian surfaces embedded in
P^4(C), Manuscripta Math. 56, 111-119, 1986
5. Cohen-Macaulay nilpotent structures, Rev. Roum. Math. Pures et Appl.,
t. 31, No 6, 563-575, 1986 (dedicated to professor Gh. Galbura)
6. Syzygies of abelian surfaces embedded in ${\Bbb P}^4({\Bbb C})$, J.
Reine und Angew. Math., 384, 180-191, 1988 \\
6'. The equations of the abelian surfaces embedded in ${\Bbb P}^4({\bf
C})$, J. reine und angew. Math., 394, 196-202, 1989
7. (with W. Decker and F.-O. Schreyer): Geometry of the
Horrocks bundle on ${\Bbb P}^5$, (Proc. of NAVF Conf. in Alg. Geom.,
Bergen 1989) London Math. Soc. Lecture Notes 179, Complex Geometry 1992,
Cambridge University Press
8. Multiple structures on smooth support, Math. Nachr. 167, 157-202,
1994
9. (with F.-O. Schreyer): Moduli of abelian surfaces with polarization
of type (1,7) embedded in P^6, Math. Nachr. 226 (2001), 177-203

**6) Eugen Mihailescu (Bucharest) "Ergodic theory with applications to dynamics"**

Description: This course is proposed for the Masters level, although it can be taken very well by students from the third or fourth University year. Some students from the current course Introduction to Dynamical Systems, taught this semester (Spring 2006) at SNSB, have expressed interest in a dynamics course at the Masters level for the next year 2006-2007. However in order to understand the proposed course, it will NOT be necessary for students to have had taken the current course. The proposed course Ergodic theory with applications to dynamics will be self-contained, and it will use notions taught in the basic courses at the University: real and complex analysis, some functional analysis, measure theory, some geometry on manifolds (notions like: smooth manifold, smooth map, critical point, submanifold, etc.) and topology (general); anything else needed will be taught in class. The course will combine methods and ideas from several fields.
We will study the important notions of ergodic theory (invariant measures, entropy, pressure, etc.), give many examples from dynamical systems (both real and complex), and apply the notions to existence of equilibrium states, Hausdorff dimension, transfer operators, classes of conjugacy; the course may also introduce students to possible research subjects.

Audience: The course may be taken both by Masters level students and also by students at the level of years 3-4. It addresses especially to students interested in real and complex analysis, measure theory, functional analysis, topology, mathematical physics. Grades will be given on the basis of regular homeworks, and some presentations.

General plan of the course: We will study the following chapters:

1) Examples of dynamical systems: rotations of the circle, horseshoes, symbolic dynamical systems, Markov chains, solenoids, etc.
2) Conjugacy, coding, stability of dynamical systems, topological dynamics; hyperbolic sets.
3) Invariant measures as linear functionals, ergodic measures.
Ergodic Theorems.
4) Entropy of a partition; entropy of a measure. Bernoulli shifts.
5) Topological entropy, relations with measure theoretic entropy.
6) Topological pressure as a continuous non-linear functional.
7) Equilibrium states. The Variational Principle.
8) Perron-Frobenius (transfer) operator, construction of conformal measures.
9) Complex dynamics; Julia sets, hyperbolicity.
10) Applications of pressure and entropy to complex dynamics in one variable.
11) Fractal sets in higher complex dimensions, holomorphic maps on complex projective spaces, currents, Lyapunov exponents.
12) Applications of pressure and entropy to complex dynamics in higher dimensions; study of the fundamental differences between the higher dimensional and the one dimensional cases.

Publications:
[1] Unstable manifolds and H"older structures associated to non-invertible maps, E. Mihailescu, Discrete and Cont. Dyn. Systems, vol. 14, no 3, 419-447, 2006
[2] Inverse topological pressure, E. Mihailescu and M. Urbanski, Comm. Contemp. Math., vol.6, no.4, 653-681, 2004
[3] The set K^{-} for hyperbolic non-invertible maps, E. Mihailescu, Ergodic Theory and Dynamical Systems, 2002, 22, 873-887.
[4] Periodic points for actions of tori in Stein manifolds, E. Mihailescu, Mathematische Annalen 314, 1999, no 1, 39-52.
[5] Estimates for the stable dimension for holomorphic maps, E. Mihailescu and M. Urbanski, Houston J. Math., vol. 31, no.2, 2005, 367-389.

[6] Applications of thermodynamic formalism in complex dynamics on \mathbb{P}^2, E. Mihailescu, Discrete and Cont. Dynamical Systems, vol.7, no 4, October 2001, 821-836.

**7) Radu Clement Popescu (Bucharest) "Knots, topology and quantum invariants"**

I will describe mainly knots and links in S3 .
For the beginning I will include some topics about the topology of the complement of a link: Wirtinger presentation of the fundamental group, asphericity theorem for knot complements, Seifert surfaces and the infinite cyclic covering of the complement, the Alexander polynomial related to this covering.
I will start then with link invariants which satisfy skein relations: Alexander polynomial via Conway's potential function, Kauffman's version of the Jones polynomial, some applications of it and HOMPLY polynomial.
Then I will turn to braids, braid group representations on Hecke algebras, Markov traces and the Jones polynomial. Here I will include Alexander theorem and Vogel's algorithm for turning links into braids and Markov theorem.
Next topic will be Vassiliev invariants and Birman-Lin's theorem which connect the above polynomials and Vassiliev invariants.

Publication:
"Topics in low dimensional topology" - Ph. D. Thesis, Columbia University, 2001

**8) Dragos Stefan (Bucharest) "Algebras of small Hochschild dimension"**
The aim of the course is to present some rather new results on the structure of separable and quasi-free algebras. Separable algebras have been intensivelly investigated in connection to the construction of the Brauer group of a commutative ring. The latter class of algebras apeeared in the work of Cuntz and Quillen, in their attempt of extending the definition of smooth algebras to the noncommutative case.
Both separable and quasi-free algebras have very nice homological properties. As a matter of fact, an algebra is separable if its Hochschild dimension is 0, while quasi-free algebras have Hochschild dimension less than or equal to 1. Therefore, homological algebra (especially Hochschild cohomology of algebras) will be one of the main tools for the investigation of these classes of algebras. Some construction, inspired from Geometry (like noncommutative differential forms), will be very useful too.

The plan of the course
1.Prerequisites (brief recall of basic constructions in Homological Algebra).
2.Hochschild cohomology. Definition, properties.
3.Separable algebras. Examples, equivalent characterizations.
4.Separable algebras over algebraically closed fields.
5.Quasi-free algeras. Examples, basic properties.
6.Noncommutative differential forms (Connes' construction). The cotangent exact sequence (noncommuative version).
7.Hochschild cohomology via noncommutative differential forms.
8.New characterizations of quasi-free algebras (in terms of 1-forms).
9.Hereditary algebras and quiver algebras. The formal neighborhoud theorem.
10.The classification of finite dimensional algebras with Hochschild dimension 1 (over an algebraically closed base field of characteristic 0) in terms of quivers.

References
1. J. Cuntz and D. Quillen , Algebra extensions and nonsigularity, J. Amer. Math. Soc. 8 (1995), 251-289.
2. D. Stefan, Algebre necomutative formal netede, Ed. Universitatii Bucuresti, 2001.

5 articles

1. The set of types of n-dimensional semisimple and cosemisimple Hopf algebras is finite, J. Algebra 193 (1997), 571-590.
2. A monoidal approach to splitting morphisms of bialgebras (with A. Ardizzoni si C. Menini), math.QA/0212326 (an improved version will appear in Trans. AMS).
3. Hochschild cohomology and "smoothness" in monoidal categories (cu A. Ardizzoni si C. Menini), to appear in J. Pure and Appl. Algebra.
4. Hopf-Cyclic homology and relative homology of Hopf-Galois extensions (cu P. Jara), math.KT/0307099 (to appear in Proceedings LMS).
5. PBW deformations of quantum symmetric algebras and a Milnor-Moore type theorems, (with A. Ardizzoni and C. Menini), math.QA/0604181.

**9) Tamas Szamuely (Budapest) "p-adic Numbers and Equations Over Finite Fields"**

In the first part of the course we introduce several constructions for the field of p-adic numbers and establish its basic algebraic and analytic properties. Extensions of the p-adic field are also described and the field C_p of `p-adic complex numbers' is constructed.

In the second part we apply p-adic methods to study the number of solutions of equations over finite fields. We prove the Ax-Katz congruence formula via a recent elementary method of D. Wan. The highlight of the course is Dwork's p-adic proof of the rationality of the zeta function of a variety over a finite field (ex Weil Conjecture I). Along the way we also introduce some techniques of p-adic analysis necessary for the proof (Newton polygon, p-adic Weierstrass preparation theorem etc.) If time permits, some more advanced results will be surveyed without proof.

Publications:
[1] (with P. Gille), Central Simple Algebras and Galois Cohomology, Cambridge Studies in Advanced Mathematics, vol. 101, Cambridge University Press, July 2006.
[2] (with D. Harari), Arithmetic duality theorems for 1-motives, J. reine angew. Math. 578 (2005), 93--128.
[3] Groupes de Galois de corps de type fini (d'apres Pop), Séminaire Bourbaki, exposé 923, juin 2003. Astérisque 294 (2004), 403--431.
[4] (with M. Spiess), On the Albanese map for smooth quasi-projective varieties, Mathematische Annalen 325 (2003), 1--17.
[5] Sur la théorie des corps de classes pour les variétés sur les corps p-adiques, J. reine angew. Math. (Crelle) 525 (2000), 183--212.