

Department of Pure Mathematics

Graduate Courses

Fall 2004

PMath 632/432	Mathematical Logic	R. Moosa
PMath 642/442	Field and Galois Theory	Y-R. Liu
PMath 653/453 /AMath 432	Functional Analysis	N. Spronk
PMath 664/464	Algebraic Curves	S. New
PMath 701	Graduate Algebra	D.Ž. Djoković
PMath 733	Topics in Group Theory: Representation Theory	W. Kuo
PMath 801	Graduate Analysis	B.E. Forrest

Winter 2005

PMath 640/440	Analytic Number Theory	TBA
PMath 644/444	Non-Commutative Algebra	TBA
PMath 651/451 /AMath 431	Measure and Integration	TBA
PMath 665/465	Differential Geometry	TBA
PMath 701	Graduate Algebra	D.Ž. Djoković
PMath 755	Topics in Geometry: Topics in Geometry	D.K. McKinnon
PMath 801	Graduate Analysis	B.E. Forrest
PMath 810	Banach Algebras and Operator Theory	TBA
PMath 833	Topics in Harmonic Analysis: Harmonic Analysis	Kathryn Hare

Students should discuss their course selection with their supervisor.
You will require a "Permission Number" in order to enroll through QUEST.

PMath 632**Mathematical Logic****R. Moosa**(held with) **PMath 432**

First-order predicate logic: syntax, semantics, definability, and the completeness, compactness and Löwenheim-Skolem theorems. Examples from and applications to mathematics; especially algebraically closed and real closed fields. Computability and incompleteness: recursive functions, the Church-Turing thesis, Gödel's incompleteness theorems, Church's theorem on the undecidability of validity, Tarski's theorem on the undefinability of truth.

Required Mathematical Logic by Joseph R. Shoenfield**Textbook:** AK Peters, Ltd, ISBN: 1-56881-135-7**References**

1. "Mathematical Logic" by Joseph R. Shoenfield. Association for Symbolic Logic, 2001.
2. "Mathematical Logic Notes" by Charles Steinhorn.
3. "Notes on Metamathematics" by Warren Goldfarb.

PMath 642**Field and Galois Theory****Y-R. Liu**(held with) **PMath 442**

Normal series, elementary properties of solvable groups and simple groups, algebraic and transcendental extensions of fields, adjoining roots, splitting fields, geometric constructions, separability, normal extensions, Galois groups, fundamental theorem of Galois theory, solvability of radicals, Galois groups of equations, cyclotomic and Kummer extensions.

Required No text required**Textbook:****Reference**

1. "Galois Theory", 2nd ed., Joseph Rotman, Springer-Verlag, 1990.
2. "Galois Theory", Joseph-Pierre Escofier, Graduate Texts in Mathematics, Springer-Verlag, 2001.
3. "Notes on Galois Theory", Peter Hoffman (recommended)

PMath 653

(held with)

PMath 453/AMath 432**Functional Analysis****N. Spronk**

Banach and Hilbert spaces, bounded linear maps, Hahn-Banach theorem, Open Mapping theorem, dual spaces, weak topologies, Tychonoff's theorem, Banach-Alaoglu theorem, reflexive spaces, compact operators.

Required A Course in Functional Analysis, 2nd ed.

Textbook: by J.B. Conway, Springer-Verlag, ISBN: 0387972455

References

1. "Linear Analysis, An Introductory Course", B. Bollobas, Cambridge Press, 1990.
2. "Applications of Functional Analysis and Operator Theory", V. Hutson and J.S. Pym, Academic Press, 1980.
3. "A Course in Functional Analysis", J.B. Conway. Springer-Verlag, 1985.
4. "Fundamentals of the theory of Operator Algebras", R.V Kadison and J.Ringrose, Academic Press.

PMath 664(held with) **PMath 464****Algebraic Curves****S. New**

An introduction to the geometry of algebraic curves with applications to elliptic curves and computational algebraic geometry. Plane curves, affine varieties, the group law on the cubic, and applications.

Required No text required

Textbook:

PMath 701

Graduate Algebra

D.Ž. Djoković

Isomorphism theorems, classical structures theorems for finite groups, nilpotent and solvable groups, free groups, presentation modules over PID's, Hilbert Basis Theorem, Groebner bases, Artin-Wedderburn Theorem, fields extensions, decompositions, calculation of Galois groups.

Course Outline: In this course we will be trying to decide what a given algebraic structure “looks like”. The emphasis will be on the use of fundamental theorems to solve problems involving particular algebraic structures. Not every classical theorem in the course will be proved from scratch, but the implications will be discussed.

Required Textbook: No textbook required

Reference: Rotman, J. *Advanced Modern Algebra*,
Prentice Hall, ISBN 0-13-087868-5

Day & Time: To be announced

Where: To be announced

An organizational meeting will be held on
Tuesday, September 14, 2004, 11:30 a.m.
in MC 5045

continued ...

PMath 733

**Topics in Group Theory:
Representation Theory**

W. Kuo

Outline:

This is a first course in representation theory aimed at graduate students. A basic knowledge of algebra, linear algebra will be necessary. One of the main themes will be how representation theory and Lie groups provide examples of interesting phenomena in algebras, geometry, and topology. We plan to cover the following topics, as much as time will allow:

representations of finite groups, classical groups, Lie algebras, the Peter-Weyl theorem, maximal tori, root systems, the classification of compact Lie groups, the Weyl character formula.

References:

- [1] T. Bröcker & T.t. Dieck, "Representations of Compact Lie groups", GTM 98, Springer-Verlag, 1985
- [2] W. Fulton & J. Harris, "Representation Theory: A First Course", GTM 128, Springer-Verlag, 1991
- [3] B.C. Hall, "Lie groups, Lie algebras, and representations: an elementary introduction", Springer-Verlag, GTM 222, New York, 2003
- [4] J.E. Humphreys, "Introduction to Lie Algebras and Representation Theory", Springer-Verlag, 1972.
- [5] W. Rossmann, "Lie Groups: An Introduction Through Linear Groups", Oxford University Press, 2003.
- [6] J.-P. Serre, "Linear representation of finite groups", Springer-Verlag, New York, 1977.

**Required
Textbook:**

No textbook is required

**Day, Time &
Room:**

To Be Announced

**An organizational meeting will be held on
Tuesday, September 14, 2004, 10:30 a.m.
in MC 5045**

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PMath 801

Graduate Analysis

B.E. Forrest

Zorn's Lemma and the Axiom of Choice, cardinality, introduction to topological spaces, bases, nets, continuous functions and weak topologies, compactness, connectedness, Banach spaces, Contraction Mapping Principle finite-dimensional spaces $C(X)$ and $C_0(X)$, Stone-Weierstrass Theorem, Arzela-Ascoli Theorem, Urysohn's Lemma, ideals in $C_0(X)$.

Outline: 1. Basic Set Theory

- Zorn's Lemma and the Axiom of Choice
- Cardinal numbers and cardinal arithmetic

2. Introduction to Topological Spaces

- Basic notions of topology
- Bases and subbases
- Nets
- Continuous functions and weak topologies
- Compact and locally compact Hausdorff spaces
- Compactness in metric spaces
- Connectedness
- Baire Category Theorem

3. Normed linear spaces and Banach spaces

- Sequence Spaces and \mathbb{R}^n
- Bounded linear maps
- Banach Contractive Mapping Theorem and its applications
- Finite dimensional spaces

4. $C(X)$ and $C_0(X)$

- Completeness and uniform convergence
- Weierstrass approximation theorem
- Stone-Weierstrass theorem for $C(X)$
- One-point compactifications
- Stone-Weierstrass Theorem for $C_0(X)$
- Urysohn's Lemma
- Ideals in $C(X)$ and $C_0(X)$
- Arzela-Ascoli Theorem and its applications

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PMath 801

Graduate Analysis

B.E. Forrest

References: Rudin, W., *Real and Complex Analysis, Third Edition*, McGraw-Hill Book Co., New York, 1987, xiv + 416pp.
ISBN: 0-07-054234-1 00A05

Textbook: No textbook

Day & Time: To Be Announced

Where: To Be Announced

To find out when an organizational meeting will be held, please contact B.E. Forrest at:

beforrest@math.uwaterloo.ca