

Department of Pure Mathematics

Graduate Courses

Fall 2008

| Course # | Course Title | Instructor | Meet Days/Time | Place |
|----------------------------|--|---------------|-------------------|----------|
| PMath 633/433 | Model Theory and Set Theory | R. Moosa | MWF 11:30 - 12:20 | MC 4041 |
| PMath 642/442 | Fields and Galois Theory | R. Willard | MWF 2:30 - 3:20 | MC 4045 |
| PMath 653/453 AMath 432 | Functional Analysis | L. Marcoux | MWF 9:00 - 10:20 | CPH 3386 |
| PMath 701 | Graduate Algebra | J. Lawrence | TBA TBA | TBA |
| PMath 801 | Graduate Analysis <i>Number Theory & Random Matrix Theory</i> | B.E. Forrest | TBA TBA | TBA |
| PMath 822 | Topics in Operator Theory <i>Nonself-adjoint Operator Algebras</i> | K.R. Davidson | TBA TBA | TBA |

* Students should discuss their course selection with their Supervisor, the Graduate Officer, or the course Professor.

* Students will require a "Permission Number" in order to enroll in 700 and 800 level Graduate courses, using QUEST. Please obtain your Permission Number from Shonn Martin in MC 5064.

* If you wish to enroll in a course after week six, you will not be able to use Quest. Please see Shonn.

**Please enroll in your courses by
Friday, October 17th, 2008.**

PMath 633
(held with)
PMath 433

Set Theory and Model Theory

R. Moosa
Office: MC 5049

This is a new course offering in pure mathematics. It will be approximately one-third set theory and two-thirds model theory. The set theory will be naïve and the model theory will be semantic (i.e., no proof theory). There will be a small overlap with the new PMATH 432/632 (First Order Logic and Computability), but this latter course is neither a pre-requisite nor an anti-requisite. No textbook is required for the course and the lectures will be self-contained. However, I do intend to loosely follow some lecture notes of Professor Altinel (Université Lyon 1) which can be found (in French) at

<http://math.univ-lyon1.fr/~altinel/Master/M1Logique/notlar.pdf>.

I will be teaching a follow-up graduate topics course in model theory (PMath 711) in Winter 2009.

Topics in Set Theory Ordered sets and ordinals, axiom of choice and equivalents, cardinals, informal discussion of the Zermelo-Fraenkel axioms and independence.

Topics in Model Theory Semantics of first order logic, the compactness theorem (via ultra-products) and its consequences, types and saturation, quantifier elimination, algebraic examples, ω -categoricity, Morley rank and ω -stability (time permitting).

PMath 642
(held with)
PMath 442

Fields and Galois Theory

R. Willard
Office: MC 5067

Topics: 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. ”.

References:

1. *An Introduction to Group Theory, 4th ed.*, J.J. Rotman, Springer-Verlag, 1995.
2. *Galois Theory*, I. Stewart, Chapman & Hall, 1989 2nd edition.
3. *Algebra*, M. Artin, Prentice-Hall 1990.

PMath 653
(held with)
PMath 453

Functional Analysis

L.W. Marcoux
Office: MC 5053

- Course** Topological vector spaces
- Outline:** Hahn-Banach Theorems, Open Mapping and Closed Graph Theorems
Weak topologies, dual spaces, weak topologies, Tychonoff's Theorem,
Banach-Alaoglu Theorem
Banach and Hilbert spaces
Bounded linear maps
- Textbook:** No textbook required.
- References:** Conway, J.B., A course in functional analysis, Graduate Texts in Mathematics 96,
Springer-Verlag, 1985.
Bollobas, B., Linear analysis, an introductory course, Cambridge Mathematical Text-
books, Cambridge University Press, 1992.
Dunford, N. and Schwartz, J., Linear operators, I, New York, Interscience, 1958.
(This book is encyclopaedic in nature, but is still an excellent reference. The nota-
tion might at times be outdated.)
Kadison, R.V. and Ringrose, J.R., Fundamentals of the Theory of Operator Alge-
bras.
Rudin, W., Functional analysis, Tata McGraw-Hill, New Dehli, 1977.
Morrison, T.J., Functional Analysis, an introduction to Banach space theory, Wiley-
Interscience, 2001.
Pryce, J.D., Basic Methods of Functional Analysis, Hutchinson University Library,
1973.
- Grades:** There will be a final exam, and most likely a midterm as well. I haven't yet decided
upon the relative weights of these.

Course Outline: Isomorphism theorems, classical structures theorems for finite groups, nilpotent and solvable groups, free groups, presentations, modules over PID's, Hilbert Basis Theorem, Jacobson radical, Artin-Wedderburn Theorem, fields extensions, Jordan and rational Canonical form, tensor products, tensor and exterior algebras.

Optional Textbook: Advanced Modern Algebra
Author: J. Rotman
ISBN: 97801308878687
Publisher: Prentice-Hall

Meet Day & Time: TBA
Please contact the professor

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
 - Basics 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

References: To be supplied in class.

Textbook: No textbook required

PMath 822

**Topics in Operator Theory:
Nonself-adjoint Operator Algebras**

K.R. Davidson
Office: MC 5080

**Course
Outline**

This course will be an introduction to several concrete classes of operator algebras. The first part will deal with nest algebras (algebras of operators with a given triangular form) up to the classification of these algebras up to similarity and some of its ramifications. Then we will consider graph algebras (both C*-algebras and nonself-adjoint). With the remaining time, I will either look at "higher rank graph" algebras or free semigroup algebras.

Textbook:

There will be no textbook. The first part will mostly be in my book "Nest Algebras", but this is out of print. There is a nice intro to "Graph Algebras" by Iain Raeburn, which is a good reference, but is only about the C*-algebra side. It is inexpensive (US\$28 from AMS).

Meet time:

TBA
Please contact the professor