Pure Math Graduate Courses
Winter 2005

PMath 640/440	Analytic Number Theory	C.L. Stewart
PMath 644/444	Non-Commutative Algebra	K.R. Davidson
PMath 651/451 /AMath 431	Measure and Integration	B.E. Forrest
PMath 665/465	Differential Geometry	B.D. Park
PMath 755	Topics in Geometry: Topics in Geometry	D.K. McKinnon
PMath 810	Banach Algebras and Operator Theory	L.W. Marcoux
PMath 833	Topics in Harmonic Analysis: Harmonic Analysis	Kathryn E. Hare

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PMath 640 Analytic Number Theory **C.L. Stewart**
(held with) **PMath 440**

Primitive roots, law of quadratic reciprocity, Gaussian sums, the Riemann zeta function, Dirichlet series, primes in arithmetical progressions.

References

1. "An Introduction to the theory of numbers", G.H. Hardly and E.M. Wright, Oxford University Press, (5th ed., 1979)
2. "Introduction to Analytic Number Theory", T.M. Apostol. Springer-Verlag, 1976.
3. "Lectures on Elementary Number Theory", H. Rademacher. Blaisdell, 1964.

PMath 644 Non–Commutative Algebra **K.R. Davidson**
(held with) **PMath 444**

Jacobson structure theory, the density theorem, Jacobson radical, Maschke's theorem. Structure of Artinian rings, the Artin–Wedderburn theorem, modules over semi–simple Artinian rings.
Representations of finite groups, characters, Fröbenius's theorem on orthogonality, applications.

References

1. "Noncommutative Algebra", B. Farb and R.K. Dennis, No.144, Grad. Texts in Math., Springer-Verlag, 1993.
2. "Noncommutative Rings", I. Herstein. Carus Monographs, No. 15, MAA, 1973.

PMath 651 **Measure and Integration** **B.E. Forrest**
(held with)
PMath 451/AMath 431

General measures, measurability, Caratheodory Extension theorem and construction of measures, integration theory, convergence theorems, L^p spaces, absolute continuity, differentiation of monotone functions, Radon-Nikodym theorem, product measures, Fubini's theorem, signed measures, Urysohn's lemma, Riesz Representation theorems for L^p and $C(X)$.

References

1. "Real Analysis", H.L. Royden. MacMillan, 1968.
2. "Real and Complex Analysis', W. Rudin. McGraw-Hill, 3rd edition, 1987.

Textbook: No text required??

PMath 665 **Differential Geometry** **B.D. Park**
(held with)
PMath 465/AMath 433

Topics to be covered (time permitting): Curves and surfaces, m-dimensional surfaces in R^n, intrinsic Riemannian geometry, mathematical aspects of General Relativity, Gauss-Bonnet Theorem, geodesics and global geometry.

Textbook: "Riemannian Geometry, A Beginner's Guide" by Frank Morgan, A.K. Peters Ltd., 1998.

Background: This is intended to be a first course in differential geometry, aimed at around fourth-year level. Undergraduate students who did not take AMath 333/PMath 365 should see the instructor for override permission.

Topics in Geometry

Course Description

We would like to study geometry, but it's too hard. So we find a way to transform our geometrical problems into algebra problems, and thereby make the geometry easier. This is what algebraic geometry is all about.

We would like to study algebra, but we don't know where to start. So we find a way to transform our algebraic problems into geometry problems, and thereby acquire a wealth of geometric intuition to apply to our algebra problems. This is what algebraic geometry is all about.

This course will begin to explore the extent to which we can realise the aspirations of the previous two paragraphs. How can we use algebra to determine that the equation $x^3 + y^3 + z^3 = 1$ defines a smooth manifold, but $x^3 + y^3 + z^3 = 0$ does not? How can we use geometrical intuition to help us prove that $\mathbf{Q}[x, y]/(y^2 - x^3)$ is not isomorphic to $\mathbf{Q}[x, y]/(y^2 - x^3 - x)$?

The course will cover roughly the first chapter of Hartshorne's book *Algebraic Geometry*, which is an introduction to the methods of classical algebraic geometry. Topics will include affine and projective varieties, morphisms of varieties, rational maps, blowing up, nonsingularity, an introduction to the dictionary between algebra and geometry, and a smattering of intersection theory.

Prerequisites	Familiarity with groups, rings, and fields, to the level of PMATH 345 and 346.
Required Text	No text required.
References	Hartshorne, R., *Algebraic Geometry*, Springer-Verlag, New York, 1977. (Graduate Texts in Mathematics 52)
	Eisenbud, D., *Commutative Algebra*, Springer-Verlag, New York, 1994. (Graduate Texts in Mathematics 150)
Meet Time	9:30 – 10:20 a.m.
Where:	MC 5158A

The first lecture will be held Wednesday, January 5, 2005.

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PMath 810 **Banach Algebras & Operator Theory** **L.W. Marcoux**

Background: PM 653 or equivalent is the prerequisite and students feeling they have the equivalent background should approach the Graduate Officer before signing up for PM 810.

Course Description: Banach algebras, functional calculus, Gelfand transform, Jacobson radical, Banach space and Hilbert space operators, Fredholm alternative, spectral theorem for compact normal operators, ideals in $C*$-algebras, linear functionals and states, GNS construction, von Neumann algebras, strong/weak operator topologies, Double Commutant theorem, Kaplansky's Density Theorem, spectral theorem for normal operators.

Textbook: A set of notes will be available for you to photocopy.

Day & Time: MWF 10:30 - 11:20 a.m. (Starting January 5, 2004)

Meet Time: MC 5158A

The first lecture will be held Wednesday, January 5, 2005.

PMath 833 **Topics in Harmonic Analysis** **Kathryn Hare**

Harmonic Analysis

Outline: This is a course on harmonic analysis on locally compact, abelian groups. The course will cover the basic topics of Fourier analysis such as convolution, characters, dual group and the Fourier transform. Some of the theorems we will study are:

Parseval's/Plancherel theorem
Pontryagin Duality theorem
Inversion theorem
Bochner's theorem

Other topics could include:

Structure of lca groups
Interpolation sets and almost periodic functions
Introduction to harmonic analysis or compact non-abelian groups
The classical groups, $\mathbb{R}^n$ and the torus, are important examples of lca groups and will be used to motivate the more abstract ideas we will investigate.

Background: Functional analysis, Lebesgue measure theory. Abstract measure theory would be helpful.

Textbook: No text required

References: "Fourier Analysis on Groups", by Walter Rudin.

"Abstract harmonic analysis", by Hewitt and Ross.

"An introduction to harmonic analysis", by Yitzhak Katznelson.

"Essays in commutative harmonic analysis", by C.C. Graham and O.C. McGehee.

Meet Time: MWF 9:30 a.m. - 10:20 a.m.

Where: MC 4044

The first lecture will be held Wednesday, January 5, 2005.