110.616 Algebraic Topology Boardman

110.616 Algebraic Topology is a continuation of 110.615, which is a prerequisite for 110.616. It will continue with Chapter 3 of Hatcher's book, which concentrates on cohomology. Additional topics will be covered as time permits.

110.617 Number Theory Ono

This is an exposition of the classical basic algebraic and analytic number theory. Along the the text book below we will study: I. General Basic Theory, II.Old and New Class Field Theory and III. Analytic Theory.
As a problem book, I recommend D. A. Marcus, Number Fields, Springer, 1977.
Textbook: S.Lang, Algebraic Number Theory (2nd ed.) , Springer, 1994.
Prerequisites: S.Lang, Algebra, Springer, 2002, Part One and Two.

110.619 Lie Groups & Lie Algebras Shalika

110.635 Microlocal Analysis Zelditch

The course starts from scratch with symplectic geometry:
symplectic forms, Lagrangian sub-manifolds, Hamiltonian flows. Then stationary phase, oscillatory integrals, Fourier integral operators. The focus will be on complex microlocal analysis: holomorphic symplectic geometry, complex FIO's, and weighted L^2 spaces.

110.640 Spectral Theory Goldberg

Primary Text: "A Short Course on Spectral Theory" by William Arveson

Description: Spectral Theory is, loosely speaking, an attempt to extend the concepts of Linear Algebra so that they apply to infinite-dimensional vector spaces. We will find (nontrivial) ways to generalize many familiar objects such as matrices, eigenvalues, and diagonalization. The subject lies at an interface between abstract algebra and analysis, borrowing facts and intuition from both sides as necessary.

Topics Covered:

- Basic theorems of Functional Analysis
- The spectrum of an operator: definition and properties
- Maximal ideals and the Gelfand map
- Operators on a Hilbert space
- The Spectral Theorem and normal functional calculus
- Compact and Fredholm operators, Fredholm Index Theorem

Prerequisites: 110.605, 110.401, 110.311 or equivalent

110.646 Riiemannian Geometry Minicozzi
The main topics will be:
1. Min-max constructions of minimal surfaces.
2. The width and mean curvature flow.
3. Finite extinction of Ricci flow on a homotopy three-sphere.

100.726 Topics in Analysis C Wang
Descriptions: In this course, we will focus on the Strichartz estimates and various improvements for the wave and Schroedinger equation, and the applications in the study of the well-posedness for nonlinear wave/Schroedinger equations.

Strichartz estimates are useful and recently active tools in the study of the well-posed problems of nonlinear wave/dispersive equations. From more general viewpoints, it is the space-time a-priori estimate for the wave/dispersive equations. We'll also discuss some of such estimates, e.g., Keel-Smith-Sogge estimate (KSS in short), weighted Strichartz estimates, X^{s,b} space (also known as Bourgain space, Klainerman-Machedon space).

Prerequisites: Some standard results in analysis, for example, the first chapter of Sogge's book, "Fourier Integrals in Classical Analysis".

Main References:
1. Sogge, Lectures on Non-Linear Wave Equations (Second Edition), International Press, 2008
2. Tao, Nonlinear Dispersive Equations: Local And Global Analysis, CBMS-106, AMS, 2006

110.728 Topics in Algebraic Topology Wilson
This will be a continuation of the Homological Algebra course being taught by me this semester.
However, In addition, I would work something out for anyone who would like to take homological algebra and start at the beginning.

110.734 Topics in Algebraic Number Theory Ono
This is a continuation of the course 733 (Fall 2008) with the same title. It is about my favorite system (g,(G,M)) where g,G are groups, M a G-module and g acts on (G,M) naturally. For each 1-cocycle c for (g,G) one defines an integer i_c(g,M) (index). In number theory situations, say, g=Gal(K/Q) , G= a group of K-integer
points of an algebraic group, M=a G-module, we may ask many questions on such an invariant inspired by Poincare (Theta series, Eisenstein series, Poincare series...)
Mike Limarzi took a notes of 733 (Fall 2008) and will do the same job for 734(Spring 2009). Please ask him if you want to know what was in 733.

110.738 Topics in Algebraic Geometry Ambro

Title: Introduction to toric varieties

Outline: Toric varieties are a special kind of algebraic varieties which can be described by lattices and convex sets. They provide a rich source of concrete examples in complex geometry or mathematical physics.

This class is an introduction to toric varieties. Starting off with lattices and convex sets, we introduce toric varieties and study their singularities and embeddings. Our final goal is a combinatorial criterion for the stability of toric embeddings (equivalently, the existence of canonical metrics on toric line bundles).

Prerequisites: Basic notions of algebraic geometry (schemes, sheaves, linear systems), as covered in 643.

Recommended reading:

1. W. Fulton, "Introduction to Toric Varieties", Annals of Mathematics Studies 1993.
2. D. Mumford, "Stability of projective varieties" l'Enseign. Math. (2), 23:1-2 (1977) pp. 39-110.
3. S. K. Donaldson, "Scalar curvature and stability of toric varieties". J. Differential Geom. 62 (2002), no. 2, 289--349.

110.742 Topics in PDE Spruck

We will develop the basics of the theory of fully nonlinear elliptic equations; including viscosity solutions, Evans-Krylov interior regularity, Monge Ampere equations, Garding cones and functions of curvature. Time permitting; we will also present some geometric applications. Familiarity with Schauder theory and quasilinear elliptic pde is recommended as well as some experience with Differential geometry.

110.760 Topics in Random Complex Geometry Shiffman and Zelditch

Topics to be discussed as time permits: Random complex polynomials. Gaussian random functions and fields. The Gaussian free field. Gaussian random holomorphic sections of line bundles. Kac-Rice formula and Poincaré-Lelong formula for the expected distribution of zeros. Correlations between zeros. Hole probabilities. Large deviations for empirical measures of zeros on Riemann surfaces. Asymptotics of Szegö kernels for holomorphic line bundles. Bedford-Taylor theorem on the complex Monge-Ampère operator.

The prerequisites are 605, 607, and some basic complex geometry, e.g. as covered in 611.