Instructor: Michael Brannan, 376 Altgeld Hall.

Lectures: Mondays and Wednesdays 11:00am - 12:20pm, 347 Altgeld Hall.

Course Webpage: http://www.math.uiuc.edu/~mbrannan/math595/

Course Overview: Much of the theory of operator algebras is motivated by results and examples arising in group theory. The aim of this course is to introduce students to various topics in operator algebras of current interest, and to motivate these topics using concrete examples coming from group (representation) theory. This course will have two distinct parts. The first part will be devoted to studying approximation properties for (mainly discrete) groups and manifestations of these properties in terms of operator algebras associated to groups. The second part will be devoted to the study of non-tracial von Neumann algebras and the modular theory of non-tracial states or weights.

Here is the rough plan for the course:

- Review of some basic Banach algebra and operator algebra theory.
- Groups, representations and operator algebras associated to them.
- Amenable groups and related topics.
- The Haagerup property.
- Weak amenability and the completely bounded approximation property.
- Kazhdan’s property (T).
- Applications to the structure of II₁-factors.
- Non-tracial von Neumann algebras, modular condition of a weight.
- Modular theory of non-tracial states and weights.
- Applications: Standard form of a von Neumann algebra, Tomita’s theorem, Connes’ cocycle derivative theorem, duality of crossed products.

Textbook: There will be no required textbook for this course. Some good general references include “C*-algebras and finite dimensional approximations” by N.P. Brown and N. Ozawa, “Fundamentals of the theory of operator algebras” (Volume 2) by R. Kadison and J. Ringrose, and “Theory of Operator Algebras” (Volumes 1-3) by M. Takesaki.

Student Evaluation:
- 60 %–Homework assignments (approx. 4 or 5).
- 40 %–End of term project on a specific topic related to the course material – 40%.
This will involve a written summary of the given topic and a 50 minute oral presentation. Specific project topics will be posted on the course webpage at a later date.