Math 842
Representation Theory of Finite & Compact Groups, and Applications
Spring 2011

Instructor: Shamgar Gurevich, 317 VV.
Time and Location: MWF 11:50-11:50, Room VVB129.
Office Hours: Monday 1–3:30pm

Texts: The course notes.
Syllabus: We will study some parts of the following:

- Motivations: Compression of music, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT).
- Heisenberg group, Heisenberg representation, Hilbert space of digital signals.
- Representation of a group, equivalence of representations, Intertwiners.
- The Time and the Frequency models of the Heisenberg representation. The DFT as an intertwiner.
- Notion of irreducible representation. Equivalency of irreducible representation and Schur's lemma. Notion of a model of (an irreducible) representation.
- The irreducible representations of the Heisenberg group and the Stone–von Neumann theorem.
- Models for the Heisenberg representation: Time model, Frequency model, Lagrangian models, Geometric Lagrangian models, Arithmetic Lagrangian (Zak) models.
- The arithmetic models and the FFT algorithm.
- Possible additional topics: Weil representation, Maschke's theorem, Diagonalization of the DFT, construction of pseudo-random functions, applications to radar and communication. Representation theory of compact groups, Peter–Weyl theorem, application to Cryo-Electron Microscopy and three-dimensional structuring of molecules.

Home works and Grading: From time to time I will give some homeworks, There will be a final project which you will need to present in the last month of the course. They will count toward the grade as follows:

HW	10%
Project	90%

Good Luck!