Department of Mathematics
University of California, Berkeley

Mathematics 252
Representation Theory

Vera Serganova, Fall 2005

My **office hours** are 10:00-11:30 on Wednesdays and Fridays, in 709 Evans Hall. I can be reached by telephone at (64)2-2150 and electronic mail at `serganov@math`. You are welcome to ask questions by email. Homework assignments and course notes can be found on my web page **http:// math.berkeley.edu/ serganov**. First homework assignment is due on Friday, September 9

There is no required text for this course. Good references are **Fulton, Harris, Representation Theory**,**Serre, Linear Representations of Finite Groups**, **Curtis, Reiner, Representation Theory of Finite Groups and Associative Algebras**,**Gabriel, Roiter, Representations of Finite-dimensional Algebras**. I will try to post course notes regularly on the web.

To understand this course you need basic knowledge of Algebra and a good knowledge of Linear Algebra. In other words you have to know basic facts about groups and rings and you should feel very comfortable when working with linear operators.

Each Friday I will give you a problem assignment (2-4 problems) on the material of the week lectures. The homework will be collected the next Friday.

The **grade** will be computed according to the following proportions: 50% for your homework and 50% for the take home final. But if you solve all problems in your final (there will be hard ones in it) you get A for the course.

Course outline

- Representations of groups. Definitions and examples
- Schur's Lemma. Complete reducibility in case of zero characteristic
- Characters and orthogonality relation
- First examples: abelian groups, dihedral group D_n, S_3, S_4, A_5 e.t.c.
- Induced representation. Frobenius reciprocity. Mackey's criterion
- Representations of associative rings. Density theorem. Semi-simple rings, Wedderburn's theorem. Decomposition of a group algebra
- Representations of non-semisimple rings. Blocks. Injective and projective modules
- Representations of symmetric groups, Young diagrams and Frobenius formula
- Representations of general linear group, Weyl duality and Schur's polynomials (if time permits)
- Complex representations of linear groups over finite fields, Hecke algebra
- Compact groups and their representations. Peter-Weyl theorem
- Real representations and representations over subfields of C. Schur indices
- Artin's and Brauer's theorems
- Representations of quivers. Definition and examples
- Gabriel's theorem
- Representations over fields of nonzero characteristic (if time permits)