Workshop I
Paul-Hermann Zieschang
Professor of Mathematics, University of Texas at Brownsville

The course is a friendly introduction to an algebraic or combinatorial area between groups and rings. It is called

Non-Commutative Rings and Group Rings

and is accessible for students who took a class in Linear Algebra.

We will start with the definition of a group and will give examples of groups. (Such examples are the symmetric groups, the dihedral groups, the cyclic groups, and the general linear groups.) After that, we begin with the theory.

We start by investigating the structure of completely reducible rings and provide examples. This leads us to the following three chapters.

1. The endomorphism ring of a vector space
2. The Theorem of Artin and Wedderburn
3. The Jacobson Radical

After that, we shall construct, for each finite group, a ring, the so-called group-ring. We first will construct and compute several group rings of low dimension, and we shall see that they all are completely reducible. With a little bit of experience in the treatment of group rings we then will be able to see that group rings are completely reducible in general. This leads us to the following three chapters.

4. Maschke's Theorem
5. Group Characters
6. The Orthogonality Relations.

The Orthogonality Relations allow us to compute the so-called character table of a finite group. Once one knows the character table of a finite group, one knows the group completely. One of the final goals will be to show how the Orthogonality Relations can be used to give substantial information about the structure of a group.

Workshop 2
Brian Birgen
Associate Professor of Mathematics, Wartburg College

Modeling, Differential Equations, and Numerical Methods

This workshop will focus on using differential equations to model problems from a variety of applications. Time will be spent on methods for solving

differential equations as well as numerical methods when closed form solutions cannot be found. Examples will include population models with interacting species, modeling motion with air resistance, modeling springs and other examples of periodicity. Numerical methods will include Euler's method and Runge-Kutta.

Workshop 3
Mariah Birgen
Associate Professor of Mathematics, Wartburg College

Infinite-Dimensional Vector Spaces

In this workshop we will take Linear Algebra to the obvious next step, what does an infinite-dimensional Vector Space look like? We will learn about how to define and find vectors, inner products, bases, and eigen-stuff in this infinite-dimensional world. This is the beginning of the study of Harmonic Analysis in general and Hilbert Space (the nicest type of infinite-dimensional vector space) in particular. This material is fascinating in its own right, but also is the foundation of modern Physics and Quantum Mechanics.