MATH 4016/6016 **Fourier Analysis**

Interdisciplinary Course Spring 2005

Tu R 1:00 - 2:25

Instructor: Dr. J. Campbell, Dept. of Math. Sci.

Purpose: Understanding some basic facts about Fourier series, Fourier transforms and finite Fourier analysis. This will allow us to see rather easily certain applications to other sciences, together with the link to such topics and partial differential equations and number theory.

Topics: Including, but not limited to, the following:

- Origins of Fourier Analysis: the **vibrating string** and the **heat-flow** problem.
- Basic properties of Fourier series.
- The Poisson kernel and Dirichlet's problem in the unit disc.
- Mean square convergence of Fourier series.
- Applications of Fourier series:
  - The isoperimetric inequality.
  - The heat equation on the circle.
  - Weyl's equidistribution theorem.
- The Fourier transform on $\mathbb{R}$.
- The Schwartz functions, Fourier inversion.
- Applications:
  - The time-dependent heat equation on the real line.
  - The steady-state heat equation in the upper half plane.
  - The Heisenberg Uncertainty Principle.
- Finite Fourier Analysis.
- Applications:
  - Fast Fourier transforms.
  - The infinitude of primes.
  - The infinitude of primes in arithmetic progressions.

Text: *Fourier Analysis* by E. Stein and R. Shakarchi, supplemented by *Fourier Analysis* by Körner.

Pre-requisites: Math 4/6350 or permission of instructor. We intend to emphasize interdisciplinary applications of Fourier analysis, thus physics, engineering, and chemistry majors will be encouraged to attend, even if they have not necessarily had Math 4350.