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# Math 421

## Fourier Series

### Autumn 2006

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**Text:** Fourier Series, by Rajendra Bhatia, Math. Assoc. of America, 2005.

**Topics Covered:**

- Ch. 1, Fourier series and the heat equation
- Ch. 2, Convergence of Fourier series
- Ch. 3, Sine and cosine series, arbitrary periods,  $\sin(x)/x$ , Gibbs's phenomenon
- Ch. 4, Convergence in  $L^2$  and  $L^1$
- Ch. 5, Applications: ergodic theorem, vibrating string
- Fourier transform
- Discrete Fourier transform (*time permitting*)
- Wavelets (*time permitting*)

**Instructor:**

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**Office Hours:** Jeffery 404

Tuesday: 1:30 - 2:30

Wednesday: 2:30 - 3:30

**Grading Scheme:**

five assignments 40%  
midterm examination 30%  
final examination 30%.

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### Assignment 1, Due September 22

Numbered exercises refer to Bhatia.

1) Let  $n$  be a positive integer and  $\omega = e^{2\pi i/n}$ . Let  $W_n$  be the  $n \times n$  matrix with  $(i, j)$ -entry  $\omega^{(i-1)(j-1)}$ ,  $1 \leq i, j \leq n$ . Write out  $W_1$ ,  $W_2$ , and  $W_3$ . Show that  $W_n$  is invertible and find  $W_n^{-1}$ .

2) 1.1.1

3) 1.1.3

4) 1.2.1

5) 1.3.2