

# **EAS 8803/4803: OBSERVATIONAL SEISMOLOGY**

## **SPRING 2011**

**Time and Location:** Monday/Wednesday 3:05 pm – 4:25 am, ES & T, L1116

**Instructor:**

Zhigang Peng, ES&T 2256, 404-894-0231, zpeng@gatech.edu

**Office Hour:** Monday/Wednesday 1:30 pm – 2:30 pm (immediately before class)

**General description:** This is an advanced level course designed to involve students into seismological research. The topics covered include digital signal processing, seismometers and seismic networks, basic and advanced seismic data processing tools, travel time and synthetic seismogram calculations, earthquake locations, etc.

**Prerequisite:** Introduction to Geophysics or equivalent

**Grading:**

60% homework assignment; 15% paper reading and discussion; 25% term paper project.

**Required Textbook:**

S. Stein and M. Wysession (2003), An Introduction to Seismology, Earthquakes, and Earth Structure, Blackwell Publishing.

**Recommended Textbook:**

K. Aki and P. Richards (2002), Quantitative Seismology, Second Edition, University Science Books.

P. Shearer (2008), Introduction to Seismology, 2<sup>nd</sup> edition, Cambridge University Press.

T. Lay and T. C. Wallace (1995), Modern Global Seismology, Academic Press.

Additional material will be either handed out in class or made available on the course website.

**Class website:** [http://geophysics.eas.gatech.edu/people/zpeng/Teaching/ObsSeis\\_2011](http://geophysics.eas.gatech.edu/people/zpeng/Teaching/ObsSeis_2011)

**Course Outline:**

1. Digital Signal Processing
  - a. Fourier analysis
  - b. Linear systems
  - c. Discrete time series and transforms
2. Seismometers, Seismic Networks, and Data Centers
  - a. Historical development and the Earth's background noise
  - b. The damped harmonic oscillator
  - c. Basic types of seismic sensors and digital recording devices
  - d. Global and regional seismic networks and data management centers
    - a. Instrument response

3. Observational Seismology
  - b. Basic data processing tools
  - c. Data request and management
  - d. Waveform stacking
  - e. Array analysis
4. Theoretical and Computational Seismology
  - a. Seismic source and representation theorems
  - b. Ray theory and travel time calculation
  - c. Theoretical seismogram calculation
  - d. Earthquake location and tomography
  - e. Scattering
5. Current topics in observational and computational seismology (tentative)
  - a. Ambient noise tomography and seismic interferometry
  - b. Waveform back projection for imaging earthquake ruptures
  - c. Spectral-element methods (SEM) and full-waveform tomography

**Homework assignment:** There will be four homework problems, which will involve analysis of selected issues, including analytical calculations, computer simulations, or data analysis. The homework is designed for each student to work by him/herself. The homework will count as 60% of your overall course grade, with each counting 15%.

**Paper reading and discussion:** In the last part of the class, we will discuss three topics of modern research in the field of observational and computational seismology. You are required to submit (electronically) a 3-page summary after each topic. Paper reading and discussion comprises 15% of your total grade, and is based on your summary, and in-class participation.

**Term paper project:** You are required to write a term paper with any topic related to this course. These can be literature reviews, or research projects involving calculations, data analysis, or theoretical results done in consultation with the instructor. The topic needed to be approved by the instructor before the spring break. Your paper should be written up in journal form with length, figures and referencing in a format suitable for submission to journals like Geophysical Research Letters (GRL). Preliminary version of the final paper should be shown to the instructor for approval at least two weeks beforehand. You will present your term paper in a 15 minute AGU-style talk; a 12 minute presentation with 3 minutes of questions. The project will count as 25% of your overall course grade, in which 15% will be based on the quality of the project, 10% on written and oral presentation.

**Academic honesty:** It is expected that all students are aware of their individual responsibilities under the Georgia Tech Academic Honor Code, which will be strictly adhered to in this class. The complete text of the Georgia Tech Academic Honor Code is at <http://www.honor.gatech.edu/>.