EAS 6316/4316: EARTHQUAKE PHYSICS - FALL SEMESTER 2021

Time and Location: Monday/Wednesday 12:30–1:45 pm, ES&T L1225

Office Hours: Monday/Wednesday 1:45–2:45 pm, ES&T 2256 (or by appointment)

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

General Description: This course consists of a series of lectures and discussions on the fundamental physical processes that control fault slips and earthquakes with a focus on the latest emerging research topics in the field.

COVID-19 Update: This course will be taught in a in-person mode. Most classes will be delivered in person. We will follow CDC and Georgia Tech's guideline on masks and social distancing practices during in person class sessions.

Grading: Midterm exam (30%), Midterm project (20%), Quiz (10%), Discussions (20%), Final course project (20%).

Final Grade:
Letter grade: A≥ 90% > B ≥ 80% > C ≥ 70% > D ≥ 60% > F
Satisfactory/Unsatisfactory grade: Satisfactory ≥ 70% > Unsatisfactory

Recommended Text Books:
Scholz, C. H., The Mechanics of Earthquakes and Faulting, 3rd Edition, Cambridge University Press, 2018, https://doi.org/10.1017/9781316681473.
Udias, A., R. Madariaga, and E. Buforn, Source Mechanisms of Earthquakes: Theory and Practice, Cambridge University Press, 2014.
S. Stein and M. Wysession, An Introduction to Seismology, Earthquakes, and Earth Structure, Blackwell Publishing, 2003.

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

Class website: http://geophysics.eas.gatech.edu/people/zpeng/Teaching/EQPhysics_2021

Course Outline:
Lectures
1. Brittle Fracture of Rock
2. Rock Friction
3. Mechanics of Faulting
4. Mechanics and Quantifications of Earthquakes
5. Collective Behaviors of Earthquakes and Faults
6. The Seismic Cycle
7. Midterm over lectures
8. Presentations from the midterm project

Discussions/Debates of Emergent Research (Tentative Titles)
1. Slow and Fast Earthquakes

2. Fracking and Injection Induced Earthquakes
3. Earthquake Triggering: Static vs. Dynamic
4. Earthquake Initiation: Nucleation vs Cascade
5. Earthquake Forecasting and Prediction

Topics and order are subject to change during the semester.

Exams: There will be a midterm exam* (30%) covering all material presented during the lecture portion of the course. Reference to texts or other documents such as previous semester course materials during the exam is strictly forbidden. Using these materials will be considered a direct violation of academic policy and will be dealt with according to the GT Academic Honor Code. The use of electronic devices (e.g. smart phones, computers etc.) other than non-programmable calculators during exams and quizzes is not allowed.

Discussions: Approximately half of this class will be comprised of detailed discussion of five topics of modern research in the field of earthquake physics (listed in the course outline). Before each discussion, you will be expected to read the assigned papers. Students will be asked to summarize the papers during discussion. After discussion is completed on that topic, you will submit a 3-page synthesis of your understanding of the current state-of-the-art of that topic. Your grade will depend on both your written summaries (15%) and in class participation (5%). In the last three topics that involve debates, we will divide the classes into opposite groups and present their arguments.

Quizzes: There will be about ten quizzes throughout the semester. The quiz is meant to help students to understand better the material learned recently in the class. More details will be provided later. The quiz will count 10% of the grade.

Course Project: There will be two course projects. The first project is due immediately after the midterm and is a fixed topic on analyzing earthquake sequences with statistical tools. The final course project is open to any topics related to earthquake physics. This can be a literature review of a selected topic, or research project involving calculations, data analysis, or theoretical results done in consultation with the instructor. The topic needed to be approved by the instructor right after the midterm. Your paper should be written up in a journal form with length, figures and referencing in a format suitable for submission to journals like Geophysical Research Letters (GRL). The minimum length is 12 pages (double space, including references and figures). You will present your term paper in a 15-minute AGU-style talk: a 12-minute presentation with 3 minutes of questions. The midterm and final project will count as 20% of your overall course grade (16% term paper, 4% presentations).

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/.

* Different exams will be assigned to graduate and undergraduate students.