EAS 4803/8803: EARTHQUAKE PHYSICS - FALL SEMESTER

General Description: This course consists of a series of lectures and discussions on the current status of physical processes that control fault slips and earthquakes.

Learning Outcomes: By the end of this course, students should have a reasonable good understanding of the fundamental physics of earthquake processes, as well as most up-to-date literatures on emerging research topics. In addition, this course should provide enough training for both undergraduate and graduate students to effectively read and summarize literatures. Students registered for the graduate section will learn how to choose and conduct research related to earthquake sciences.

Grading: Midterm Exam* (30%), Midterm Project (20%), Discussions (25%), Second Midterm (25%, Undergraduate Only), Final course project (25%, Graduate Only).
* Each student will be graded independently. Different exams will be assigned to graduate and undergraduate students.

Textbooks: No official required textbook. Below are a list of recommended books. Additional reading material will either be handed out in class or made available on course website.

Scholz, C. H., The Mechanics of Earthquakes and Faulting, 2nd Edition, Cambridge University Press, 471 pp., 2002.
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.

Class website: http://geophysics.eas.gatech.edu/classes/EQPhysics/

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 Emerging Research (Tentative Titles#)
1. Slow and Fast Earthquakes
2. Human 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 for future classes depending on students' interests.

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. cellular phones, computers etc.) other than non-programmable calculators during exams and quizzes is not allowed. For undergraduate session only, there is a second midterm to cover the topics discussed in the second half of the paper reading/discussions.

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, students 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, each students will submit a 3-page synthesis of your understanding of the current state-of-the-art of that topic. The grade will depend on both your written summaries (15%) and in class participation (5%). In the last three topics that involve debates, students will be divided into opposite groups and present their arguments. Also, please see the Institute Absence policy is available at: www.catalog.gatech.edu/rules/4/.

Course Project: The first project is due immediately after the midterm and is a fixed topic for both undergraduate and graduate students on analyzing earthquake sequences. The final course project is open to any topics related to earthquake physics, and is only for students registered for the graduate sessions. 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. The term 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 page (double space, including references and figures). Graduate students will present the term paper in a 15 minute AGU-style talk; a 12 minute presentation with 3 minutes of questions. The midterm project will count as 20%, and the final project will count as 25% of your overall course grade.

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/.

Learning Accommodations:
If needed, we will make classroom accommodations for students with documented disabilities. These accommodations must be arranged in advance and in accordance with the Office of Disability Services (http://disabilityservices.gatech.edu).

Example Course Schedule (Based on Fall 2017)
Class website: http://geophysics.eas.gatech.edu/classes/EQPhysics

ID	Date	Lecture/Topic	Deadline	Reading
1	08/22/2017	Introduction		Chap 1.1
2	08/24/2017	Brittle fracture of rocks		
3	08/29/2017	Fracture mechanics		Chap 1.2
4	08/31/2017	Fracture and faulting		Chap 1.2
5	09/05/2017	Rock strength		Chap 1.3
6	09/07/2017	Pore-fluid effects and brittle ductile transition		Chap 1.3-1.4
7	09/12/2017	Friction		Chap 2.1-2.2
8	09/14/2017	Stick slip and stable faulting		Chap 2.3
9	09/19/2017	Mechanics of faulting		Chap 3.1-3.2
10	09/21/2017	Fault rocks and structures		Chap 3.3
11	09/26/2017	Mechanics of earthquakes		Chap 4.1-4.2
12	09/28/2017	Earthquake source parameters		Chap 4.3-4.4
13	10/03/2017	Collective behavior of earthquakes	Mid-term project assigned	Chap 4.5 and assigned papers
14	10/05/2017	Seismic cycle and earthquake forecasting		Chap 5.3,7.1-7.3
15	10/10/2017	Fall break, no class		
16	10/12/2017	Case Study: Oklahoma		
17	10/17/2017	Mid-term review		
18	10/19/2017	Mid-term exam		
19	10/24/2017	Discussion #1: Fast and slow earthquakes		Three assigned papers
20	10/26/2017	Discussion #1: Fast and slow earthquakes		Three assigned papers
21	10/31/2017	Discussion #2: Induced earthquakes	Writing summary #1 due	Three assigned papers
22	11/01/2017	Mid-term project presentation	Mid-term project due	
23	11/07/2017	Discussion #2: Induced earthquakes		Three assigned papers
24	11/09/2017	Discussion #3: Earthquake triggering	Writing summary #2 due	Three assigned papers
24	11/14/2017	Discussion continued		
25	11/16/2017	Discussion #3: Earthquake triggering		Three assigned papers
26	11/21/2017	Discussion #4: Earthquake initiation	Writing summary #3 due	Three assigned papers
27	11/23/2017	No class (thanksgiving)		
28	11/28/2017	Discussion #4: Earthquake initiation		Three assigned papers

29	11/30/2017	Discussion #5: Earthquake prediction	Writing summary #4 due	Three assigned papers
30	12/05/2017	Discussion #5: Earthquake prediction		Three assigned papers
31	12/07/2017	Final term paper presentation	Writing summary #5 due	
	12/15/2017		Final written term paper due	