# CERI 7275/8275 Crustal Dynamics

(Listed as CERI 7270/8270, Earthquake Source Physics)

#### When and Where:

Tue and Thu 9:40 to 11:05 a.m. Spring Semester, 2021 Mac Lab, Long Building, CERI

#### Instructor:

Thomas Göbel, office: CERI House 2, room 107, 901-678-4885 Office hours: T 2 to 4 p.m. 3890 Central Avenue, EQ2, Room 107

#### **Course Description**

This course covers the mechanisms of brittle deformation processes from rock fracture to earthquakes. We will examine how the Earth deforms at various time scales, how faults evolve from single fractures to mature fault systems and how faults and seismicity impact larger scale processes across the brittle crust. Topics covered range from fracture mechanics and friction to mechanics of faulting, the seismic cycle and fluid flow processes.

#### Who should take this course?

This class is for earth science and geophysics students at the beginning of their graduate studies. Interested undergraduate students can be admitted after consulting the instructor. Students are expected to have a strong foundational knowledge of geophysics and seismology.

#### **Course Topics**

А.	Stress, strain and brittle fracture
В.	Rock friction
C.	Mechanics of faulting
D.	Mechanics of earthquakes
Е.	The seismic cycle
F.	Seismicity statistics and earthquake prediction
G.	Induced Seismicity

# Textbooks, Supplementary Materials, Hardware and Software Requirements

## **Required Textbooks**

1. Chris Scholz. *The mechanics of Earthquakes and Faulting*. Cambridge University Press, 3<sup>rd</sup> ed 2019.

## **Supplementary Materials**

1. Paul Segall. Earthquake and Volcano Deformation, Princeton University Press, 2010

# Assessment and Grading

## **Grading Procedure**

- 50% Homework, 50% Term Project.
- Homework problems will be assigned depending on course registration (i.e. 7275 vs 8275 level). 8000 level students will be assigned more advanced homework problems.
- Term paper topics and lengths will differ depending on course registration. 8000 level students are expected to submit term papers that are 30% longer.

# **Grading Scale**

- A: >95%
- A-: 90 94%
- B+: 86 -89%
- B: 82 85%
- B-: 78 81%
- C+: 74 77%
- C: 70 73% C-: 66 - 69%
  - 66 -Fail

# **Assignments and Projects**

1. TBD

#### **Final Project:**

A large part of your class assessment will be based on the final project. Make sure you contact me early (i.e. about half-way through the class) so that we can find a suitable and interesting topic for your final project. It is Okay to choose a topic that is closely related to your MSc or PhD research. The final project has to include a significant portion of quantitative analysis in addition to comprehensive literature review. Students can work on data-analysis problems or numerical modeling. The final project includes two components: (i) term-paper (max. 10 pages) and (ii) 15min oral presentation. Details will be announced during the class.

#### **Class Schedule**

The following class schedule is preliminary and subject to change

Module	Торіс	Learning Objectives	Assessment/Activity
1	Stress and Strain		
2	Brittle Failure		
3	Friction		
4	Laboratory rock mechanics		HW1- Lab: Fracture energy and slip weakening
5	Mechanics of faulting		
6	Machanics of earthquakes		HW2.
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7	The seismic cycle		
8	Seismicity statistics		HW4: Earthquake catalog analysis

Module	Торіс	Learning Objectives	Assessment/Activity
9	Crustal stress and fault orientations		
10	Induced Seismicity I		
11	Induced Seismicity II		HW5: - Rocky Mountain arsenal earthquake prediction experiment
12	Earthquake prediction		Discussion: What are the ingredients of robust earthquake predictions?
13	Machine Learning Applications to Earthquake Prediction		
14	Fractals and Chaos		
15	Term Paper	Work on Final Projects	Term Paper / Presentation

#### Plagiarism and Integrity

Plagiarism, cheating, and other forms of academic dishonesty are prohibited. Students guilty of academic misconduct, either directly or indirectly, through participation or assistance, are immediately responsible to the instructor of the class in addition to other possible disciplinary sanctions which may be imposed through the regular institutional disciplinary procedures. Expectations for academic integrity and student conduct are described in detail on the website of the <u>Office of Student Accountability</u>. Please read in particular, the section about "<u>Academic Misconduct</u>".

#### Turnitin.com

Your written work may be submitted to <u>Turnitin.com</u>, or a similar electronic detection method, for an evaluation of the originality of your ideas and proper use and attribution of sources. As part of this process, you may be required to submit electronic as well as hard copies of your written work, or be given other instructions to follow. By taking this course, you agree that all assignments may undergo this review process and that the assignment may be included as a source document in Turnitin.com's restricted access database solely for the purpose of detecting plagiarism in such documents. Any assignment not submitted according to the procedures given by the instructor may be penalized or may not be accepted at all.

#### Library, Tutoring, and Other Resources

- The myMemphis Portal system, eCampus Student tab provides access to <u>University</u> <u>library</u>.
- The tutoring link in the course navigation bar provides access to free online tutoring through UpSwing tutoring.

#### Students With Disabilities

Qualified students with disabilities will be provided reasonable and necessary academic accommodations if determined eligible by disability services staff at the University of Memphis. Prior to granting disability accommodations in this course, the instructor must receive written verification of a student's eligibility for specific accommodations from the disability services staff. It is the student's responsibility to initiate contact with <u>Disability Resources for</u> <u>Students</u> (DRS) and to follow the established procedures for having the accommodation notice sent to the instructor.

#### Sexual Misconduct and Domestic Violence Policy

This policy specifically addresses sexual misconduct which includes dating violence, domestic violence, sexual assault, and stalking. The policy establishes procedures for responding to Title IX-related allegations of sexual misconduct. Complaints can be reported to the Office for Institutional Equity (OIE). You may contact OIE by phone at 901.678.2713 or by email at <u>oie@memphis.edu</u>. Complaints can be submitted online at <u>File a Complaint</u>. OIE's office is located at 156 Administration Building.

#### Non-Discrimination and Anti-Harassment Policy

University policy prohibiting discrimination and harassment based on protected characteristics and classes. Complaints of discrimination and harassment can be reported to the Office for

Institutional Equity (OIE). You may contact OIE by phone at 901.678.2713 or by email at oie@memphis.edu. The full text of the policy can be found at <u>GE2030 - Non-Discrimination and</u> <u>Antiharassment</u>.

#### Technology Requirements

The following is a list of the minimum requirements to use our learning management system. Some courses will have more advanced requirements.

- Access to a reliable, high-speed Internet connection (DSL or Cable).
- Test your device to ensure it is compatible with our LMS (Learning Management System) using the <u>System Check Wizard</u>.
- Open PDF files using the free downloadable PDF software.
- Access Flash-based content with <u>Adobe Flash Player</u> (free).
- Use Microsoft Office for document creation (available for students via <a href="http://umapps.memphis.edu/">http://umapps.memphis.edu/</a>)

#### Play media content with <u>Real Player (free)</u>, <u>OuickTime</u> (free), or <u>Windows Media</u> <u>Player(free)</u>.

#### Syllabus Changes

The instructor reserves the right to make changes as necessary to this syllabus. If changes are necessitated during the term of the course, the instructor will immediately notify students of such changes both by individual email communication and posting both notification and nature of change(s) on the course bulletin board.

Technical Support Call the Helpdesk: 901-678-8888 <u>Online Helpdesk</u>