



## Course Syllabus: Seismotectonics - ErSE 217

<b>Division</b>	Physical Science and Engineering Division
<b>Course Number</b>	ErSE 217
<b>Course Title</b>	Seismotectonics
<b>Academic Semester</b>	Spring
<b>Academic Year</b>	2018/2019
<b>Semester Start Date</b>	01/27/2019
<b>Semester End Date</b>	05/23/2019
<b>Class Schedule</b> (Days & Time)	10:30 AM - 12:00 PM   Tue Thu

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Sigurjon Jonsson	sigurjon.jonsson@kaust.edu.sa	+966128080291	3136, 1, Al-Khawarizmi (bldg. 1)	To be determined.

Teaching Assistant(s)	
Name	Email

Course Information	
<b>Comprehensive Course Description</b>	<p>In this course we discuss the relationship between tectonics and earthquakes. We begin by going through some basics in continuum mechanics, discuss different earth rheologies and how material fails. Fault friction and fault mechanics are among the topics, as well as the conditions for stable and unstable sliding. We will go through representations of earthquake sources, such as finite fault models and moment tensors and how such information can be used in earthquake hazard analysis. We will discuss earthquake interaction and Coulomb failure stress change calculations. In addition, earthquake cycles will be discussed, not only the earthquakes themselves, but also interseismic deformation and post-seismic processes and deformation. Related topics like slip transients and earthquake swarms, as well as earthquake scaling and statistics will be covered as well. Finally, slip rate determination, seismic hazard assessments and paleoseismology will be discussed.</p> <p>We expect to have guest lectures on earthquake geology and paleoseismology from outside collaborators. In addition, the students taking the course will have the chance to join 1-2 fieldtrips to northwestern Saudi Arabia during the semester.</p> <p>To get familiar with the course topics we will have 4-5 homework exercises, a midterm, and one student presentation during the course. The grading will be based on the performance in these activities and there will be no final exam.</p> <p>Note: As pre-requisite requirement it may state "ErSE 204 Geophysical Continuum Mechanics or consent with instructor". This information is outdated, as ErSE 204 is not offered anymore. There are no pre-requisite requirements anymore, instead, we will have a bit more thorough introduction.</p>
<b>Course Description from Program Guide</b>	Stress and strain, tensor analysis, rheology, brittle vs. ductile deformation, fracture, fault mechanics, friction, stable and unstable sliding, double-couple representation of earthquake sources, moment tensors, coulomb failure stress changes, earthquake triggering, stress drop, Kostrov's summation, comparative seismotectonics.

<b>Goals and Objectives</b>	<p>By the end of the course, students are expected to</p> <ul style="list-style-type: none"> <li>-understand stresses and strain in the crust and be able to resolve stresses on faults, apply coordinate transformations and assess failure criteria</li> <li>-know the behavior of materials and faults in the crust under different conditions</li> <li>-know how to interpret focal mechanisms and moment tensors in seismotectonics</li> <li>-be able to derive information for seismic hazard assessment of an area, when provided with basic geological and geophysical data</li> </ul>
<b>Required Knowledge</b>	<p>Along with general geology and geophysics knowledge, some insights into continuum mechanics and seismology concepts are needed, as well as basic knowledge of Matlab. Please consult with instructor if further information is needed.</p>
<b>Reference Texts</b>	<p>Stein and M. Wysession, An introduction to seismology, earthquakes and earth structure, Blackwell Publishing, Malden, USA, (2003).</p>
<b>Method of evaluation</b>	<p><b>10.00%</b> - Attendance and Participation  <b>15.00%</b> - Oral presentation  <b>40.00%</b> - Midterm exam  <b>35.00%</b> - Homework /Assignments</p>
<b>Nature of the assignments</b>	<p>There will be 4-5 problem sets during the semester, one midterm exam, and one student presentation.</p>
<b>Course Policies</b>	<p>Students are expected to turn in all assignments, attend the midterm, and give one oral presentation during the semester.</p>
<b>Additional Information</b>	

## Tentative Course Schedule

*(Time, topic/emphasis & resources)*

Week	Lectures	Topic
1	Tue 01/29/2019	Introduction
1	Thu 01/31/2019	Stress and strain (stresses)
2	Tue 02/05/2019	Possible fieldtrip to Gulf of Aqaba
2	Thu 02/07/2019	Possible fieldtrip to Gulf of Aqaba
3	Tue 02/12/2019	More on stress and strain, principal stresses, normal and shear stresses (more on stresses)
3	Thu 02/14/2019	More on stress and strain, tensor coordinate transformations
4	Tue 02/19/2019	Elastic, viscous, and viscoelastic rheologies
4	Thu 02/21/2019	Brittle and ductile failure
5	Tue 02/26/2019	Frictional sliding, Mohr's circle for fracture/friction, fluid effects on failure (strain)
5	Thu 02/28/2019	Possible fieldtrip to northwestern Saudi Arabia
6	Tue 03/05/2019	Possible fieldtrip to northwestern Saudi Arabia
6	Thu 03/07/2019	Anderson's theory on faulting, stable and unstable sliding (rheology)
7	Tue 03/12/2019	Earthquake mechanisms and moment tensors (rheology, failure)
7	Thu 03/14/2019	Earthquake mechanisms and moment tensors (failure)
8	Tue 03/19/2019	Earthquake scaling and size (failure, instability)
8	Thu 03/21/2019	Stress drop and Kostrov's summation (instability)
9	Tue 03/26/2019	Spring Break
9	Thu 03/28/2019	Spring Break
10	Tue 04/02/2019	Coulomb failure stress changes (moment tensors)
10	Thu 04/04/2019	Earthquake cycles and deformation (moment tensors)
11	Tue 04/09/2019	EGU conference in Vienna
11	Thu 04/11/2019	EGU conference in Vienna
12	Tue 04/16/2019	Midterm exam in class
12	Thu 04/18/2019	Interseismic deformation (earthquake scaling)
13	Tue 04/23/2019	Postseismic processes and deformation (CFS changes)
13	Thu 04/25/2019	Fault slip transients, stable fault sliding (earthquake cycles)
14	Tue 04/30/2019	Slip rate determination
14	Thu 05/02/2019	Earthquake statistics
15	Tue 05/07/2019	Earthquake hazard assessments, PSHA
15	Thu 05/09/2019	Earthquake geology and paleoseismology
16	Tue 05/14/2019	Earthquake geology and paleoseismology
16	Thu 05/16/2019	Student presentations
17	Tue 05/21/2019	Final Exam Week
17	Thu 05/23/2019	Final Exam Week

### Note

The instructor reserves the right to make changes to this syllabus as necessary.