

ERTH303 – Structural Geology – Fall 2021

Department of Earth Sciences

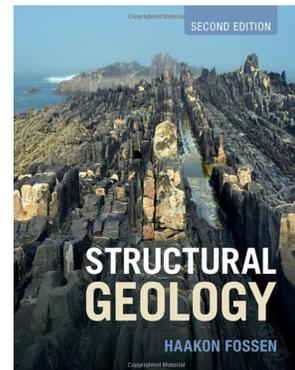


Instructor: Bridget Smith-Konter
Email: brkonter@hawaii.edu

Lecture: Tues/Thurs 12:00 - 1:15 pm
Lab: Fri 12:30-3:20*
Room: POST 702/706 (lecture) & 733/703 (lab)

COURSE DESCRIPTION: This course explores the geometry, kinematics, and mechanics of crustal deformation and continuum mechanics in geology. We develop skills in three-dimensional thinking through geologic maps, cross sections, various projections, experiments, and vector analyses. Topics covered include kinematics and mechanics, stress and strain, rheology, fracture and brittle deformation, tectonics and deformation regimes, and rock failure.

PREREQUISITES: EARTH 200, EARTH 250, MATH 241 or MATH 251, and PHYS 151 or PHYS 170, or instructor consent



TEXT: [Structural Geology](#), by H. Fossen (2nd Edition). Relevant lecture and reading material will also be provided on the course website and [Laulima](#).

MEETING TIMES AND FORMAT: EARTH303 will plan to meet primarily in-person at the times and locations provided above, but given the ongoing uncertainty associated with the COVID-19 pandemic, there may be times when class meeting format is temporarily shifted to online (via Zoom). Unexpected COVID-related circumstances (i.e., COVID exposure, positive test results, etc.) may also arise that may prevent a student from attending in-person class meetings. To alleviate unnecessary stress, a recurring Zoom meeting link for EARTH303 will be used for all class meetings:

<https://hawaii.zoom.us/j/91997487668>
Meeting ID: 919 9748 7668
Passcode: (check email)

*Please also note that Lab meeting time lengths will vary for a portion of the semester (i.e., from 12:30-2:30 pm; 2-hr labs instead of ~3-hr labs). This is an intentional adjustment in course hours to accommodate the 3-hr course credit designation of EARTH 303. A tentative course schedule is provided on pg. 5-6, with adjusted lab meeting times highlighted in yellow.

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GRADING: Grades will be formed based on a combination of problem sets/labs, pre-class exercises, Midterm Exams (2), a Final Exam, and class participation (more details on participation on pg. 3):

Pre-class prep	10%
Problem sets and labs	40%
Class participation	10%
Midterm Exams (each)	15% (x2)
Final Exam	10%

COURSE TOPICS

- Basic Earth observations: Realizing plate tectonics, deformation, and relative ages
- Geometry of structures: strike, dip, stereonet projections
- Faults, folds
- Relating structures and tectonism
- Shear zones, extensional regimes, contractional regimes
- Mathematics of deformation: vector and tensor analyses
- Deformation and velocity fields
- Strain, strain rate, strain ellipsoids
- Stress, kinematics and paleostress fields
- Deformation mechanisms, rheology, constitutive laws
- Fracture, brittle deformation, rock failure
- Joint and vein formation
- Rock and soil strength, slope stability, landslide mechanics

COURSEWORK

- **Assignments:** Pre-class prep activities, homework assignments, and lab exercises will be assigned approximately weekly. Deadlines may vary but will typically be due at the beginning of class 1 week after they are assigned (unless otherwise stated - the due date will be stated on the assignment); pre-class prep activities (i.e., reading assignments, review/preview exercises) may be assigned informally and will usually be due before the next class meeting
- **Working together on homework and labs:** Studies have shown that students learn best when they work together. You are encouraged to work with each other on assignments and labs. However, each student must turn in their own assignment, written using their own words. Any student who fails to follow this rule will receive zero credit for the question, and if the offense is severe, for the assignment.
- **Plagiarism and/or cheating will result with an F for the exam or assignment.**
- **Format:** Neatness, clarity of expression, and completeness are essential to obtain full credit on exams, assignments, and labs. *Please make sure to:*
 - Write out equations, or derive new ones, that you will use to solve problems, and explain (in words) your reasoning. Specify known and unknown information.
 - Draw illustrative figures that describe the problem.
 - Show clearly how you solved the problem.
 - Check your answer – does your solution make physical sense? Check units! Explain why you think your answer is correct.

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EXAM POLICY

- **Make-Up Exams/Early Exams.** Make-up exams will not be given except when a student misses the exam for a legitimate reason such as illness or family emergency (a doctor's note or other documentation is required). Please get in touch with me as soon as possible if such a situation arises. Anyone with sporting event conflicts must provide at least 2 weeks notice with appropriate signed paperwork.
- **Note that make-up and/or early exams will be essay format and will be substantially more difficult than the standard exam given to the rest of the class.**

CLASS PARTICIPATION

General stuff:

- **Come to class prepared.**
- Read class-related emails and announcements to enhance your participation and stay current; pay attention to course-related documents and deadlines.
- Watch any online lectures (as applicable).
- Read the assigned readings.
- Complete all assignments on time.
- Ask relevant questions.

In-class contributions:

- Attendance: attendance will be taken and you will earn credit for physically (or virtually) taking part in class each day.
- Class preparation: you should not only bring your body to class, but your mind and your concentration as well; complete and review pre-class assignments *before class begins*.
- Class contribution: as a student of EARTH303, you should attempt to contribute readily to class discussions and conversations. EARTH303 students will also be expected to show interest in and respect for others' contributions. Active participation and cooperation in groups will also be expected.

TIPS FOR SUCCESS

- **Lectures:** Attend every lecture, as they are the key to your success in this course. Some aspects of the course material will be covered in more detail in class than is provided the text.
- **Assignments and labs:** Do *each* assignment, and submit *each* one on time. Homework assignments and labs help you learn the material and are a great study guide for the exams.
- **Exams:** Do not miss an exam. Study. Read. Review.
- **Questions:** Questions are welcome and encouraged. Your questions are likely to help other students as well, so you should never feel intimidated to ask questions about course material.
- **Read:** Any assigned reading material will reinforce lecture material, so do complete each reading assignment.

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STUDENT LEARNING OBJECTIVES

The **Department of Earth Sciences** has established the following undergraduate student learning objectives. All of these objectives are relevant targets for the curriculum of EARTH303.

1. Students can explain the relevance of geology and geophysics to human needs, including those appropriate to Hawaii, and be able to discuss issues related to geology and its impact on society and planet Earth.
2. Students can apply technical knowledge of relevant computer applications, laboratory methods, and field methods to solve real-world problems in geology and geophysics.
3. Students use the scientific method to define, critically analyze, and solve a problem in earth science.
4. Students can reconstruct, clearly and ethically, geological knowledge in both oral presentations and written reports.
5. Students can evaluate, interpret, and summarize the basic principles of geology and geophysics, including the fundamental tenets of the sub-disciplines, and their context in relationship to other core sciences, to explain complex phenomena in geology and geophysics.

STUDENT CONDUCT AND ACADEMIC INTEGRITY University guidelines for acceptable student conduct are very specific and will be strictly followed. Academic integrity is a basic principal that requires all students to take credit for the ideas and efforts that are their own. Cheating, plagiarism, and other forms of academic dishonesty are defined as the submission of materials in assignment, exams, or other academic work that is based on sources prohibited by the faculty member. Academic dishonesty is defined further in the [UHM Student Code of Conduct](#). In addition to any adverse academic action, which may result from the academically dishonest behavior, the University specifically reserves the right to address and sanction the conduct involved through student judicial review procedures and the Academic Dispute Resolution Procedure specified in the University catalogue.

In a nutshell:

- *Cheating, of any form, will not be tolerated.*
- *Blind copying of intellectual material (text) from resources such as books, journals, and the internet is plagiarism and is illegal. Instead, you should write things in your own words with a proper reference to your source. If any assignments require you to look up an answer in something else than the class textbook, I will expect you to reference the source and write it in your own words.*

DISABILITY ACCESS The Earth Sciences Department will make every effort to assist those with disability and related access needs. If you need disability-related accommodations, please notify the Office for Students with Disabilities (known as “Kokua”), located in the Queen Lili’uokalani Center for Student Services (Room 013). <http://www.hawaii.edu/kokua/>

TITLE IX The University of Hawai’i is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources on your campus to support and assist you. Staff can also direct you to resources that are in the community. Here are some of your options:

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As members of the University faculty, your instructors are required to immediately report any incident of potential sex discrimination or gender-based violence to the campus Title IX Coordinator. Although the Title IX Coordinator and your instructors cannot guarantee confidentiality, you will still have options about how your case will be handled. Our goal is to make sure you are aware of the range of options available to you and have access to the resources and support you need.

If you wish to remain ANONYMOUS, speak with someone CONFIDENTIALLY, or would like to receive information and support in a CONFIDENTIAL setting, use the confidential resources available here: <http://www.manoa.hawaii.edu/titleix/resources.html#confidential>

If you wish to directly REPORT an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence or stalking as well as receive information and support, contact: Dee Unwood Title IX Coordinator (808) 956-2299 t9uhm@hawaii.edu.

BASIC NEEDS Basic needs include food and housing, childcare, mental health, financial resources and transportation, among others. Student basic needs security is critical for ensuring strong academic performance, persistence and graduation and overall student well-being. If you or someone you know are experiencing basic needs insecurity, please see [UH System Basic Needs](https://www.hawaii.edu/student-basic-needs/) (<https://www.hawaii.edu/student-basic-needs/>).

EMERGENCIES In the event of an emergency, this course syllabus may be modified and updated as needed. You will be notified of any changes that occur or modifications to the course schedule.

Tentative Course Schedule

PART I: INTRODUCTION TO STRUCTURAL GEOLOGY AND TECTONICS

Week 1	Aug 24	T	Intro to structural geology and deformation	Fo-Ch1	
	Aug 26	Th	Geometry of structures: Strikes, dips, stereonet* [*]	Fo-Ch1	
	Aug 27	F-Lab	Lab 1: Measuring strike, dip; stereonet* [*]		12:30-3:20 POST 703*
Week 2	Aug 31	T	Plate Tectonics I*	TS-Ch1	
	Sept 01	Th	Plate Tectonics II*	TS-Ch1	
	Sept 02	F-Lab	Lab 2: Topographic cross section lab*		12:30-3:20 POST 703*
Week 3	Sept 07	T	Faults: types, causes, and identification*	Fo-Ch9; Su-Ch8	
	Sept 09	Th	Folds: types, causes, and identification*	Fo-Ch3 & 12; Su-Ch9	
	Sept 10	F-Lab	Lab 3: Geologic map and cross section lab*		12:30-3:20 POST 703*
Week 4	Sept 14	T	Structures & tectonism: Extension/contraction regimes*	Fo-Ch17 & 18	
	Sept 16	Th	Structures & tectonism: Strike-slip regimes*	Fo-Ch19	
	Sept 17	F-Lab	Lab 4: Mapping exercise*		12:30-3:20 POST 703*
Week 5	Sept 21	T	Midterm I		
	Sept 23	Th	Math review: vectors, tensors, linear algebra basics		
	Sept 24	F-Lab	[no lab – credit hour compensation]		[no lab]

* Denotes joint class meeting with EARTH333

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PART II: PRINCIPLES OF DEFORMATION (MATHEMATICS)

Week 6	Sept 28	T	Deformation and mechanics basics	Fo-Ch2	
	Sept 30	Th	Strain	Fo-Ch2	
	Oct 01	F-Lab	Lab 5: Mathematics of deformation		12:30-2:30** POST 733
Week 7	Oct 05	T	Velocity fields and strain rate	Fo-Ch2	
	Oct 07	Th	Stress	Fo-Ch4	
	Oct 08	F-Lab	Lab 6: Deformation, strain, strain rate, rotation		12:30-2:30** POST 733
Week 8	Oct 12	T	Stress/strain in the lithosphere, measurements, apps	Fo-Ch5	
	Oct 14	Th	Kinematics and paleostress indicators	Fo-Ch10	
	Oct 15	F-Lab	Lab 7: Stress tensors and indicators		12:30-2:30** POST 733
Week 9	Oct 19	T	Rheology, constitutive laws, deformation mechanisms	Fo-Ch6	
	Oct 21	Th	Shear zones deformation	Fo-Ch16	
	Oct 22	F-Lab	Lab 8: Rheology applications		12:30-2:30** POST 733
Week 10	Oct 26	T	Midterm II review		
	Oct 28	Th	Midterm II		
	Oct 29	F-Lab	No lab [credit-hour compensation]		[no lab]

PART III: DEFORMATION MECHANISMS (CONT.), TYPES OF STRUCTURES, PROCESSES

Week 11	Nov 02	T	Fracture and brittle deformation	Fo-Ch7	
	Nov 04	Th	Failure, faulting, yield strength	Fo-Ch7	
	Nov 05	F-Lab	Lab 9: Fractures and failure		12:30-2:30** POST 733
Week 12	Nov 09	T	Joints, veins	Fo-Ch8	
	Nov 11	Th	HOLIDAY: Veterans' Day		
	Nov 12	F-Lab	No lab [credit-hour compensation]		[no lab]
Week 13	Nov 16	T	Soils: basic concepts*	TBA	
	Nov 18	Th	Hawaiian soils*	TBA	
	Nov 19	F-Lab	Lab 10: Hawaiian soils ID and field trip*		12:30-3:20 POST 703*
Week 14	Nov 23	T	Rock and soil strength, slope stability*	TBA	
	Nov 25	Th	Thanksgiving Holiday		
	Nov 26	F-Lab	Thanksgiving Holiday		[no lab]
Week 15	Nov 30	T	Landslide case studies I*	TBA	
	Dec 02	Th	Landslide case studies II*	TBA	
	Dec 03	F-Lab	Lab 11: Landslide field trip*		12:30-3:20 POST 703*
Week 16	Dec 07	T	Structural synthesis – regimes and applications		
	Dec 09	Th	Structural synthesis – regimes and applications		
	Dec 10	F-Lab	Structural synthesis lab		12:30-2:30** POST 733
Week 17	Dec 14		Final Exam		12:00-2:00

** Reduced lab meeting hours dur to credit hour compensation