

GEOPHYSICS: SOLID, FLUID, AND WAVE MECHANICS

DEPARTMENT OF EARTH SCIENCES | SOEST | UNIVERSITY OF HAWAII AT MĀNOA

WHO, WHAT, WHERE, WHEN...

INSTRUCTOR: Helen Janiszewski
CONTACT: hajanisz@hawaii.edu
OFFICE: POST 614A

CLASS TIME: TTh 1:30 - 2:45
MEETING ROOM: POST 723
OFFICE HOURS: By appointment

COURSE INFORMATION

The solid Earth deforms over a wide range of length scales, locations, and time scales, and in a variety of ways in response to different forcing mechanisms. In this class, we will study continuum mechanics in geophysics, as applied to the deformation of Earth materials (elastic, viscoelastic, and plastic deformations) and seismic wave propagation (body waves, surface waves, anisotropy, and attenuation). Topics to be covered include tensors, stress and strain in solids, rock failure, moment tensors, elasticity, ductile rheology, viscous flow, equations of motion and boundary conditions, the vector wave equation, wave field energy, reflection and transmission of seismic waves, and surface waves.

PREREQUISITES

PHYS 170, PHYS 272, MATH 307 or EARTH 312 (or equivalent), with a minimum grade of B-.

GRADING

Problem Sets (40%)

Weekly(ish) problem sets. Problem sets may be corrected and resubmitted for half credit.

Class Attendance (10%)

Students are expected to regularly attend lectures.

Class Participation (10%)

Students are expected to answer and ask questions during lecture, and participate in discussions.

Class Preparation (20%)

Students will be asked to review readings before class, and come prepared with a brief summary of the most important points of the reading to discuss. This may include readings from the texts or recent scientific papers.

Final Projects (20%)

Written and oral report on a topic of your choice related to the course material. May involve literature review, data analysis, or a combination of the above.

TEXTS

Geodynamics; Turcotte and Schubert

Introduction to Seismology, Earthquakes, and Earth Structure; Stein and Wysession

WEEK	TOPICS
1	Introduction and overview Vectors and tensors
2	Vectors and tensors, continued Definitions, relationship, and the stress tensor
3	The stress tensor continued Stress in the earth, equations of motion
4	Strain tensor The seismic wave equation
5	The seismic wave equation continued Plane and spherical waves
6	P and S waves Ray theory, Snell's Law
7	Reflection and transmission coefficients Travel time curves
8	Seismic phases Travel time tomography
9	Surface waves Dispersion
10	Anisotropy, Attenuation Seismic imaging techniques, discoveries
11	Stress, faulting, and earthquakes Focal mechanisms and moment tensors
12	Seismic wave radiation <i>No class - Veterans Day</i>
13	Brittle rock failure Anderson theory of faulting
14	Rock rheology <i>No class - Thanksgiving</i>
15	Viscoelasticity, ductile deformation Fluid mechanics, Newtonian fluids, viscosity
16	Fluid mechanics continued Presentations, additional discussion

EARTH LEARNING OBJECTIVES

This course will introduce the following Earth Department [Student Learning Objectives](#) (SLOs).

For the M.S. degree: (1) Technical knowledge; (2) Scientific method; (3) Communicate geological knowledge; (4) Employability/contributions post-graduation.

For the Ph.D. degree: (1) Technical knowledge; (2) Expertise in a sub-discipline; (3) Scientific method; (4) Communicate geological knowledge; (5) Employability/contributions post-graduation.

STUDENT CONDUCT AND ACADEMIC INTEGRITY

University guidelines for acceptable student conduct are very specific and will be strictly followed. Please read the [guidelines](#) and contact me if you have any concerns. Key points:

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.

In this graduate level class, you are encouraged to discuss problem sets and course material with your classmates, but absolutely all work submitted must be your own. Please mention any classmates that you collaborated with on problem sets prior to submission. You may also encounter problems that require references outside of the lecture material and textbooks. All information must be properly attributed; text should never be copied verbatim, any copied figures should be properly cited. Any plagiarized work will receive a zero for the whole assignment and cannot be re-done or made up.

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:

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](#). 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 Uwono Title IX Coordinator (808) 956-2299 t9uhm@hawaii.edu.

DISABILITY ACCESS

The Earth Sciences Department will make every effort to assist those with disability and related access needs. For confidential services, please contact the Office for Students with Disabilities (known as "Kokua") located in the Queen Lili'uokalani Center for Student Services (Room 013): KOKUA Program; 2600 Campus Road; Honolulu, Hawaii 96822. Voice: 956-7511; Email: kokua@hawaii.edu; URL: www.hawaii.edu/kokua