GEOPHYSICS: SOLID, FLUID, AND WAVE MECHANICS

DEPARTMENT OF EARTH SCIENCES | SOEST | UNIVERSITY OF HAWAI'I AT MĀNOA

WHO, WHAT, WHERE, WHEN...

INSTRUCTOR: Helen Janiszewski
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OFFICE: POST 614A

CLASS TIME: TTh 1:30 - 2:45
MEETING ROOM: POST 702
OFFICE HOURS: TBD

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.

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.

PREREQUISITES

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

GRADING

Homework (50%)

Weekly(ish) problem sets. Expectations for written work will be discussed in class. May be corrected and resubmitted for up to 50% of the missing problems. Problem sets should be turned in at the beginning of each class when it is due. If you are having difficulty, please talk with me. Otherwise, 10% will be deducted for each late class period.

Class Participation (20%)

Students are expected to regularly attend class, participate in discussions, and by answering and asking questions. If you must miss a class, please do your best to notify me ahead of time.

Project (30%)

There will be a final project that will apply the concepts you have learned in the class to a dataset of interest. It will involve a short in-class presentation of your findings, and a 10-page paper to be turned in at the end of the semester. We will discuss additional instructions and guidance in class.

TEXTS
MAIN TEXTS
Geodynamics; Turcotte and Schubert
Introduction to Seismology, Earthquakes, and Earth Structure; Stein and Wysession
ADDITIONAL RESOURCES
Introduction to Continuum Mechanics; Lai, Rubin, and Krempl
The Solid Earth: An Introduction to Global Geophysics; Fowler

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

WEEK	TOPICS
1	**Mathematics Fundamentals** Introduction and overview Vectors and tensors
2	Vectors and tensors, continued **Stress and Strain** Definitions, relationship, and the stress tensor
3	The stress tensor continued Stress in the earth, coordinate systems
4	Equations of motion Strain tensor
5	**Waves and Seismology** The seismic wave equation Plane waves
6	P and S waves Ray theory, travel time curves
7	Travel time tomography Seismic phases
8	Snell's law Reflection and transmission coefficients
9	Surface waves Dispersion
10	Anisotropy, Attenuation Seismic imaging techniques, discoveries
11	*No class - Election Day* **Rock Properties and Deformation** Stress, faulting, and earthquakes
12	Focal mechanisms Seismic wave radiation
13	Brittle rock failure, Mohr Coulomb Anderson theory of faulting, pore fluids
14	Rock rheology, elastic deformation *No class - Thanksgiving*
15	Viscoelasticity, ductile deformation Fluid Mechanics, Newtonian fluids, viscosity
16	Class presentations Additional discussion