

Introduction to Seismology

Department of Earth and Planetary Sciences, EPS452
Tuesdays and Thursdays, 10:00 - 11:20 am, Rudolph Hall 102
Fall, 2019

Contact Information

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Office hours upon request

Course Description

- This course will provide the fundamental background for the field of seismology. It is designed to be useful for a range of students: upperclass undergraduate EPS majors, first- or second-year graduate students who may or may not be concentrating in seismology, and students from other backgrounds (physics, math, engineering, etc.) who are interested in the topic.
- The course covers the normal sequence of topics for a university Intro Seismology course, including wave propagation, using seismic waves to determine earth structure, detecting and measuring earthquakes and other seismic sources, understanding plate tectonics through seismotectonics, and the basics of signal processing and inversion theory.

Course Learning Objectives for Students

- Use mathematics and analytical thinking to solve seismological problems.
- Construct explanations for geophysical phenomena based on seismological data.
- Understand the current trends and controversies in seismology.
- Use computational methods to address seismological questions.
- Develop scientific writing skills to synthesize seismological and earthquake-related information.
- Develop oral presentation skills using seismology and earthquake-related topics.

Required Texts

“Introduction to Seismology, Earthquakes, and Earth Structure,” by Seth Stein and Michael Wyession (available in the Book Store, EPS Library, and through resale options such as Amazon).

Grading

- Grading will be based upon weekly homework assignments and three projects, each with a writing component and a class presentation:

Final Grade Breakdown:

Homework 70% of final grade

Writing 15% of final grade

Presentations 15% of final grade

Assignments & Homework

- In general, homework assignments will be due on Thursdays and returned on Tuesdays. Homework assignments will still be accepted late, though marked 10% off each day they are late, until homeworks are handed back.
- Working together on homework problems is allowed, although each student is expected to have worked on problems individually before meeting as a group.
- Writing assignments and presentation powerpoints are expected to be done alone. Writing assignments will be edited and corrected and can be revised as many times as you like. It is therefore possible to always get full credit on writing assignments.
- The three projects will concern an earthquake of each student's choosing, an internal structure, layer, or feature of each student's choosing, and a Seismological "Grand Challenge" topic of each student's choosing.

Attendance, Participation, and Classroom Climate

- Classroom attendance is expected. Class time will involve a combination of lecture, discussion, and problem solving. Lectures will preview material required for completing the homework assignments. It is recommended that students read the portions of the book related to the homework when it is assigned.
- All classroom interactions are expected to remain civil, respectful, and supportive. For WashU's policy on Inclusive Learning, please see <https://diversity.wustl.edu/framework/advisory-best-practice-groups/inclusive-learning-environment/>.

University-Wide Policies

Statement on Military Service Leave

Washington University recognizes that students serving in the U.S. Armed Forces and their family members may encounter situations where military service forces them to withdraw from a course of study, sometimes with little notice. Students may contact the Office of Military and Veteran Services at (314) 935-2609 or veterans@wustl.edu and their academic dean for guidance and assistance. See: <https://veterans.wustl.edu/policies/policy-for-military-students/>.

Preferred Names and Gender Inclusive Pronouns

In order to affirm each person's gender identity and lived experiences, it is important that we ask and check in with others about pronouns. This simple effort can make a profound difference in a person's experience of safety, respect, and support. See: <https://students.wustl.edu/gender-pronouns-information/>, <https://registrar.wustl.edu/student-records/ssn-name-changes/preferred-name/>

Reporting Sexual Assault

If a student discusses or discloses an instance of sexual assault, sexual discrimination, sexual harassment, dating violence, domestic violence or stalking, or if a faculty member otherwise observes or becomes aware of such an allegation, they will keep the information as private as possible, but as a faculty member of Washington University, they are required to immediately report it to the Department Chair or Dean or directly to Ms. Jessica Kennedy, the University's Title IX Directory, at (314) 935-3118, jwkennedy@wustl.edu. Additionally, you can report incidents or complaints to the Office of Student Conduct and Community Standards or by contacting

WUPD at (314) 935-5555. Students who wish to speak with a confidential resource may wish to reach out to the Relationship and Sexual Violence Prevention Center (RSVP) at 935-8761 or by visiting the 4th floor of Seigle Hall.

Accommodations for Sexual Assault

The University is committed to offering reasonable academic accommodations (e.g., no contact order, course changes) to students who are victims of relationship or sexual violence, regardless of whether they seek criminal or disciplinary action. If you need to request such accommodations, please contact the Relationship and Sexual Violence Prevention Center (RSVP) at rsvpcenter@wustl.edu or (314) 935-3445 to schedule an appointment with an RSVP confidential, licensed counselor. Information shared with counselors is confidential. However, requests for accommodations will be coordinated with the appropriate University administrators and faculty.

Emergency Preparedness

Before an emergency, familiarize yourself with the building(s) that you frequent. Know the layout, including exit locations, stairwells and the Emergency Assembly Point (EAP). Review the “Quick Guide for Emergencies” that is found near the door in many classrooms for specific emergency information and instructions. For additional Information and EAP maps, visit emergency.wustl.edu. To ensure that you receive emergency notifications, make sure your information and cell phone number is updated in SIS, and/or download. The WUSTL app and enable notifications.

To report an emergency:

Danforth Campus: (314) 935-5555

School of Medicine Campus: (314) 362-4357

North/West/South and Off Campus: 911 then (314) 935-5555

Resources for Students

Disability Resources

Washington At Washington University we strive to make the academic experience accessible and inclusive. If you anticipate or experience barriers based on disability, please contact Disability Resources at 314.935.5970, disabilityresources@wustl.edu, or visit our website for information about requesting academic accommodations. See: <https://students.wustl.edu/disability-resources/>

The Writing Center

The Writing Center, located in Olin Library, offers free one-on-one writing tutorials to WashU students, as well as workshops designed to help students become better writers. The Writing Center staff can assist by providing feedback on the strength of an argument, clarity, and organization. Contact them at 935-4981 or writing@wustl.edu.

The Learning Center

The Learning Center works collaboratively with University partners to provide undergraduate students key resources, like academic peer mentoring, to enhance their academic progress. Contact them at learningcenter.wustl.edu to find out what support they may offer for your classes.

Mental Health Services

Mental Health Services’ professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about

friends and family, concerns about eating or drinking patterns, and feelings of anxiety and depression. For more information, visit: www.students.wustl.edu/mental-health-services/

Relationship and Sexual Violence Prevention Center (RSVP)

The Relationship and Sexual Violence Prevention Center (RSVP) offers support for those who have experienced sexual violence, sexual misconduct, dating violence, domestic violence or stalking. RSVP can help those who are not sure what steps they wish to take to respond to their experiences. They offer confidential support and can help arrange for necessary classroom accommodations. To get help, contact the RSVP Center at 935-3445 or rsvpcenter@wustl.edu. Their office is located in Seigle Hall, Suite 435.

Bias Report and Support System (BRSS)

The University has a process through which students, faculty, staff, and community members who have experienced or witnessed incidents of bias, prejudice, or discrimination against a student can report their experiences to the University's Bias Report and Support System (BRSS) team. To report an instance of bias, visit www.brss.wustl.edu.

Center for Diversity and Inclusion (CDI)

The Center for Diversity and Inclusion (CDI) supports and advocates for undergraduate, graduate, and professional school students from underrepresented and/or marginalized populations, collaborates with campus and community partners, and promotes dialogue and social change to cultivate and foster a supportive campus climate for students of all backgrounds, cultures and identities. See: <https://diversityinclusion.wustl.edu/>

Course Schedule (Tentative)

Aug	27	Course Introduction
	29	Math Quiz and interpretation
Sep	3	2.1 & 2.2: Waves on a string
	5	2.3: Stress and strain
	10	2.4: Seismic Waves
	12	2.5: Snell's law
	17	2.6: Plane wave reflection and transmission
	19	2.7: Surface waves and 2.8: Dispersion
	24	2.9: Normal modes
	26	3.1 & 3.2: Refraction seismology
Oct	1	3.3: Reflection seismology
	3	3.4: Seismic waves in a spherical earth and 3.5: Body waves
	8	3.6: Anisotropy
	10	3.7: Attenuation and anelasticity and 3.8: Composition of the mantle and core
	15	Fall Break

	17	4.1 & 4.2: Focal mechanisms
	22	4.3 & 4.4: Waveform modeling and Moment Tensors
	24	4.5: Earthquake geodesy and 4.6: Earthquake source parameters
	29	4.7: Earthquake statistics
	31	5.1 & 5.2: Plate kinematics
Nov	5	5.3: Spreading centers
	7	5.4: Subduction zones
	12	5.5 & 5.6: Intraplate earthquakes
	14	5.7: Faulting processes
	19	6.1 to 6.3: Fourier analysis and Linear Systems
	21	6.4 & 6.5: Discrete time series and transforms and Stacking
	26	6.6: Seismometers
	28	Thanksgiving
Dec	3	7.1 & 7.2: Inverse problems: Earthquake locations
	5	7.3: Inverse problems: Travel time tomography