COURSE SYLLABUS

GEO 5640/6640 Seismology

Fall 2024 Lecture: TR 9:00-10:15 am rm 308

Professor: Tony Lowry (Department of Geosciences)

- Geology Bldg Room 106 (Phone: 435-557-6780)
- Email: Tony.Lowry@usu.edu
- Office Hours: TR 10:30-12:30 (or by appt)
- Website: http://aconcagua.geol.usu.edu/~arlowry/Seismo/index.html

CONCEPTUAL & SKILL OBJECTIVES

Primary: Earth as a complex system; Earth materials; Earth structure; Applying strong quantitative skills

Secondary: Properties of Earth's interior and structural features, including processes that influence plate tectonics and geologic hazards of our region; Pathways, fluxes, and influence of water and other fluids in Earth's subsurface

Course Objectives:

By the end of this course, you will be able to:

- Utilize computational skills for managing and analyzing multi-component datasets
- Describe large-scale internal Earth processes and the features produced by them
- Produce and interpret geophysical measurements of subsurface properties

COURSE DESCRIPTION

Seismology is a geophysical toolbox that uses the elastic wave equation to address a wide variety of different basic and applied problems.

Seismic waves combine information about strain energy released at a source and the physical properties of the medium through which the wave propagates. Hence seismology is used both for 3D imaging of the Earth's interior and for characterization of strain sources, including earthquakes and explosions, but also more exotic creatures like slow fault slip, glacial calving events, drilling activity and storm waves in distant oceans. This introductory course teaches some of the fundamentals of seismology and discusses applications to current events and important problems of all types. This course briefly touches on near-surface imaging applications commonly used in industry, but these are treated in much greater detail in GEO 5660/6660, Introduction to Applied Geophysics.

Not surprisingly, the tools we discuss (and use) in this course are fundamentally mathematical. We'll try to stick to basic concepts of calculus, linear algebra and probability & statistics that in some cases will be familiar territory (and when they're not, we'll introduce the unfamiliar concepts more gradually).

About the professor:

I am a geophysicist ("Physics of the Earth") who focuses on measuring and understanding how and why planets deform. On Earth, this relates most directly to processes of fault slip, deep ductile flow, earthquakes and volcanoes, but also has implications for mass transfer in the atmosphere, hydrosphere and cryosphere.

Course Text
(Required): **An Introduction to Seismology, Earthquakes and Earth Structure** (Stein & Wysession). Reading assignments to be announced.
(Recommended): **Quantitative Seismology: Theory and Methods**, (Aki & Richards), particularly if you intend to pursue further studies in seismology.

TENTATIVE SCHEDULE

27–29 Aug:	Introduction; The Seismogram	S&W 1-38
3–5 Sep:	Vectors, Derivatives, & Complex Variables	
10-12 Sep:	Tensors, Stress and Strain	S&W 39-74
17–19 Sep:	Equations of Motion; the Wave Equation	
24–26 Sep:	Spherical Coordinates; Ray Theory; the Seismic Source	
1–3 Oct:	Plane Wave Reflection/Transmission; Evanescent Waves	
8–10 Oct:	Surface Waves: Rayleigh & Love Waves	
15–17 Oct:	Normal Modes; Take-home exam 1.	
22–24 Oct:	Reflection/Refraction Seismology	
29–31 Oct:	Reflection Methods	
5–7 Nov:	Body waves; Imaging Earth's Deep Interior	
12–14 Nov:	Anisotropy	
19–21 Nov:	Amplitudes & Attenuation	
26 Nov:	Earthquakes and Focal Mechanisms	
	(Nov 27–29 is Thanksgiving break)	
3–5 Dec:	Moment Tensors; Source Theory	

Final Course Project: (Grad students only) This will require both an oral presentation and a written report, both due on the final exam date.

Finals Week: Take-home Exam 2 due at the end of the final exam period (9:30 AM, Friday December 13).

Web materials (incl. lecture ppt's), updated scheduling and announcements will be available at http://aconcagua.geol.usu.edu/~arlowry/Seismo/index.html

Grading:		**5640**	**6640**
Short exercises	~4	50%	33.3%
Take-home exams	2	50%	33.3%
(Grads) Semester Project		---	33.3%

Differences between the 5000 and 6000 level course:
In addition to doing a semester project, as noted above, taking the course at the graduate level entails doing a few additional (more challenging) problems for the assignments and exams.

Notice to veterans and students with disabilities: **Students with ADA-documented physical, sensory, emotional or medical impairments are eligible for reasonable accommodations. Veterans may also be eligible for services. All accommodations are coordinated through the Disability Resource Center (DRC) in Room 101 of the University Inn, (435) 797-2444 voice, (435) 797-0740 TTY, or toll free at 1-800-259-2966. Please contact the DRC as early in the semester as possible. Alternate format materials (Braille, large print or digital) can be made available.**