COURSE SYLLABUS

GEO 5640/6640 Seismology

Fall 2022 Lecture: MWF 8:30-9:20 am rm 301c

Professor: Tony Lowry (Department of Geosciences)

- Geology Bldg Room 106 (Phone: 557-6780)
- Email: Tony.Lowry@usu.edu
- Office Drop-in Hours: MWF 9:30-10:30 (or by appt)
- Website: http://aconcagua.geol.usu.edu/~arlowry/Seismo/index.html

COURSE DESCRIPTION

About Seismology:
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. The 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 will 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 slowly). And, we will try to illustrate these concepts with hands-on analysis of seismic data (focusing on the interests of students in the class).

Ultimately, this course is meant to provide you (the student) with a set of tools and skills that will be helpful in your later career and (in the case of graduate students) your current thesis research.

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 and research in seismology.

Course Objectives
By the end of this course, you will be able to:
• Utilize strong computational skills for managing and analyzing seismic datasets
• Describe large-scale internal Earth processes and the features produced by them
• Produce and interpret geophysical measurements of subsurface properties

TENTATIVE SCHEDULE

29 A–2 S:	Introduction; The Seismogram	S&W 1-38
7–9 Sep:	Vectors, Derivatives, & Complex Variables (Sep 5 is Labor Day; no class)	
12–16 Sep:	Tensors, Stress and Strain	S&W 39-74
19–23 Sep:	Equations of Motion; the Wave Equation	
26–30 Sep:	Spherical Coordinates; Ray Theory; the Seismic Source	
3–7 Oct:	Plane Wave Reflection/Transmission; Evanescent Waves	
10–14 Oct:	Surface Waves: Rayleigh & Love Waves	
17–21 Oct:	Normal Modes; Take-home exam 1.	
24–28 Oct:	Reflection/Refraction Seismology	
31 O–4 N:	Reflection Methods	
7–11 Nov:	Body waves; Imaging Earth's Deep Interior	
14–18 Nov:	Anisotropy	
21 Nov:	Amplitudes & Attenuation (Nov 23-25 is Thanksgiving break)	
28 N–2 D:	Earthquakes and Focal Mechanisms	
5–9 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, Monday December 12).

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	~6	50%	33.3%
Take-home exams	2	50%	33.3%
(Grads) Semester Project		---	33.3%

Late Assignment Policy:
All assignments are due at the date & time specified, but in extenuating circumstances late assignments will be accepted. **However**, recognize that falling behind can result in a cascade of unfinished work that results in a daunting workload, and that many students who have fallen behind in courses I have taught previously, never managed to complete the course. Oftentimes, if an assignment is not quite complete at the date and time due, your best course of action (i.e., leading to the highest final grade) will be to turn in what you have and move on to the next assignment.

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.**