Spring 2-1-2018

GEO 582.01: Topics in Structure & Geophysics

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Geo 582: ST: Topics in Structure and Geophysics
Seismology and Geodesy

Instructor information

Instructor: Dr. Hilary Martens | Office: CHCB 329/330
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Lecture hours: TR 10:00-11:20 am | Office hours: TBD

Course description:

We will explore modern topics in geophysics, with a focus on seismology and geodesy. Advanced topics may vary with each offering, but will generally include selections from continuum mechanics, inverse theory, seismic wave propagation, earthquake location, tidal analysis and prediction, GNSS theory and analysis, spheroidal Earth deformation, and surface mass loading. Students will have the opportunity to engage directly with real seismic and geodetic datasets using computational tools, as well as to investigate problems of personal interest through individual research projects. *Prerequisites*: PHSX207 or PHSX217 or equivalent, M263 or M172 or equivalent, and GEO439 or equivalent, or consent of instructor. 3 credits. Offered Spring.

Learning Outcomes:

By the end of the course, students should be able to:

1. Describe the causes and consequences of plate tectonics
2. Visualize and explain how the solid Earth responds to loading and gravitational forcing
3. Solve basic geophysical inverse problems
4. Quantify stress and strain relationships in solids
5. Assess the advantages and disadvantages of various geophysical methods used to probe Earth structure and dynamics
6. Acquire, process, visualize, and interpret seismic and geodetic data using computational tools
7. Apply geophysical theory and methods to problems in their own research areas
8. Appreciate the importance and relevance of geophysics to society
9. Navigate file systems from a Linux terminal and write simple shell scripts
10. Write simple computer programs in Python to solve geophysical problems

Course Calendar*:

* Subject to change: We will try to stick to the schedule as best as possible, but may need to adjust from time to time.

Dates	Topic	Assignment	Due Date
Week 1	**Welcome**		
23 January	Welcome | Pre-Quiz		
25 January	Linux Lab	Linux and Python Tutorials	Thursday 1 February at 10 am
Week 2	**Earth Structure and Dynamics I**		
30 January	Planetary Formation and Evolution		
1 February	Earth Structure	Problem Set 1	Thursday 8 February at 10 am
Week 3	**Earth Structure and Dynamics II**		
6 February	Global Tectonics		
8 February	Heat Flow -- Project Introductions	Problem Set 2 -- Project: Part 1	Thursday 15 February at 10 am -- Thursday 8 March at 10 am
Week 4	**Rock Mechanics**		
13 February	Rock Mechanics I		
15 February	Rock Mechanics II	Problem Set 3	Thursday 22 February at 10 am
Week 5	**Earthquake Seismology I**		
20 February	Seismology I		
22 February	Seismology II	Problem Set 4	Thursday 1 March at 10 am
Week 6	**Earthquake Seismology II**		
27 February	Seismology III		
1 March	GMT Lab	GMT Tutorials -- Project: Part 2	Thursday 8 March at 10 am -- Thursday 12 April at 10 am
Week 7	**Earthquake Seismology III**		

Dates	Topic	Assignment	Due Date
6 March	Seismic Data Acquisition and Analysis		
8 March	SAC Lab	SAC Tutorials	Thursday 15 March at 10 am
Week 8	**Earthquake Seismology IV**		
13 March	Seismic Case Studies		
15 March	ObsPy Lab	Problem Set 5	Thursday 5 April at 10 am
Week 9	**Inverse Theory**		
20 March	Inverse Theory I		
22 March	Inverse Theory II	Work on PS5 and Projects	Final Reports by Thursday 3 May
Week 10	**Spring Break**		
Week 11	**Gravity and Geodesy**		
3 April	Gravity and Geodesy I		
5 April	Gravity and Geodesy II	Problem Set 6	Thursday 12 April at 10 am
Week 12	**GNSS Processing and Analysis**		
10 April	Fundamentals of GNSS		
12 April	GIPSY Lab	Problem Set 7 -- Project: Part 3	Thursday 19 April at 10 am -- Thursday 3 May at 10 am
Week 13	**Tidal Analysis and Prediction**		
17 April	Tidal Analysis and Prediction I		
19 April	Tidal Analysis and Prediction II	Problem Set 8	Thursday 26 April at 10 am
Week 14	**Loading and Earth Deformation I**		
24 April	Loading and Earth Deformation I		
26 April	Loading and Earth Deformation II	Project: Part 4	Wednesday 9 May at 8 am
Week 15	**Loading and Earth Deformation II**		
1 May	Loading and Earth Deformation III		
3 May	Course Wrap-Up and Evaluations		
Week 16	**Student Presentations**		
Wed. 9 May 8-10 am	Independent Research Project: Oral Presentations		

Required assignments:

1. Problem Set 1: Moments of Inertia
2. Problem Set 2: Planetary Density Structure
3. Problem Set 3: Stress and Strain in Solids
4. Problem Set 4: Earthquake Hypocenters and Focal Mechanisms
5. Problem Set 5: Graphical Visualizations
6. Problem Set 6: Inverse Theory
7. Problem Set 7: Earthquake Location
8. Problem Set 8: Earth and Ocean Tides
9. Independent Research Project: Geophysical Methods and Applications
10. Computer Tutorials: Linux, Shell scripting, Vi text editor, Python, GMT, SAC, ObsPy, GIPSY

Required textbooks:

No textbooks are specifically required for the course. Applicable reading materials may be provided throughout the semester.

Suggestions for further reading include:

- Lowrie, W. (2007), *Fundamentals of Geophysics*, 2nd Ed., Cambridge University Press.
- Stacey, F.D., and P.M. Davis (2008), *Physics of the Earth*, 4th Ed., Cambridge University Press.
- Turcotte, D.L., and G. Schubert (2002), *Geodynamics*, 2nd Ed., Cambridge University Press.
- Lai, W.M., D. Rubin, and E. Krempl (2010), *Introduction to Continuum Mechanics*, 4th Ed., Elsevier Ltd.
- Shearer, P.M. (2009), *Introduction to Seismology*, 2nd Ed., Cambridge University Press.
- Aster, R.C., B. Borchers, and C.H. Thurber (2013), *Parameter Estimation and Inverse Problems*, 2nd Ed., Academic Press.
- Jaeger, J.C., N.G.W. Cook, and R. Zimmerman (2007), *Fundamentals of Rock Mechanics*, 4th Ed., Wiley.

Course guidelines and policies:

Student Conduct Code

All students are expected to abide by The University of Montana's Student Conduct Code:
https://www.umt.edu/vpsa/policies/student_conduct.php

Attendance

Regular attendance is encouraged and expected. If you need to miss a class, please inform the instructor in advance.

Course withdrawal

Please refer to Institute policy on adding, dropping, and withdrawing from courses:
https://www.umt.edu/registrar/students/dropadd.php

Disability modifications

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or call 406.243.2243. I will work with you and Disability Services to provide an appropriate modification.

Assignment expectations

Assignments are expected to be completed thoughtfully and on-time. More information on UM's academic policies and procedures:
http://archive.umt.edu/catalog/14_15/academics/academic-policy-procedure.php

Honor code (from Caltech): "No member of the community shall take unfair advantage of any other member of the community."

Plagiarism: Reproducing the work of someone else, and representing the work as your own, without appropriate citation and attribution is forbidden. Plagiarism extends beyond tangible material to also include ideas. When in doubt, cite.

Collaboration: Collaboration on problem sets, projects, and tutorials is encouraged. You may consult external references (e.g., internet, books, journal papers, etc.) with appropriate citations and attributions. You may also work with others provided that all solutions that you submit represent your own work (written up individually and reflecting your own understanding of the material). As a general guideline, you should be able to reproduce solutions from your submitted problem sets without help from anyone else.

Grading policy

Problem sets: 50% || Independent Research Project: 30% || Tutorials/Labs: 20%

It is recommended to start assignments early to avoid last-minute complications. I understand that sometimes situations arise that are out of our control. For that reason, you will be allowed one late-assignment grace period during the term. When electing to use your grace period, you must submit the late assignment within 48 hours of the original due date. Please plan accordingly, and let me know in advance if you may not be able to complete an assignment on time.

Additional Information and resources:

Student Academic Resources *

Disability Services for Students (DSS): http://www.umt.edu/dss/ *
Office for Student Success: http://www.umt.edu/oss/ *
Career Services: http://www.umt.edu/career/ *
Mansfield Library: http://www.lib.umt.edu *
UM Writing and Public Speaking Center: http://www.umt.edu/writingcenter/ *

Student Health and Wellbeing *

Curry Health Center (mental health, physical health, pharmacy, health promotion): http://www.umt.edu/curry-health-center/ *
Campus Recreation: http://www.umt.edu/crec/ *
DiverseU: http://www.umt.edu/diverseu/ *
Student Activity Groups: http://TDwww.umt.edu/asum/student_groups/ *