Geo 491 – Introduction to Geophysics

Instructor information

Instructor: Dr. Hilary Martens | Office: CHCB 329/330
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Lecture hours: TR 10:00–11:20 am (CHCB 304) | Office hours: Monday 1:00 – 2:30 pm; Tuesday 11:30 am – 12:30 pm

Course description:

We will explore a variety of fundamental topics in geophysics, including Earth formation, Earth structure, plate tectonics, gravity, seismology, and magnetics. The course will also cover modern geophysical surveying methods, including reflection seismology, refraction seismology, gravity surveying, and magnetic surveying. *Prerequisites*: Two semesters calculus; one semester physics.

Learning Outcomes:

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

1. Describe the structure of Earth's interior
2. Apply the law of universal gravitation to the Earth
3. Describe gravitational potential and the geoid
4. Make appropriate corrections to gravity measurements and interpret data collected by a gravity survey
5. Describe the different types of seismic waves and write down the equations for seismic-wave velocities
6. Interpret earthquake focal mechanisms
7. Analyze seismic reflection and refraction data
8. Interpret magnetic anomalies

Required textbooks:

Lowrie, W. (2007), *Fundamentals of Geophysics*, 2nd Ed., Cambridge University Press

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	Reading	Assignment	Due Date
Week 1	**Welcome**			
31 August	Welcome | What is geophysics?	M&K, Cassini Handouts	Homework 1	Thursday, 09/07, 3pm
Week 2	**Earth as a Planet I**			
5 September	Solar System I	1.1.1 – 1.1.3.4		
7 September	Solar System II	1.1.3.5 – 1.1.4	Homework 2	Thursday, 09/14, 3pm
Week 3	**Earth as a Planet II**			
12 September	Plate Tectonics I	1.2.1 – 1.2.3		
14 September	Plate Tectonics II	1.2.4 – 1.2.6	Homework 3	Thursday, 09/21, 3pm
Week 4	**Gravity and Geodynamics I**			
19 September	Gravitation Theory I	2.1 – 2.2		
21 September	Gravitation Theory II	2.3.1 – 2.3.3	Homework 4	Thursday, 09/28, 3pm
Week 5	**Gravity and Geodynamics II**			
26 September	Earth's Figure and Gravity	2.4.1 – 2.4.3		
28 September	Isostasy and Rheology	2.7.1 – 2.8.1	Homework 5	Thursday, 10/05, 3pm
Week 6	**Gravity and Geodynamics III**			
03 October	Gravity Surveying I	2.4.4 – 2.4.5; 2.5.3		
05 October	Gravity Surveying II	2.5.4; 2.5.5.4; 2.5.6	Homework 6	Thursday, 10/12, 3pm
Week 7	**Gravity and Geodynamics IV**			
10 October	Gravity Surveying III	2.6.1 – 2.6.3.5		
12 October	Gravity Surveying IV	2.6.4	Midterm Study	
Week 8	**Midterm I**			
17 October	Midterm I			

Dates	Topic	Reading	Assignment	Due Date
19 October	Elasticity Theory	3.1 – 3.2	Homework 7	Thursday, 10/26, 3pm
Week 9	**Seismology and Structure I**			
24 October	Seismic Waves	3.3.1 – 3.3.2.4		
26 October	Earthquake Seismology	3.5.1 – 3.5.3	Homework 8	Thursday, 11/02, 3pm
Week 10	**Seismology and Structure II**			
31 October	Reflection Seismology I	3.6.5 – 3.6.5.1		
2 November	Reflection Seismology II	3.6.5.2 – 3.6.5.6	Homework 9	Thursday, 11/09, 3pm
Week 11	**Seismology and Structure III**			
7 November	Refraction Seismology I	3.6.6 – 3.6.6.2		
9 November	Refraction Seismology II	3.6.6.3 – 3.7.1	Homework 10	Thursday, 11/16, 3pm
Week 12	**Seismology and Structure IV**			
14 November	Focal Mechanisms	3.5.4		
16 November	Review / Catch-up		Midterm Study	
Week 13	**Midterm II**			
21 November	Midterm II			
23 November	Thanksgiving Break: No Class		Break	
Week 14	**Geomagnetism I**			
28 November	Magnetism Theory I	5.1		
30 November	Magnetism Theory II	5.2.1 – 5.2.5	Homework 11	Thursday, 12/07, 3pm
Week 15	**Geomagnetism II**			
5 December	Geomagnetism	5.4.1 – 5.4.4.2		
7 December	Magnetic Surveying	5.5.1; 5.5.5	Final Study	
Week 16	**Final Exam**			
12 December	Review / Catch-up			
?? December	Final Exam			

Required assignments and exams:

1. Homework 1: Cassini
2. Homework 2: Solar system
3. Homework 3: Plate tectonics
4. Homework 4: Gravity
5. Homework 5: Isostasy
6. Homework 6: Gravity anomalies
7. Homework 7: Elasticity
8. Homework 8: Earthquake seismology
9. Homework 9: Reflection seismology
10. Homework 10: Refraction seismology
11. Homework 11: Magnetics
12. **Midterm Exam 1**: Tectonics and Gravity
13. **Midterm Exam 2**: Seismology
14. **Final Exam**: Comprehensive

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 participation in course exercises is expected. If you need to miss a class lecture or activity, please inform me 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.

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

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 homework sets is encouraged, provided that all solutions that you submit represent your own work. In particular, homework solutions should be written up individually and reflect your own understanding of the material. As a general guideline, you should be able to reproduce solutions from your submitted homework sets without help from anyone else. You may consult external references (e.g., websites, textbooks, etc.), with citations and attributions included as appropriate.

More information on UM's academic policies and procedures:
http://archive.umt.edu/catalog/14_15/academics/academic-policy-procedure.php

Grading policy

Homework: 50%
Midterm Exam 1: 10%
Midterm Exam 2: 10%
Final Exam: 25%
Class Participation (Discussions, in-class exercises, attendance, etc.): 5%

Late assignments, without pre-approval, will not be accepted. To accommodate unforeseen circumstances, your lowest homework score will be dropped at the end of the term. Under extenuating circumstances, you may also speak with me about a possible homework extension well in advance (generally at least one week) of the due date. Extensions are not guaranteed unless pre-approved. It is always recommended that you begin homework assignments well in advance of the due date, so that you may have more time to work through the problems and also to avoid unexpected situations that might prevent you from finishing.

Problem sets will generally be due on Thursdays by 3 pm. The extra time beyond our normal class period is provided as a courtesy. Thursday lectures are not intended for working on the sets or for asking questions about the sets. Assignments should be started well in advance of the deadlines so that you may have time to work through unanticipated issues. Assignments may be submitted at the start of the class period on Thursdays, or directly to me in my office by 3 pm. If I am away, slip your set under my office door.

Additional Information and resources

Student Academic Resources

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

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://www.umt.edu/asum/student_groups/