

GLY 4451 Solid Earth Geophysics

Term:

Fall 2024

Instructor:

Dr. Xavier Comas

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Class modality and Schedule:

Class modality: in-person.

Schedule: Monday (2:00pm-4:50pm),

Science Building Boca, Room 417

Office hours:

Monday (10:00 am-2:00 pm), room 460, or by appointment; available online

Teaching Assistant:

Shelley Peirce

speirce2019@fau.edu

Office hours: Monday (10:00am-2:00pm), and Tuesday (12:00pm-2:00pm)

Prerequisites:

None

Credit hours:

3 credits hours

Class textbook: (recommended)

“Looking into the Earth: An Introduction to Geological Geophysics”, by M. Mussett and M. A. Khan, Cambridge University Press, Cambridge, 2001, 608 pp.

“Fundamentals of Geophysics”, 2nd edition by W. Lowrie, Cambridge University Press, 2007, 381 pp.

Course description:

The course gives an introduction of the fundamental principles of each major branch of geophysics: seismology, gravitation, magnetism, electrical and thermal properties. Emphasis is given to geodynamics and plate tectonics. A comprehensive overview of geophysical techniques is also given to better understand the relation between measurements taken at the Earth’s surface and physical properties investigated in relation to the Earth’s interior. The course is designed for students with basic grounding in math and physics. Sets of practical exercises will be completed at the end of each chapter and will be designed to give students a practical approach to geophysical methods while enhancing their skills in quantitative problem solving.

Since this class involves both undergraduates and graduate students, and in order to normalize grades between the two levels, graduate students will be required to complete additional tasks during the assignments and examinations that will be graded separately and included in their final grade.

Course Objectives:

1) To provide an overview of the theoretical basis and principles of geophysical methods; 2) to examine how different types of geophysical observations offer constraints on Earth's structure and composition; 3) to present an overview of the plate tectonics framework and its dynamics; 4) to become familiar with case studies and exercises related to the use of geophysics for the study of Earth's internal dynamics.

Method of instruction:

Combination of theory and practical exercises in the classroom and in the field. Practical exercises will be initiated in the classroom towards the end of selected lecture sessions (see intended course calendar for details). One fieldtrip will be scheduled during the first 4-5 weeks of classes. Students will be responsible for completing and submitting the exercises as homework assignments.

Contents:

The general course structure will be as follows (see intended course calendar for further details):

- 1) Introduction: general overview of geophysical data acquisition and processing
- 2) Seismology: waves, earthquakes, refraction and reflection methods and interpretation
- 3) Gravity: gravitational field, anomalies, isostasy, methods and modeling
- 4) Magnetism: magnetic field, geomagnetism, anomalies, methods, paleomagnetism
- 5) Electrical electromagnetic methods: heat transfer, flow, geoelectricity, methods
- 6) Radioactivity: radioactive dating and surveying
- 7) Geothermics: heat flow and temperature, geothermal energy

Assessment procedure:

Exams:	Mid-term:	25%
	Final:	25%
Practical exercises/Labs:		25%
Presentation:		20%
Quizzes:		5%

Make-up policy:

You must have an exceptional circumstance in order to qualify for a make-up exam. Make-up exams will only apply to mid-term and final, and only one make-up will be granted if requested prior to the exam with a justification. No make-ups will be granted for quizzes.

Extra credit policy:

No extra credit will be granted under any circumstances

Grading scheme:

Florida Atlantic University has a plus/minus (+/-) grading system. Grades for the undergraduate and graduate courses are reported by the symbols indicated in the following table

A	93-100%
A-	90-92.9%
B+	87-89.9%
B	83-86.9%
B-	80-82.9%
C+	77-79.9%
C	70-76.9%
D	63-69.9%
F	63% or lower

Grades for all quizzes, exams, and labs will be posted on Canvas less than a week after being completed. An email announcement will be sent immediately after every posting.

Attendance:

Students are expected to attend all of their scheduled University classes and to satisfy all academic objectives as outlined by the instructor. The effect of absences upon grades is determined by the instructor, and the University reserves the right to deal at any time with individual cases of non-attendance. Students are responsible for arranging to make up work missed because of legitimate class absence, such as illness, family emergencies, military obligation, court-imposed legal obligations or participation in University-approved activities. Examples of University-approved reasons for absences include participating on an athletic or scholastic team, musical and theatrical performances and debate activities. It is the student's responsibility to give the instructor notice prior to any anticipated absences and within a reasonable amount of time after an unanticipated absence, ordinarily by the next scheduled class meeting. Instructors must allow each student who is absent for a University-approved reason the opportunity to make up work missed without any reduction in the student's final course grade as a direct result of such absence.

Readings and practical exercises:

Lectures will be based on selected chapters from the textbook. Material for practical exercises will be provided whenever necessary and will be based on selected textbooks from the bibliography list. Assigned text readings and exercises are to serve as reference material to lecture topics. In the readings assigned, you are only responsible for the material discussed in class.

Lecture notes:

A pdf version of the lecture notes will be posted on Canvas the day prior to each lecture. Announcements and grades will also be posted on Canvas.

Policies:

Academic policies and regulations for this class reflect those shown in the FAU University Catalog. For more information visit:

<http://www.fau.edu/academic/registrar/catalog/academics.php>

Classroom etiquette policy

University policy on the use of electronic devices states: “In order to enhance and maintain a productive atmosphere for education, personal communication devices, such as cellular telephones and pagers, are to be disabled in class sessions.”

Disability policy statement

In compliance with the Americans with Disabilities Act Amendments Act (ADAAA), students who require reasonable accommodations due to a disability to properly execute coursework must register with Student Accessibility Services (SAS) and follow all SAS procedures. SAS has offices across three of FAU’s campuses – Boca Raton, Davie and Jupiter – however disability services are available for students on all campuses. For more information, please visit the SAS website at <http://www.fau.edu/sas/>.

Counseling and Psychological Services (CAPS) Center

Life as a university student can be challenging physically, mentally and emotionally. Students who find stress negatively affecting their ability to achieve academic or personal goals may wish to consider utilizing FAU’s Counseling and Psychological Services (CAPS) Center. CAPS provides FAU students a range of services – individual counseling, support meetings, and psychiatric services, to name a few – offered to help improve and maintain emotional well-being. For more information, go to <http://www.fau.edu/counseling/>

Honor Code policy statement

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty, including cheating and plagiarism, is considered a serious breach of these ethical standards, because it interferes with the University mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the University. Cheating in any form will not be tolerated. The first occurrence of any of this will result in a grade of “F”. More details can be found at: http://www.fau.edu/ctl/4.001_Code_of_Academic_Integrity.pdf

Policy on the Recording of Lectures

Students enrolled in this course may record video or audio of class lectures for their own personal educational use. A class lecture is defined as a formal or methodical oral presentation as part of a university course intended to present information or teach students about a particular subject. Recording class activities other than class lectures, including but not limited to student presentations (whether individually or as part of a group), class discussion (except when incidental to and incorporated within a class lecture), labs, clinical presentations such as patient history, academic exercises involving student participation, test or examination administrations, field trips, and private conversations between students in the class or between a student and the lecturer, is prohibited. Recordings may not be used as a substitute for class participation or class

attendance and may not be published or shared without the written consent of the faculty member. Failure to adhere to these requirements may constitute a violation of the University's Student Code of Conduct and/or the Code of Academic Integrity.

Suggested bibliography:

1. *“Looking into the Earth: An Introduction to Geological Geophysics”*, by M. Mussett and M. A. Khan, Cambridge University Press, Cambridge, 2001, 608 pp.
2. *“Fundamentals of Geophysics”*, 2nd edition by W. Lowrie, Cambridge University Press, 2007, 381 pp.
3. *“The Solid Earth: An Introduction to Global Geophysics”*, 2nd edition, by C. M. Fowler, R. Cambridge University Press, Cambridge, 2005, 685 pp.
4. *“Whole Earth Geophysics: An Introductory Textbook for Geologists and Geophysicists”*, by R. Lillie, Prentice-Hall, Inc., Upper Saddle River, New Jersey, 1999, 361 pp.
5. *“Applied Geophysics”*, 2nd edition, by W.M. Telford, L.P. Geldart and R.E. Sheriff, Cambridge University Press, Cambridge, 1991, 770 pp.

Calendar (intended):

Week	Topic	Exercise	Textbook
1	Introduction	1) Global tectonics	Ch. 1 (Lowrie, 2007)
2	Data acquisition and processing	2) Data processing: Fourier analysis and filtering	Ch. 2, 3 (Musset and Khan, 2001)
3	NO CLASS: September 4 th : Labor Day		
4	Seismology and earthquakes	3) Earthquake seismology: seismic stations, arrival times, intensities	Ch.4, 5
5	Seismology I: refraction seismology	4) Seismic surveying I	Ch.6
6	Fieldtrip: seismic refraction: TBA but during regular class time	5) Seismic data processing	Ch.7

7	Seismology II: reflection seismology	6) Seismic data processing	
8	MIDTERM – October 9th: regular class time		
9	Gravity	7) Isostatic equilibrium	Ch.8, 9
10	Magnetism I: Earth's magnetic field, magnetization of materials (types), induced magnetic anomalies	8) Paleomagnetism: magnetic inclination and continent dynamics	Ch. 10
11	Magnetism II: paleomagnetism (types of remanent magnetization, and paleomagnetic interpretation)	9) Magnetic surveying	Ch. 11
12	Geothermics: heat flow and temperature	10) Heat: Geothermal gradient, heat transfer and tectonic settings	Ch. 17
13	Electrical methods: resistivity, induced polarization and self-potential	Student presentations	Ch. 12, 13
14	Electromagnetic methods: magnetotelluric and ground penetrating radar	Student presentations	Ch. 14
15	Radioactivity: radiometric dating	Student presentations	Ch. 15
16	FINAL – December 11th: 1:15pm - 3:45pm		