

EAS 3610/8803: Introduction to Geophysics

THE GEORGIA INSTITUTE OF TECHNOLOGY

August 19 - December 07, 2020

Wed. Fri., 9:30a - 10:45 a in ES&T L1118 (*Intent on being fully-remote*)

Instructor: Andrew Newman, anewman@gatech.edu, office:404-894-3976, ES&T 2254 (*Mostly-remote*)

<http://geophysics.eas.gatech.edu/classes/Geophysics>

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General

This course is an introduction to methods used to visualize and understand the history, shape, mechanical structure, and dynamics of the solid-earth system. We will discuss how geophysical tools, including seismology, gravity, magnetism, heat flow, geochronology, and geodesy, are used to understand the age, whole-earth, and near-surface structure, and to quantify the kinematics and dynamics of plate tectonics.

Prerequisites: Physics 2212: *Introduction to Physics I* and EAS 2600: *Earth Processes*

Instructor Office Hours: After discussion with other faculty about best approaches during this year, I've determined its best to not have pre-determined office hours, as students rarely attend these. Instead, I will be open to your communications online, and will focus on establishing one-on-one and small group meetings when necessary. Canvas messages/Email are preferred for quick, short-answer questions, particularly about logistics. However, if you've run into a conceptual block, or would like to discuss a topic in more detail, this is best done by appointment.

Required Text: Fowler, C.M.R., *The Solid Earth: An Introduction to Global Geophysics*, 2nd Edition, Cambridge University Press, 685 pp., 2005.

Required Electronics: Students must have a computer with reliable high-bandwidth internet, a functional webcam, speakers, and microphone (headphones are fine). A quiet and minimally disruptive environment for online activities and study are important.

Online Resources and Communication: Canvas is the primary organizational resource for information about the class. Lectures are planned to be live or pre-recorded with discussion to follow. We will be using The BlueJeans Meeting schedule within Canvas for classes unless you hear otherwise during the semester. All lecture material will be recorded and available on Canvas. Being at class and on-time is essential for performing best in this course.

Communication is planned too through Canvas using either the internal email-like application, Canvas announcements, or discussion. If you need to email me outside of Canvas, please identify [EAS Geophysics] at the beginning of the subject line.

Health: For any face-to-face contact, all people involved must have a good mask covering their mouth and nose at all times. All interactions should be with at least 1.8 meters (we'll be using SI units in this course) of separation. All materials and discussions are planned to be made available for remote instruction. If we have any in-class activities attendance will only be monitored for contact-tracing, and will not be used for determination of your grades. Your safety, that of your families, our TA's, and mine are of the utmost importance, followed by a quality education. More information on GT guidance with regards to face-coverings and other COVID-related information is available at: <http://health.gatech.edu/coronavirus/students>

Students with Disabilities: If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or <http://disabilityservices.gatech.edu>, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Evaluation

Course Grade:

Undergraduate section: Your grade is based on homework (30%), and quizzes (70%).

Graduate Section: Your grade is based on homework (30%), quizzes (60%), and an oral presentation (10%).

The Undergraduate and Graduate sections will be graded and possibly curved independently.

- Letter Grade: $A \geq 90\% > B \geq 80\% > C \geq 70\% > D \geq 60\% > F$
- Satisfactory/Unsatisfactory: $S \geq 70\% > U$

Homework: Homework will be assigned approximately every 2 weeks and will be due one week from assignment. Graduate students will be assigned additional problems in each of the assigned problem sets. Late homework will not be accepted without prior authorization. See the academic honesty section (below), for information on working together.

Quizzes: There will be bi-monthly quizzes administered during class time. Quizzes are equally weighted, with the lowest score being dropped. Missed quizzes will receive zero credit and the first would be considered your dropped grade. If you're happy with your grade after the last quiz during normal class time (Quiz 6), you will not need to take the final quiz (on December 7th), which will incorporate material throughout the class. Consult the course outline for planned quiz dates.

Academic Honesty

General: It is expected that all students are aware of their individual responsibilities under the Georgia Tech Academic Honor Code, which will be strictly adhered to in this class (<http://www.honor.gatech.edu/>).

Problem Sets: Students are encouraged to work together on developing solutions to problem sets; however, the solutions that are turned in must be the work of each individual. Include the name of individuals consulted for each problem that you sought aid in answering (including me).

Quizzes: Reference texts or other documents during exams will be allowed this semester, however it is very important to study throughout semester because quiz-taking will be troublesome for those relying on look-up strategies. You **are forbidden from sharing answers** during, or otherwise while a quiz or exam is still open for others to take. If there is a substantial evidence of such, you will be reported to the Dean of Students, receive a zero (0%) on the quiz and will, and that score **will not be dropped in determining your final grade**.

Student-Faculty Expectations

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty and students. Please see <http://catalog.gatech.edu/rules/22/> for some basic expectation that we should have of each other. Ultimately, we should respect each others time, hard work, and quest for knowledge. We all should strive to build an environment for cordial and effective interaction.

Course Outline

This is an approximate outline of topics and timing and is subject to change throughout the semester.

| Date | Topic | Quiz |
|---------------|--|-------------------|
| 8/19 - 8/21 | Introduction: - Why Geophysics? - Math review - Geophysical approximation | |
| 8/28 - 9/11 | Plate tectonics and geodynamics - The geometry and kinematics of plate motions - Survey and characterization of plate motions - Types and importance of plate boundaries - Plate reconstructions and dating - Paleomagnetism and polar wander - Modern measurements of plate motions | |
| 9/9 | (<i>Wednesday</i>) - Mechanisms and consequences of plate tectonics | Quiz 1 |
| 9/16 - 9/30 | Seismology: Earth imaging and earthquake characterization - Seismic waves - Earthquake seismology | |
| 9/23 | (<i>Wednesday</i>) - Seismic imaging: reflection, refraction, and tomography - The seismometer | Quiz 2 |
| 10/2 - 10/16 | Earth gravity - Mass distribution and relation to gravity | |
| 10/7 | (<i>Wednesday</i>) - Geopotential and the shape of the earth - Gravity anomalies - The gravimeter - Isostasy | Quiz 3 |
| 10/21 - 10/23 | Geochronology: - Geologic time: from relative to absolute - Principles of geochronology | |
| 10/21 | (<i>Wednesday</i>) - Modern methods - Estimations of the Earth's age | Quiz 4 |
| 10/28 - 11/6 | Internal heat engine: - Sources of Earth's heat - Mechanisms of heat transport - Global heat flow and heat loss | |
| 11/4 | (<i>Wednesday</i>) - Tapping Earth heat: geothermal energy | Quiz 5 |
| 11/11 - 11/13 | Deep Earth structure: - Internal structure from seismology - Planetary inertia and moment - Mantle convection - The geodynamo | |
| 11/18 | Lithospheric structure: - Oceanic lithospheric formation - Oceanic lithospheric destruction - Growth of continents - Formation of continental basins | |
| 11/20 | (<i>Friday</i>) | Quiz 6 |
| 11/20 | Course Wrap-up: Emergent geophysics <i>Graduate Student Presentations on Geophysical Research</i> | |
| 12/07 | (<i>Monday @ 8am</i>) | Final quiz |

Campus Resources for Students

In your time at Georgia Tech, you may find yourself in need of support. Below you will find some resources to support you both as a student and as a person.

Academic support

- Center for Academic Success <http://success.gatech.edu>:
 - 1-to-1 tutoring <http://success.gatech.edu/1-1-tutoring>
 - Peer-Led Undergraduate Study (PLUS) <http://success.gatech.edu/tutoring/plus>
 - Academic coaching <http://success.gatech.edu/coaching>
- Drop-in tutoring for many 1000 level courses: *Residence Life's Learning Assistance Program*: <https://housing.gatech.edu/learning-assistance-program>
- Group study sessions and tutoring programs: <http://omed.gatech.edu/programs/academic-support>
- Individualized help with writing and multimedia projects: *Communication Center* (<http://www.communicationcenter.gatech.edu>)
- Academic advisors for your major: <http://advising.gatech.edu/>

Personal Support at Georgia Tech Resources

- The Office of the Dean of Students: <http://studentlife.gatech.edu/content/services>; 404-894-6367; Smithgall Student Services Building 2nd floor: *You also may request assistance at https://gatech-advocate.symplicity.com/care_report/*
- Counseling Center: <http://counseling.gatech.edu>; 404-894-2575; Smithgall Student Services Building 2nd floor
 - Services include short-term individual counseling, group counseling, couples counseling, testing and assessment, referral services, and crisis intervention. Their website also includes links to state and national resources.
 - Students in crisis may walk in during business hours (8am-5pm, Monday through Friday) or contact the counselor on call after hours at 404-894-2204.
- Students' Temporary Assistance and Resources (STAR): <http://studentlife.gatech.edu/content/need-help>: *Can assist with interview clothing, food, and housing needs.*
- Stamps Health Services: <https://health.gatech.edu>; 404-894-1420: *Primary care, pharmacy, women's health, psychiatry, immunization, allergy, health, nutrition*
- OMED: Educational Services: <http://www.omed.gatech.edu>
- Women's Resource Center: <http://www.womenscenter.gatech.edu>; 404-385-0230
- LGBTQIA Resource Center: <http://lgbtqia.gatech.edu/>; 404-385-2679
- Veteran's Resource Center: <http://veterans.gatech.edu/>; 404-385-2067
- Georgia Tech Police: 404-894-2500