

University of Colorado Boulder
ASEN 5519
Cross listed with EARTH/PHYS/ASTR 6620 [EPP2]
Geodesy
Fall 2026 Course Syllabus

❖ **General Information**

Instructor: Prof. Khosro Ghobadi-Far (khosro.ghobadifar@colorado.edu)

Instructor Office Hours: In-Person + Zoom, [see details on Canvas](#).

Lecture Time and Location: Mon & Wed 02:30 PM - 03:45 PM, AERO N240.

All lectures will be recorded and posted online via course website.

If you use assistive technology to access the course material, please contact the instructor immediately to discuss it.

Course Website: canvas.colorado.edu will be used for posting all recorded lectures, homework assignments, exams, announcements, Zoom link for office hours, etc.

Course Materials and Textbooks: There is no single textbook that adequately covers all the topics included in this course at an appropriate level for students. Lecture slides will serve as the primary course material. The textbooks listed below are recommended references and provide additional background and supplementary reading on specific topics (See Canvas for PDF files or links to (e)Books available through the CU Library.).

- *Geodesy and Gravity* by John Wahr, Class Notes, Samizdat Press, 1996.
- *Geodesy* by Wolfgang Torge, Jürgen Müller & Roland Pail, 5th Edition, De Gruyter, 2023.
- *Physical Geodesy* by Bernhard Hofmann-Wellenhof & Helmut Moritz, Springer, 2006.
- *Global gravity field modeling from satellite-to-satellite tracking data* by Naeimi & Flury (editors), Springer, 2017.
- *Geodesy: Treatise on Geophysics* (Vol. 3) by Tom Herring (editor), Elsevier, 2005.
- *The Earth's Variable Rotation: Geophysical Causes and Consequences* by Kurt Lambeck, Cambridge Press, 2009.

❖ **Course Details**

Course Description: This course introduces the fundamentals of gravity and geodesy. Students will learn the principles of measuring the shape, gravity field, rotation, and their temporal

variations of the Earth and planetary bodies. The course explores how these observations provide a unique quantitative view of the Earth and other planetary bodies and are used to investigate a wide range of applications. The principles introduced in this course have broad applications across the Earth, space and planetary sciences, including high-resolution gravity field modeling of the Earth, Moon, and other planets; the use of gravity models for precise orbit determination and investigating the internal structure of planetary bodies; monitoring groundwater depletion and quantifying glacier and ice sheet mass loss and the resulting sea-level rise through satellite gravimetry; measuring changes in Earth's rotation; and observing crustal deformation caused by surface loading such as snow accumulation over the Rocky Mountains.

A basic knowledge of calculus, differential equations and linear algebra is required to follow the material presented for this course. With that being said, the instructor will approach each topic from a basic level, and derive all the theories starting from fundamental principles.

Learning Objectives: This course develops a rigorous understanding of the fundamental principles of gravity and geodesy by deriving the underlying theories from first principles. Rather than emphasizing isolated applications, the course equips students with the physical and mathematical foundations needed to understand, analyze, and solve a broad range of problems in geodesy using space geodesy techniques. This foundation will prepare students to tackle challenging research and engineering problems involving the observation, modeling, and interpretation of the Earth's gravity field, deformation, and rotation. By the end of this course, students will:

1. be well-acquainted with potential theory and its application to formulation of gravity field of Earth and planetary bodies.
2. be able to construct and analyze high-resolution gravity field models from satellite observations and apply them to various science and engineering problems.
3. use time-variable gravity measurements from NASA satellites to study Earth system processes such as icesheet mass change, groundwater depletion, and impact of the 2026 Colorado drought on water resources.
4. describe physical mechanisms responsible for Earth tides, deformation caused by surface loading, and variations in Earth's rotation rate and movement of rotation axis, and explain how measurements of these processes can be used to investigate Earth system dynamics.

Anticipated Course Schedule (subject to change)

Week(s)	Topic
1	Intro & overview
2–4	Potential theory
5–7	Gravity field of the Earth & Isostasy
7–9	Gravity field modeling from satellite data
9–10	Stress & strain; Earth's elastic deformation by surface loads
11	Inversion of gravity (change) to mass (change)
12	Earth tides
13–14	Earth's variable rotation

Grading, Assignments and Exams: Course grades will be determined based on **homework (30%)**, **midterm 1 (20%)**; administered during weeks 7–8), **midterm 2 (20%)**; administered during weeks 11–12), and a **final project (30%)**; released on week 12).

Important things to note:

- Students will be expected to work in groups of 2 or 3 for the final project. Exceptions on group size must be explicitly approved by the instructor.
- Weekly homework will be assigned, collected, and (partially) graded. Solutions for full homework problems will be posted to Canvas.
- Collaboration on homework is encouraged, but students must turn in their own homework before they are due. **Late submissions of homework assignments will not be accepted.**
- All exams will be take-home and open-note. Students will have exactly one week to complete each exam and should not collaborate with anyone in any way. The use of the internet, online resources, Generative AI tools, and any other unauthorized external materials is strictly prohibited (the CU Honor Code applies).
- Students will not require an exam proctor, but will submit all assignments and exams electronically for grading via Gradescope (see requirements on submission quality).
- Students may opt to answer optional “*Advanced Questions*” in homework assignments and exams for possible extra credit, but extra credit will only be considered if all regular homework assignment questions are also completed (zero extra credit received otherwise). Also, there will be no partial credit on the advanced questions. Note that help from instructor/TA will be much more limited on these questions, and solutions will not be posted for advanced questions.

Conditional Generative AI Use: You are permitted (but not required) to conditionally use generative AI tools in this course for the following purposes only: (1) partial code generation (i.e., less than 25% as measured by total lines of code submitted) for **programming exercises** on **homework assignments** and for the **final project** assignment; and (2) to review or study course material and topics on your own.

If you use generative AI tools for partial code generation on homework assignments or the final project, you must document your usage by stating this explicitly at the top of your assignment and cite the portions (lines of code) that were generated by the specific tool you used. **Failure to properly document generative AI usage for coding assignments on homework and the final project will be treated as a potential CU Honor Code violation.**

You may **not** use generative AI tools to produce solutions for non-programming questions on homework or final project assignments.

You may **not** use generative AI tools for any kind of question (whether programming or non-programming) on midterm exams.

Work submitted for grading must conform to these guidelines in order to receive full credit reflective of your own individual competency, learning, and understanding of the material.

Electronic assignment submission requirements: It is your responsibility to submit legible and complete electronic submissions for homework assignments, exams, and projects. If your submission is not legible for grading, you will receive one and only one warning to resubmit your assignment. Repeated failure to comply with legibility requirements after the first warning will result in zero credit for that assignment.

Regrade policy: Requests for regrades on any assignment must be submitted via Gradescope within 2 weeks of the assignment being returned to the class (no exceptions). Requests must clearly articulate the specific reasons for the regrade request, although entire assignment will be regraded by instructor if request is granted, and thus there is no guarantee of receiving a higher grade.

Rescheduling homework submissions: Requests for homework extensions must be submitted at least 48 hours before the assignment deadline. Approval of an extension is not guaranteed and will be considered on a case-by-case basis. This policy will be strictly enforced, so students are expected to plan ahead and manage their time accordingly. Do not wait until the last minute to begin assignments or request an extension.

University Policies

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the [Honor Code](#). Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. Understanding the course's syllabus is a vital part in adhering to the Honor Code.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: StudentConduct@colorado.edu. Students found responsible for violating the [Honor Code](#) will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit [Honor Code](#) for more information on the academic integrity policy.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the [Disability Services website](#). Contact Disability Services at 303-492-8671

or DSinfo@colorado.edu for further assistance. If you have a temporary medical condition, see [Temporary Medical Conditions](#) on the Disability Services website.

If you have a temporary illness, injury or required medical isolation for which you require adjustment, please email the instructor as soon as possible to make necessary arrangements.

Accommodation for Religious Obligations

Campus policy requires faculty to provide reasonable accommodations for students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please communicate the need for a religious accommodation in a timely manner. In this class, you must alert the instructors with the need for a religious accommodation during the first two weeks of classes, i.e., by January 24, 2025.

See the [campus policy regarding religious observances](#) for full details.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Classroom Behavior

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, marital status, political affiliation, or political philosophy.

For more information, see the [classroom behavior policy](#), the [Student Code of Conduct](#), and the [Office of Institutional Equity and Compliance](#).

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits [protected-class](#) discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who have been subjected to misconduct can contact OIEC at 303-492-2127 or email CUreport@colorado.edu. Information about university policies, [reporting options](#), and [OIEC support resources](#) including confidential services can be found on the [OIEC website](#).

Please know that faculty and graduate instructors are required to inform OIEC when they are made aware of incidents related to these concerns regardless of when or where something

occurred. This is to ensure that individuals impacted receive outreach from OIEC about their options and support resources. To learn more about reporting and support for a variety of concerns, visit the [Don't Ignore It page](#).

Mental Health and Wellness

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact [Counseling and Psychiatric Services \(CAPS\)](#) located in C4C or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through [Academic Live Care](#). The Academic Live Care site also provides information about additional wellness services on campus that are available to students.