



## COURSE OUTLINE

1. **Course:** GOPH 351, Introduction to Geophysics and Planetary Physics - Fall 2023

Lecture 01 : MWF 13:00 - 13:50 in MS 325

<b>Instructor</b>	<b>Email</b>	<b>Phone</b>	<b>Office</b>	<b>Hours</b>
Dr Jan Dettmer	jan.dettmer@ucalgary.ca	403 220-4606	ES 212	TBA

This course provides an introduction to important geophysical concepts and methods that are used to study the Earth and solve various geoscientific problems. Topics include tectonics on a sphere, isostasy, gravity and magnetism, heat flow, radioactivity and geochronology, earthquake seismology, reflection and refraction seismology.

To account for any necessary transition to remote learning for the current semester, courses with in-person lectures, labs, or tutorials may be shifted to remote delivery for a certain period of time. In addition, adjustments may be made to the modality and format of assessments and deadlines, as well as to other course components and/or requirements, so that all coursework tasks are in line with the necessary and evolving health precautions for all involved (students and staff).

### **In Person Delivery Details:**

Lectures and exams for this course are in person.

### **Course Site:**

D2L: GOPH 351 L01-(Fall 2023)-Introduction to Geophysics

**Note:** Students must use their U of C account for all course correspondence.

### **Equity Diversity & Inclusion:**

The University of Calgary is committed to creating an equitable, diverse and inclusive campus, and condemns harm and discrimination of any form. We value all persons regardless of their race, gender, ethnicity, age, LGBTQIA2S+ identity and expression, disability, religion, spirituality, and socioeconomic status. The Faculty of Science strives to extend these values in every aspect of our courses, research, and teachings to better promote academic excellence and foster belonging for all.

2. **Requisites:**

See section [3.5.C](#) in the Faculty of Science section of the online Calendar.

#### **Prerequisite(s):**

Geology 201 and 202; and Mathematics 267 or 277; and Physics 211 or 221, and 223.

#### **Antirequisite(s):**

Credit for Geophysics 351 and 359 will not be allowed.

3. **Grading:**

The University policy on grading and related matters is described in [F.1](#) and [F.2](#) of the online University Calendar.

In determining the overall grade in the course the following weights will be used:

Course Component	Weight	Due Date (duration for exams)	Modality for exams	Location for exams
TopHat	5%	Ongoing		
Laboratory assignments <sup>1</sup>	30%	Ongoing		
Term Test 1 <sup>2</sup>	15%	Oct 04 2023 at 01:00 pm (50 Minutes)	in-person	In Class
Term Test 2 <sup>3</sup>	15%	Nov 08 2023 at 01:00 pm (50 Minutes)	in-person	In Class
Registrar Scheduled Final Exam <sup>4</sup>	35%	Will be available when the final exam schedule is released by the Registrar	online	Will be available when the final exam schedule is released by the Registrar

<sup>1</sup> Throughout the term.

<sup>2</sup> Closed book, calculator permitted.

<sup>3</sup> Closed book, calculator permitted.

<sup>4</sup> The exam will be carried out on the D2L platform.

Each piece of work (reports, assignments, quizzes, midterm exam(s) or final examination) submitted by the student will be assigned a grade. The student's grade for each component listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade.

The conversion between a percentage grade and letter grade is as follows.

	A+	A	A-	B+	B	B-	C+	C	C-	D+	D
<b>Minimum % Required</b>	95 %	90 %	85 %	80%	75%	70 %	65 %	60%	56%	53 %	50 %

Scores within 0.5% of the upper boundary of a percent range (e.g., 79.5%) may or may not be rounded up at the discretion of the instructor (a decision will be made based on the student's performance in the course). For percent grades on a boundary, the higher grade will be chosen (e.g., 75% is a B, not a B-).

This course will have a Registrar Scheduled Final exam that will be delivered on-line. [The Final Examination Schedule](#) will be published by the Registrar's Office approximately one month after the start of the term. The final exam for this course will be designed to be completed within 50 hours.

Per section [G.5](#) of the online Academic Calendar, timed final exams administered using an on-line platform, such as D2L, will be available on the platform. Due to the scheduling of the final exams, the additional time will be added to **the end** of the registrar scheduled **synchronous** exam to support students. This way, your exam schedule accurately reflects the **start time** of the exam for any **synchronous** exams. E.g. If a **synchronous** exam is designed for 2 hours and the final exam is scheduled from 9-11am in your student centre, the additional time will be added to the **end** time of the **synchronous** exam. This means that if the exam has a 1 hour buffer time, a synchronous exam would start at 9 am and finish at 12pm.

This course will employ TopHat during lectures to conduct quizzes. There will be a minimum of 50 in-class questions. Each correctly answered question counts for 0.1 percent and results are added up to a maximum of 5 percent.

The University of Calgary offers a [flexible grade option](#), Credit Granted (CG) to support student's breadth of learning and student wellness. Faculty units may have additional requirements or restrictions for the use of the CG grade at the faculty, degree or program level. To see the full list of Faculty of Science courses where CG is not eligible, please visit the following website: <https://science.ucalgary.ca/current-students/undergraduate/program-advising/flexible-grading-option-cg-grade>

#### 4. **Missed Components Of Term Work:**

In the event that a student legitimately fails to submit any online or in-person assessment on time (e.g. due to illness, domestic affliction, etc...), please contact the course coordinator, or the course instructor if this course does not have a coordinator to arrange for a re-adjustment of a submission date, or possible exemption and reweighing of components. Absences not reported within 48 hours will not be accommodated. Students may be asked to provide supporting documentation ([Section M.1](#)) for an excused absence, See [FAQ](#).

If an excused absence is approved, options for how the missed assessment is dealt with is at the discretion of the coordinator or course instructor. Some options such as an exemption and pro-rating among the components of the course may not be a viable option based on the design of this course.

#### 5. **Scheduled Out-of-Class Activities:**

There are no scheduled out of class activities for this course.

## 6. Course Materials:

Required Textbook(s):

Fowler, C.M.R., *The Solid Earth: An Introduction to Global Geophysics, 2nd edition* Cambridge.

Other materials: posted on D2L.

In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam/Camera (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Stable internet connection.

For more information please refer to the UofC [ELearning](#) online website.

## 7. Examination Policy:

1-sided, letter-size, handwritten equation sheet is allowed. The content of the sheet is up to the students.

Students should also read the Calendar, [Section G](#), on Examinations.

## 8. Approved Mandatory And Optional Course Supplemental Fees:

There are no mandatory or optional course supplemental fees for this course.

## 9. Writing Across The Curriculum Statement:

For all components of the course, in any written work, the quality of the student's writing (language, spelling, grammar, presentation etc.) can be a factor in the evaluation of the work. See also Section [E.2](#) of the University Calendar.

## 10. Human Studies Statement:

Students will not participate as subjects or researchers in human studies.

See also [Section E.5](#) of the University Calendar.

## 11. Reappraisal Of Grades:

A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See [Section I.3](#) of the University Calendar.

- Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **ten business days** of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall submit the Reappraisal of Graded Term work [form](#) to the department in which the course is offered within 2 business days of receiving the decision from the instructor. The Department will arrange for a reappraisal of the work within the next ten business days. The reappraisal will only be considered if the student provides a detailed rationale that outlines where and for what reason an error is suspected. See sections [I.1](#) and [I.2](#) of the University Calendar
- Final Exam:** The student shall submit the request to Enrolment Services. See [Section I.3](#) of the University Calendar.

## 12. Other Important Information For Students:

- Mental Health** The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (Room 370, MacEwan Student Centre, [Mental Health Services Website](#)) and the Campus Mental Health Strategy website ([Mental Health](#)).

- b. **SU Wellness Services:** For more information, see their [website](#) or call [403-210-9355](tel:403-210-9355).
- c. **Sexual Violence:** The Sexual Violence Support Advocate, Carla Bertsch, can provide confidential support and information regarding sexual violence to all members of the university community. Carla can be reached by email ([svsa@ucalgary.ca](mailto:svsa@ucalgary.ca)) or phone at [403-220-2208](tel:403-220-2208). The complete University of Calgary policy on sexual violence can be viewed [here](#).
- d. **Student Ombuds Office:** A safe place for all students of the University of Calgary to discuss student related issues, interpersonal conflict, academic and non-academic concerns, and many other problems.
- e. **Student Union Information:** [SU contact](#), Email your SU Science Reps: [science1@su.ucalgary.ca](mailto:science1@su.ucalgary.ca), [science2@su.ucalgary.ca](mailto:science2@su.ucalgary.ca), [science3@su.ucalgary.ca](mailto:science3@su.ucalgary.ca),
- f. **Academic Accommodation Policy:**

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The student accommodation policy can be found at: <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Student-Accommodation-Policy.pdf>

Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities: <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf>.

Students needing an accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, by filling out the [Request for Academic Accommodation Form](#) and sending it to Brandon Karchewski by email [brandon.karchewski@ucalgary.ca](mailto:brandon.karchewski@ucalgary.ca) preferably 10 business days before the due date of an assessment or scheduled absence.

- g. **Misconduct:** Academic integrity is the foundation of the development and acquisition of knowledge and is based on values of honesty, trust, responsibility, and respect. We expect members of our community to act with integrity. Research integrity, ethics, and principles of conduct are key to academic integrity. Members of our campus community are required to abide by our institutional [Code of Conduct](#) and promote academic integrity in upholding the University of Calgary's reputation of excellence. Some examples of academic misconduct include but are not limited to: posting course material to online platforms or file sharing without the course instructor's consent; submitting or presenting work as if it were the student's own work; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; borrowing experimental values from others without the instructor's approval; falsification/fabrication of experimental values in a report. Please read the following to inform yourself more on academic integrity:

[Student Handbook on Academic Integrity](#)  
[Student Academic Misconduct Policy and Procedure](#)  
[Faculty of Science Academic Misconduct Process](#)  
[Research Integrity Policy](#)

Additional information is available on the [Student Success Centre Academic Integrity page](#)

- h. **Copyright of Course Materials:** All course materials (including those posted on the course D2L site, a course website, or used in any teaching activity such as (but not limited to) examinations, quizzes, assignments, laboratory manuals, lecture slides or lecture materials and other course notes) are protected by law. These materials are for the sole use of students registered in this course and must not be redistributed. Sharing these materials with anyone else would be a breach of the terms and conditions governing student access to D2L, as well as a violation of the copyright in these materials, and may be pursued as a case of student academic or [non-academic misconduct](#), in addition to any other remedies available at law.
- i. **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). Students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information, see [Legal Services](#) website.
- j. **Surveys:** At the University of Calgary, feedback through the Universal Student Ratings of Instruction ([USRI](#)) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference - please participate in these surveys.

Tentative Lecture schedule:

1. Introduction: The physical basis for geophysical properties. How Earth's interior is inferred from geophysical methods. Forward and inverse geophysical modelling.
2. Tectonics on a sphere: Rotation vectors and rotation poles. Past and present-day plate motions. Plate boundaries and their evolution over time.
3. Gravity and geodesy: Newton's Universal Law of gravitation. Gravitational potential and Earth's gravitational field. Geodesy and lithospheric flexure.
4. Geomagnetism: Origin of Earth's magnetic field. Magnetic potential and dipole field strength. Rock magnetism. Paleomagnetism and past plate motions.
5. Applications of potential-field data: Instruments for measuring gravitational and magnetic field strength. Basic data processing. Forward modeling and inversion.
6. Radioactivity and geochronology: Nuclear decay and radioactivity. General theory for radiometric age dating. Overview of geochronology methods. Age of the Earth.
7. Terrestrial heat flow: Conductive heat flow. Calculation of simple geotherms. Global heat flow, continents versus oceans.
8. Applications of heat flow measurements: The adiabat and melting in the mantle. Metamorphism: geotherms in the continental crust.
9. Deep interior of the Earth: Internal structure of the Earth. Convection in the mantle. Earth's core.
10. Seismic waves: Linear elasticity. Stress and strain. Basic principles of seismology: waves, rays, Snell's law, Huygens' principle. Reflection and refraction. Surface and body waves.
11. Earthquakes and global seismology. Anderson's theory of faulting. Earthquake magnitude scales. Probing Earth's deep interior using seismic waves.
12. Review

Tentative Laboratory Schedule:

1. Basic mathematics exercises: Error propagation, least-squares method, plate motions.
2. Gravity and Isostasy
3. Gravity and lithospheric flexure
4. Geochronology and heat flow
5. Elastic Earth properties and earthquake location
6. Earthquake seismology
7. Reflection seismology, migration
8. Refraction seismology

**Course Outcomes:**

- To explain the physical basis for geophysical properties (heat generation and transfer, seismic waves, magnetism, gravity).
- To interpret physical properties of the Earth from geophysical measurements (e.g., thickness of the crust and lithosphere, age of the Earth and its components, earthquake hazard, potential drilling locations from seismic data)
- To apply geophysical inference to deduce basic physical properties and structure of the Earth.
- To calculate relative motions of plates on a sphere, steady-state geotherms, satellite orbital parameters, earthquake magnitude and location, overburden thickness from seismic refraction observations.
- To perform error analysis for basic geophysical calculations such as geochronological age estimation and seismic velocity determination.
- To communicate important geophysical concepts in written and oral form.

Electronically Approved - Aug 28 2023 12:52

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**Department Approval**

Electronically Approved - Aug 29 2023 16:44

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**Associate Dean's Approval**

