

# **Earth Sciences 2220b: Environmental and Exploration Geophysics I Course Outline – Winter 2026**

## **1. Course Information**

### **ES2220b – Environmental and Exploration Geophysics I**

**List of Prerequisites:** 0.5 course from Calculus 1000A/B or Calculus 1500A/B, Mathematics 1225A/B or equivalent (please refer to the UWO Calendar).

Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Advisors) to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

## **2. Instructor Information**

<b>Instructors</b>	<b>Email</b>	<b>Office</b>	<b>Phone</b>	<b>Office Hours</b>
Dr. Robert Shcherbakov (Course Instructor)	<a href="mailto:rshcherb@uwo.ca">rshcherb@uwo.ca</a>	B&GS 1080	x84212	By appointment
TA: Charlotte Matuzas	<a href="mailto:cmotuzas@uwo.ca">cmotuzas@uwo.ca</a>			

## **3. Course Syllabus, Schedule, Delivery Mode**

This course provides a brief introduction to the discipline of applied seismology - the branch of geophysics that investigates earthquakes, and Earth structure using sound waves in rocks. The source of seismic waves can be either artificial (e.g., an explosion, vibrational device or a hammer blow), or natural (most often earthquakes). In many ways, seismology is to the Earth Sciences what radiology is to Medicine; it is our window into the Earth's interior, providing a way to map and study, *in situ*, the inner workings of our planet at different scales.

Several different seismic methods are in common use. Seismic-reflection methods, a cornerstone of oil and gas exploration in sedimentary basins, use a large number of detectors, or geophones, located close to the seismic source. Reflection techniques are mainly used for creating highly resolved images of the Earth's interior. Modern applications use areal arrays of sources and receivers to render these images in three-dimensions. Seismic-refraction methods use detectors that are spread over a greater distance relative to the target depth. These methods are mainly used for measuring the seismic velocity of the subsurface, from which quantitative information about rock type and physical conditions can be inferred. Both methods are commonly used on either land or sea, at scales of investigation from a few m (environmental applications) to hundreds of km (crustal studies).

This is a lab-oriented course that will provide extensive hands-on computer experience, particularly with the general-purpose numerical analysis program Matlab. Geophysical concepts will be

emphasized, but underlying mathematical principles will also be discussed where needed to gain a complete understanding of the methods and their applications.

### Course Objectives and Learning Outcomes:

Upon successful completion of this course, students will be able to:

- describe and identify basic aspects of several exploration seismology methods;
- discriminate between geological and geophysical approaches to investigate the subsurface structure of the Earth;
- identify the key aspects of a typical workflow of the geophysical exploration methods comprising data acquisition, processing, and interpretation;
- describe the environmental impacts of exploration and consequences following large devastating earthquakes;
- apply the skills required to work with the scientific computer software Matlab.

### Lecture and Lab Schedule:

Week	Lecture Topics	Labs	Assessment
1	Introduction and Outline. Geophysical methods and data analysis.	Lab 1	Assignment 1
2	Waves, pulses, rays. Seismic waves. Wave propagation. Reflection and refraction.	Lab 2	Assignment 2
3	Body and surface waves. Forces and deformation. Stress and strain.	Lab 3	Assignment 3
4	Global seismology. Internal structure of the Earth. Seismic-refraction method: Basic principles and techniques.	Lab 4	Assignment 4
5	Seismic-refraction method: Time-distance diagrams. Multiple layers. Dipping interfaces.	Lab 5	Assignment 5
6	Seismic-refraction method: Hidden layers. Ray tracing. Seismic reflection method: Basic principles. Data acquisition.		
Reading week			
7	Seismic reflection method: Normal moveout. Stacking. Seismic sections. Data processing.		Midterm (Feb 27)
8	Seismic reflection method: Signal processing. Deconvolution. Static corrections. Properties of a reflector.	Lab 6	Assignment 6
9	Seismic reflection method: Seismic migration. Seismic properties of rocks. Seismic Imaging. Geological interpretation.	Lab 7	Assignment 7
10	Earthquakes: Measuring earthquakes. Earthquake magnitudes.	Lab 8	Assignment 8
11	Earthquakes: Elastic rebound theory	Lab 9	Assignment 9
12	Earthquakes: Seismicity. Seismicity of Canada.		
13	Ground Penetrating Radar: Basic principles.		
Exam period			Final Exam

## **Summary of Lecture Topics (approximate and subject to change!):**

- Introduction and Outline. What is geophysics?
- Geophysical methods and data analysis.
- Waves, pulses, rays. Seismic waves.
- Wave propagation. Reflection and refraction.
- Body and surface waves.
- Forces and deformation. Stress and strain.
- Global seismology. Internal structure of the Earth.
- Seismic-refraction method: Basic principles and techniques.
- Seismic reflection-methods: Data acquisition, basic processing, interpretation, 3-D methods and case histories.
- Earthquakes and global seismology.
- Earthquake magnitudes and seismic moment.
- Seismicity and earthquake statistics.
- Introduction to basics of the ground penetrating radar.

## **Course Work**

The lecture and laboratory components cover theory and "hands-on" components of the course, respectively. Lab/tutorials will be held in the ES computer labs. Lecture notes and assignments are going to be available through OWL (<https://westernu.brightspace.com/>).

## **The relevant Key Sessional Dates:**

Classes begin: January 5, 2026  
Reading Week: February 14 – 22, 2026  
Classes end: April 9, 2026  
Exam period: April 12 – 30, 2026

## **Contingency plan:**

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.

## **4. Course Materials**

### **Required Textbook:**

- Mussett, A.E. and Khan, M.A., *Looking into the Earth: An Introduction to Geological Geophysics*, Cambridge University Press, 2000. The textbook can be purchased from a Campus Store or at Amazon.ca and costs between \$69.95CAD and \$97.95CAD depending on electronic or paperback editions.

### **Other Recommended Textbooks:**

- Dentith M. and Mudge S.T., *Geophysics for the Mineral Exploration Geoscientist*, Cambridge University Press, 2014.
- Kearey, P., Brooks, M., Hill I., *An Introduction to Geophysical Exploration*, Blackwell, 2002.
- Reynolds, J.M., *An Introduction to Applied and Environmental Geophysics*, Wiley, 2011.
- Sheriff R., and Geldart L., *Exploration Seismology*, Cambridge University Press, 1995.

- Stein, S. and Wysession, M., *An Introduction to Seismology, Earthquakes, and Earth Structure*, Blackwell, 2003.

Matlab software package is going to be used for Labs. It can be installed on your personal computer using Western site license. It is also installed on all computers in BGS 0184 or it can be accessed through MyVlab. The instructions will be provided.

All course material will be posted to OWL: <https://westernu.brightspace.com/>

Students are responsible for checking the course OWL site (<https://westernu.brightspace.com/>) regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL site, they can seek support on the [OWL Brightspace Help](#) page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

## 5. Methods of Evaluation

The overall course grade will be calculated as listed below:

Assignments/Labs	Midterm Test	Final Exam	Participation
30%	25%	35%	10%

Assignments will consist of examination-style short-answer questions and require no formal writeup. In many cases, assignments will require the use of Matlab. Unless indicated otherwise, assignments should be submitted to the TA at the beginning of the next lab/tutorial session. Late submissions will be accepted with a 5% per day penalty. Under exceptional circumstances, late submissions will be accepted with no penalty, provided that adequate documentation is given. With a few exceptions, only SI units should be used to report any physical quantities.

The midterm exam will be held during the lab period on Friday, February 27. The final exam will be **two hours** in length and will take place during the April examination period. For both exams, a **single-sided hand-written crib sheet** and a non-programmable calculator may be used.

**Plagiarism:** *Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).*

### Use of Generative AI Tools

The use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

## General information about missed coursework

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar:  
[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/academic\\_consideration\\_Sep24.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf)

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult [Accessible Education](#).

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage:  
[https://registrar.uwo.ca/academics/academic\\_considerations/](https://registrar.uwo.ca/academics/academic_considerations/)

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

- Examinations scheduled during official examination periods (Defined by policy)
- Practical laboratory and performance tests (Defined by policy)
- Midterm/Presentation (Designated by the instructor as the one assessment that always requires documentation when requesting Academic Consideration)

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

When a student *mistakenly* submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

## Evaluation Scheme for Missed Assessments

Unless indicated otherwise, assignments should be submitted by the due date. Late submissions will be accepted with a 5% per day penalty. Under exceptional circumstances, late submissions will be accepted with no penalty, provided that adequate documentation is given. With a few exceptions, only SI units should be used to report any physical quantities.

When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final

Exam). See the Academic Calendar for details (under [Special Examinations](#)), especially for those who miss multiple final exams within one examination period.

## 6. Additional Statements

### 6.1 Religious Accommodation

When a recognized religious holiday or observance conflicts with an examination, test, or other scheduled academic obligation, students must request accommodation via the University's Student Absence Portal (SAP). This request should identify the conflict and specify which course component(s) (e.g. test, midterm, exam) are affected.

Students are encouraged to submit the SAP request as early as possible, but no later than two weeks before any examination, or one week before any mid-term test or quiz, to allow sufficient time for adjustment.

The SAP request serves as official notification to both the course instructor and the Academic Advising Office, in accordance with University policy:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_religious.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf)

The Faculty of Science considers religious accommodations as scheduling conflicts. Instructors should provide either a make-up exam or an earlier sitting of the same exam to accommodate the student.

For more information on recognized religious holidays, please visit the Diversity Calendar posted on the Equity, Diversity & Inclusion website - <https://www.edi.uwo.ca>

### 6.2 Academic Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/Academic\\_Accommodation\\_disabilities.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf)

### 6.3 General Academic Policies

The website for Registrar Services is <https://www.registrar.uwo.ca/>.

**Use of @uwo.ca email:** In accordance with policy,

[https://www.uwo.ca/univsec/pdf/policies\\_procedures/section1/mapp113.pdf](https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf), the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

**Requests for Relief** (formally known as “appeals”)

Policy on Request for Relief from Academic Decision:

[https://uwo.ca/univsec//pdf/academic\\_policies/appeals/requests\\_for\\_relief\\_from\\_academic\\_decisions.pdf](https://uwo.ca/univsec//pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf)

Procedures on Request for Relief from Academic Decision (Undergraduate):

[https://uwo.ca/univsec//pdf/academic\\_policies/appeals/undergrad\\_requests\\_for\\_relief\\_procedure.pdf](https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_requests_for_relief_procedure.pdf)

For both mid-term and final exams, a single-sided hand-written crib sheet and a non-programmable calculator may be used.

## 6.4 Scholastic Offences

Policy on Scholastic Offences:

[https://uwo.ca/univsec//pdf/academic\\_policies/appeals/scholastic\\_offences.pdf](https://uwo.ca/univsec//pdf/academic_policies/appeals/scholastic_offences.pdf)

Procedures on Scholastic Offences (Undergraduate):

[https://uwo.ca/univsec//pdf/academic\\_policies/appeals/undergrad\\_scholastic\\_offence\\_procedure.pdf](https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf)

## Use of Electronic Devices During Assessments

In courses offered by the Faculty of Science, the possession of unauthorized electronic devices during any in-person assessment (such as tests, midterms, and final examinations) is strictly prohibited. This includes, but is not limited to: mobile phones, smart watches, smart glasses, and wireless earbuds or headphones.

Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at your desk, on your person, or within reach during an assessment will be treated as a *scholastic offence*, even if the device is not in use.

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is your responsibility to review and comply with these expectations.

## Use of Generative AI Tools

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**.

If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is your responsibility to seek clarification before using any AI tools in academic work.

## 6.5 Support Services

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, requests for relief, exam conflicts, and many other academic-related matters: <https://www.uwo.ca/sci/counselling/>.

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced GBSV (either recently or in the past), you will find information about support services for survivors, including emergency contacts, at:

[https://www.uwo.ca/health/student\\_support/survivor\\_support/get-help.html](https://www.uwo.ca/health/student_support/survivor_support/get-help.html).

To connect with a case manager or set up an appointment, please contact [support@uwo.ca](mailto:support@uwo.ca).

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. If you have any questions regarding accommodations, you may also wish to contact Accessible Education at

[http://academicsupport.uwo.ca/accessible\\_education/index.html](http://academicsupport.uwo.ca/accessible_education/index.html)

Learning-skills counsellors at Learning Development and Success (<https://learning.uwo.ca>) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Additional student-run support services are offered by the USC, <https://westernusc.ca/services/>.