DALHOUSIE UNIVERSITY

# Faculty of Science Course Syllabus (Section A)
# Department of Earth and Environmental Sciences

*Introduction to Applied Geophysics - ERTH/PHYS 2270*
*Winter Term 2025*

***Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people***.

***We acknowledge the histories, contributions, and legacies of the African Nova Scotian people and communities who have been here for over 400 years.***

**Instructor(s):** Miao Zhang, miao.zhang@dal.ca

**Lectures**: Wednesdays and Fridays, 11:35 AM – 12:55 AM, LSC C210

**Laboratories/Tutorials**: Fridays, 10:35 – 11:25, LSC B2012

**Course delivery: In-person**

**Field Experiments: TBD**

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## Course Description

An introduction to using physical principles to explore the Earth's subsurface, with an emphasis on near-surface applications. Topics will include seismic, gravity, magnetic, electrical, and electromagnetic surveying techniques, and their application in prospecting, hydrogeology, environmental assessments, and well-logging. The geophysics field school is an integral part of this class for equipment and method demonstration.

## Course Prerequisites

First-year physics and mathematics.

## Course Objectives/Learning Outcomes

ERTH/PHYS 2270.01 covers all most commonly used geophysical techniques: Seismic refraction, seismic reflection, resistivity, gravity, magnetics and electromagnetics. Focus is on their application in the shallow crust, where most of the exploratory work is carried out.

Computer Usage:
Students will use their personal computers to solve computational problems handed out as part of their assignments.

Tutorials/Labs:
Students will learn how to solve various numerical problems and how to use the software.

## Course Materials

Textbook – Burger, Robert, E., Sheenean, Anne F. and Jones, Craig, H., Introduction to Applied Geophysics; Exploring the Shallow Subsurface, W. W. Norton & Company, New York - London, 2006 version or 2024 version.
The textbook is required. It is accompanied by a CD, which contains mandatory software in this course (for labs, assignments, and exams).

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**Course Assessment**

The final grade of the class will be based on the following:

| | |
|---|---|
| Five Assignments (TBD) | 35% |
| Mid-term (TBD) | 20% |
| Final Examination (TBD) | 20% |
| Field experiment report (TBD) | 10% |
| Quizzes | 10% |
| Attendance and participation at labs | 5% |

**Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A+ | (90-100) | B+ | (77-79) | C+ | (65-69) | D | (50-54) |
| A | (85-89) | B | (73-76) | C | (60-64) | F | (<50) |
| A- | (80-84) | B- | (70-72) | C- | (55-59) | | |

**Course Policies**

Assignments handed in late will be deducted 10% per day. Assignments handed in more than 5 days late will not be graded. There will be no make-up scheduled for the mid-term and final exam. If you must miss for illness (let me know in advance), the missing exam will be re-weighted from your assignments. Students must use the Student Declaration of Absence form for missed lectures or labs (at most twice). Additional information is in the supplemental syllabus.

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**Course Content** (Course closely follows the required textbook)

| Lecture# | Chapters of the textbook |
|---|---|
| Lecture 1 | Course policy and self-introduction |
| Lecture 2 | Overview of the course; chapter 1 |
| Lecture 3 | Seismic waves and wave propagation; chapter 2.1 |
| Lecture 4 | Ray paths in layered media; chapter 2.2 |
| Lecture 5 | Attenuation, amplitude, and acquisition; chapters 2.3, 2.4, 2.5 |
| Lecture 6 | Refraction: horizontal interfaces; chapters 3.1, 3.2, 3.3, 3.4 |
| Lecture 7 | Refraction: dipping and nonideal; chapters 3.5, 3.6, 3.7.1, 3.7.2 |
| Lecture 8 | Refraction: nonideal and field procedures; chapters 3.7.3, 3.7.4, 3.8, 3.10, 3.11 |
| Lecture 9 | Reflection: single interface; chapter 4.1 |
| Lecture 10 | Reflection: multiple interfaces; chapter 4.2 |
| Lecture 11 | Hands-on practices and review of all previous lectures |
| Lecture 12 | Reflection: Field procedures; chapters 4.4 and 4.5 |
| Lecture 13 | Reflection: computer processing; chapter 4.6 |
| Mid-term | In-class exam |
| Lecture 14 | Review of mid-term and intro to electrical resistivity; chapters 5.1, 5.2 |
| Lecture 15 | Resistivity: Current flow and electrical potential; chapters 5.3, 5.4, 5.5 |
| Lecture 16 | Resistivity: Field procedures; chapters 5.8, 5.9, 9.10 |
| Lecture 17 | Gravity: fundamentals; chapters 6.1, 6.2, 6.3 |
| Lecture 18 | Gravity: correction; chapters 6.3, 6.4 |
| Lecture 19 | Gravity: anomalies and interpretation; chapters 6.5, 6.6, 6.7 |
| Lecture 20 | Magnetics: fundamentals and field variations; chapter 7.1, 7.2 |
| Lecture 21 | Applications in Geology - guest lecture by Prof. James Brenan |
| Lecture 22 | Electromagnetic: GPR; chapter 8.4 & Review of the whole content |
| Lecture 23 | Field experiments: introduction and hands-on practices |

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**Faculty of Science Course Syllabus (Section B)**

## Winter 2024-25

*Introduction to Applied Geophysics - ERTH/PHYS 2270*

# University Policies and Statements

## This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

### Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

**Information**: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

### Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

**Information**: https://www.dal.ca/campus_life/academic-support/accessibility.html

### Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

**Code**: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

### Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

**Statement**: http://www.dal.ca/cultureofrespect.html

### Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

**Information**: https://www.dal.ca/campus_life/communities/indigenous.html

**Important Dates** in the Academic Year (including add/drop dates)
https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=117&chapterid=-1&topicgroupid=31821&loaduseredits=False

### University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

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**Faculty of Science Course Syllabus (Section C)**

# Winter 2024-25

*Introduction to Applied Geophysics - ERTH/PHYS 2270*

## Student Resources and Support

### Advising

**General Advising** https://www.dal.ca/campus_life/academic-support/advising.html

**Science Program Advisors**: https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html

**Indigenous Student Centre:** https://www.dal.ca/campus_life/communities/indigenous.html

**Black Students Advising Centre**: https://www.dal.ca/campus_life/communities/black-student-advising.html

**International Centre**: https://www.dal.ca/campus_life/international-centre/current-students.html

### Academic supports

**Library:** https://libraries.dal.ca/

**Writing Centre**: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

**Studying for Success:** https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

**Copyright Office**: https://libraries.dal.ca/services/copyright-office.html

**Fair Dealing Guidelines** https://libraries.dal.ca/services/copyright-office/fair-dealing.html

### Other supports and services

**Student Health & Wellness Centre**: https://www.dal.ca/campus_life/health-and-wellness.html

**Student Advocacy**: https://dsu.ca/dsas

**Ombudsperson**: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

### Safety

**Biosafety**: https://www.dal.ca/dept/safety/programs-services/biosafety.html

**Chemical Safety**: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

**Radiation Safety**: https://www.dal.ca/dept/safety/programs-services/radiation-safety.html

**Scent-Free Program:** https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html

**Dalhousie COVID-19 information and updates**: https://www.dal.ca/covid-19-information-and-updates.html