

# Petroleum Geology & Energy Systems Syllabus

## Department of Earth and Environmental Sciences

### ERTH4153 Fall 2023

*Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.*

*Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.*

#### Course Instructor(s)

Name	Email	Office Hours
Professor Grant Wach	grant.wach@dal.ca	Contact through email

#### Course Description

The course is an introduction to petroleum geoscience (gas, oil and unconventional) and energy systems with discussion of alternative and renewable energy sources including geothermal, hydrogen, wind and CCS (Carbon Capture and Storage) as the World economies experience a fundamental change- the Energy Transition. We examine the elements of the petroleum system- source, migration, reservoir, trap and seal through integrated study of basin analysis, source rock evaluation, seismic and well log sequence stratigraphy, biostratigraphy, core and outcrop description, depositional facies analysis, nonconventional resources and oil sands, drilling and completions, petrophysics and well log analysis in addition to other topics. We will discuss methane extraction and mitigation from Carboniferous coal-bearing basins, analyse CO<sub>2</sub> sequestration in Paleozoic and Mesozoic basins, and SedHeat geothermal production from sedimentary basins. Practical work includes laboratory and class exercises including core and cuttings descriptions and a term paper. Field excursions will discuss basin evolution and study evidence from outcrops to discern past paleoclimates, depositional systems and the elements of petroleum, geothermal, and carbon sequestration systems.

#### Course Prerequisites

ERTH 2270—Intro to Applied Geophysics, ERTH 3140—Structural Geology, ERTH 3303—Stratigraphy, or permission of instructor

## Student Resources

A list of student resources is available on Brightspace under General Course Files.

## Course Structure

### *Course Delivery*

All lectures, labs, and field trips will be presented in person. Course material such as PowerPoints will be available on Brightspace (typically posted after the lecture is presented), but lectures and labs will not be recorded. A number of guest lectures will be presented through recorded media, students will be notified of when these lectures will occur and if the lectures will be presented in class or otherwise.

### *Lectures*

**Lectures are every Tuesday and Thursday from 10:05AM - 11:25AM in the Milligan Room (LSC 8007).** The first lecture will be held on September 5th, and the final will be on November 30th.

### *Laboratories*

**Labs are every Thursday from 2:35PM - 5:25PM.** Excluding the first week of class, the first lab will be held on September 12th, and the final lab will be on November 28th.

### *Field Trips*

This trip is taken with the assumption that everyone has at least some experience working in the field. You will be notified of specific potential hazards, as well as emergency contact information suited to the site we access. You will be provided with numerous field safety forms detailing the risks and your acceptance of such - you will not be permitted to participate in any field trip prior to signing these forms. If you are unsure of anything regarding these field trips and your participation in them, please notify the professor and/or TA.

## Course Materials

These materials have been selected to expand your understanding of petroleum geoscience and renewable energy systems.

### MANDATORY

1) "Petroleum Geology & Energy Systems" class reader (available on BrightSpace)

### Recommended Textbooks:

- Last Billion Years, Atlantic Geoscience Society (2022, 2<sup>nd</sup> edition)

- Petroleum Geoscience: From Sedimentary Environments to Rock Physics – Knut Bjorylkke (2010) [In Killam Library: TN 870.5 B56 2010]
- N.P. James & R.W. Dalrymple (2010) “Facies Models 4”

### Assessment

Component	Weight (% of final grade)	Date Due
Labs	40%	Labs are due at the beginning of the following week's lab unless stated otherwise
Participation	15%	Attendance & in-class assignments
Field Trip Report	20%	Field trip report/exercise material are due 2 weeks after the field trip date
Term Paper	25%	Sept 14 – Topic submission Oct 5 – Essay outlines due for feedback Nov 21 – Finished Term Paper

*\*Note there will be no midterm or final exam.*

Please refer to the Course Content schedule for a more detailed listing of labs, field trips, and associated assignments and due dates.

#### Labs

*Completed lab assignments are due by the beginning of the following week's lab period unless otherwise stated.* Labs may be submitted either in physical copy or scanned and submitted through Brightspace. Please note, when scanning in a multi-page assignment for submission, be sure to combine the pages into a single Word or PDF file, rather than a collection of multiple image files.

#### Participation

15% of your grade will be based on your participation in the course. This will include your attendance at lectures, labs, and field trip, and completion of in-class assignments and lecture review. If you are unable to attend a scheduled course period, please contact the professor and TA to indicate you will not be present. In-class assignments are given during many of the lecture periods to engage students in the material and provide an opportunity for hands-on learning, while lecture reviews are typically a set of questions regarding a guest lecture to ensure information retention. In-class assignments and lecture reviews will not be graded on strict criteria but will be collected as part of your participation grade - if you complete the work and show evidence of understanding, it will count towards the 15% participation component. In-class assignments are due at the end

of the class they are given in, and there will be individual submission boxes provided on Brightspace for the lecture reviews.

### *Field Trip Reports*

For the field trip, you are to complete a Field Trip Report. This report will be worth 20% of your final grade. The report will consist of the completed set of exercises provided to you, a summary of the trip and the purpose of the report, an introduction and conclusion, and a background written on the geologic setting of the area, alongside relevant references. The Field Trip Report is due roughly two weeks after the field trip takes place. Reports are to be completed individually, while you are permitted to work together while in the field.

### *Term Paper*

Rather than a final exam, you will be asked to complete a Term Paper for your primary assessment in the course where you will be classifying a resource-based project based on the UN Framework Classification of Resources. You will be provided with a template on formatting expectations. To encourage an early start in the semester, you will need to define your topic by **Thursday September 14th**. If you would like to receive any feedback prior to submission of the final copy, it must be submitted by **Thursday October 5th**. An outline submission is not required, but *strongly suggested*.

The finished term paper is due at the **beginning of the lecture period on Tuesday November 21st**. **Extensions will not be provided.** For every day or part of a day that the paper is late, there will be a *5% reduction on the overall Term Paper grade* (i.e. if submitted 4 days past the deadline, the maximum total you could receive on the paper would be 80%, or a loss of 5% off your total course grade). Considering this assessment is worth the most of any individual assignment, and you are provided over two months to complete it, we suggest it is handed in on time.

### *Other course requirements*

All work will be done on a *professional level* of presentation in both laboratory and class. This course will help prepare you for your professional career and future professional accreditation (APGNS, APEGGA, etc.). As such, students are expected to maintain a high ethical and professional standard in their work and behavior.

### **Related Courses**

ERTH 4157 – Petroleum Geoscience and Energy Systems Field Methods (Trinidad)  
ERTH 4131 – Advanced Petroleum Geoscience (not offered every year)

Conversion of numerical grades to final letter grades follows the

[Dalhousie Grade Scale](#)

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

### **Course Policies on Missed or Late Academic Requirements**

**Attendance** is mandatory for all labs and field trips and is ***strongly recommended*** for the lectures. There are no make-up sessions and part of your grade will be based on attendance. Some assignments may be able to be completed online, however the lab experience will not be comparable and will only be used as a last resort. A Student Declaration of Absence may be submitted up to two times per semester. If you are unable to attend a lecture, lab, or field trip, please notify the professor and/or TA prior to.

**Late penalty** for all assignments, including labs, field trip material, papers, etc. **will be 5% per day** (or part of a day) after the due date. **No exceptions.**

### **Course Policies related to Academic Integrity**

All data will be your own work. Ask questions of both your classmates, TAs, and the instructor but **do not copy others' work**. Plagiarism will result in direct referral to the University Senate Committee on Academic Discipline & Integrity. For any assignment completed in a group, please provide a brief breakdown of the work between team members. Both Field Trip Reports can be completed in a team of four or fewer. For lab work, you will be notified during the lab whether the assignment can be submitted in a group. The Term Paper is to be a completely independent assignment subject to additional scrutiny.

We strongly discourage the use of AI and large language models in the completion of course work. The purpose of this course is to enhance your understanding of certain topics, which cannot be assisted by AI generated material. If you feel that the use of AI models in the course would improve your comprehension, please discuss with the professor and/or TA to determine potential while encouraging critical thinking and veering away from plagiarism. Keep in mind AI models are not reliable sources, and anything created or found in such programs would need to be cross referenced for accuracy.

## Learning Objectives

Successful completion of the course will equip students to:

1. Demonstrate knowledge and understanding of the concepts of the energy transition, petroleum geoscience and energy systems, and the elements of effective petroleum, geothermal, and carbon sequestration systems.
2. Gain “hands-on” laboratory techniques and field experience.
3. Organize ideas, summarize teachings, and describe findings appropriate for academic writing in the Earth Sciences.
4. Evaluate sedimentary basins and fields, and present technical analysis and interpretation.
5. Learn the value of integrated data sets to deciphering petroleum and renewable energy systems.

## Course Content

Schedule and specific content are subject to change. Detailed schedule will be provided upon the start of the course.

*Lecture material covered will include:*

- Petroleum Geology
  - o Basics of the petroleum system
  - o Source rock formation
  - o Reservoir Characterization
  - o Petrophysics
- Linked Depositional Systems
- Well Logging & Correlation
- Carbon Capture
  - o Utilization and enhanced oil recovery
  - o Transportation
  - o Geostorage and alternative storage of CO<sub>2</sub> and other gases
- Geothermal Energy Systems
- The Energy Transition and Carbon Neutrality

*Lab exercises covered will include:*

- Risk Analysis for Petroleum Systems and Geothermal Systems
- Well Log Correlation
- Oil Sands Core Description
- Oil Sands Drilled Cuttings Analysis
- Petrophysical Well Log Analysis
- Offshore NS Seismic Interpretation

## University Policies and Statements

### 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 at 1321 Edward St or [elders@dal.ca](mailto:elders@dal.ca). Additional information regarding the Indigenous Student Centre can be found at: [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

### Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

### Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all 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. Additional academic integrity information can be found at: [https://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](https://www.dal.ca/dept/university_secretariat/academic-integrity.html)

### Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre ([https://www.dal.ca/campus\\_life/academic-support/accessibility.html](https://www.dal.ca/campus_life/academic-support/accessibility.html)) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

### Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

## **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 (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.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. The full Code of Student Conduct can be found at:

[https://www.dal.ca/dept/university\\_secretariat/policies/student-life/code-of-student-conduct.html](https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html)

## **Fair Dealing Policy**

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/fair-dealing-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html)

## **Originality Checking Software**

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at:

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html)



## **Student Use of Course Materials**

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.