



**Carleton**  
**UNIVERSITY**  
**Department of Earth Sciences**

## ERTH 4804: Exploration Geophysics Winter 2022

Instructor: Dr. Wasiu O. Raji  
Office: 2249 Hertzberg  
Email: [wasiuraji@cunet.carleton.ca](mailto:wasiuraji@cunet.carleton.ca)  
Office hours: by appointment

Teaching Assistant: Fateme Hormozzade Ghalati  
Email: [fatemehormozzadeghal@cmail.carleton.ca](mailto:fatemehormozzadeghal@cmail.carleton.ca)  
Office Hours: By appointment.

### **Day, Time and Place:**

Lecture: Thursdays -11:30 am – 1:30 pm SYNCHRONOUS ONLINE until further notice; later in-person **room to be communicated later**

Laboratory: Friday – 11:30 am - 2:30 pm @ SYNCHRONOUS ONLINE until further notice; later in-person **room to be communicated later**

### **Course Description**

Geophysics is a branch of Earth Sciences that deals with the study of the composition and structure of the earth using specialised methods to measure the physical property (such as density, electrical resistivity, wave velocity, changes in gravity and magnetic field) of the earth. The difference in these physical properties, between the target and the neighbouring rocks is used to identify areas rich in oil, natural gas, water, and other natural resources such as platinum, copper, gold, iron, coal, etc; to investigate and mitigate environmental hazard and pollution; and evaluate sites for the construction of landfills, dams, boreholes, hydropower and nuclear power plants.

ERTH 4804 – Exploration Geophysics teaches the fundamentals of geophysical methods of survey and the applications of the methods to the exploration of shallow subsurface for natural resources and geological structures of interest. The course will start off with a broad introduction to the different geophysical methods - Seismic, Electrical, Gravity, Magnetic, Electromagnetic, and the miscellaneous methods, and their corresponding operative physical quantities; the consideration for selecting the most appropriate method for different targets and situations; instrumentation,

methodology and field procedures. Having covered seismic reflection & refraction, Electrical and gravity method in a previous course, EARTH 4804, this year, will concentrate on Magnetism and Electromagnetic methods and the application of these methods to the understanding of subsurface geology for identifying and evaluating targets. The course will teach data acquisition, processing, and interpretation as they relate to the different geophysical methods. The course involves lectures, laboratory work, discussion of case histories, and fieldwork demonstrations, where necessary. The course is very interactive and engaging.

### **Aim of the course**

The aim of the course is to give students sound knowledge of the geophysical methods used in exploring shallow subsurface. The course will provide solid grounding for future career, further study, or research in exploring the subsurface for natural resources including oil and gas, water, and mineral resources.

### **Course Topics**

- introduction & Revision on geophysical methods
- Magnetism; basic theory, rock magnetism, Earth's magnetic field
- Exploration using the magnetic method
- Magnetic effect of simple geometric shapes
- Data processing and interpretation-magnetic method
- Electromagnetic waves, surveying, and field techniques
- Data Processing and interpretation -electromagnetic method
- Ground Penetrating Radar

### **Learning Outcomes**

Students who enrolled in and completed the course will be able to:

- Explain the fundamental principles behind different geophysical method of survey
- Describe applications, suitability, and the limitations of the different methods of geophysics
- Describe and demonstrate data acquisition using relevant geophysical equipment
- Process, analyze and interpret magnetic and electromagnetic data
- Examine and discuss exploration survey results

### **Course Format and Structure**

The class will consist of two hours lecture and three hours laboratory work every week. Both lectures and labs will be held ONLINE until at least January 28<sup>th</sup>. **Once course delivery reverts to in-person, the room location for both lectures and labs will be released. Note that all students must follow the COVID-19 protocols for in-class attendance, including being doubly vaccinated.** Lecture note and other course materials will be provided. Students who enrolled in the course are expected to attend lectures and participate in laboratory work every

week, read ahead of lectures, do assignments and submit them at scheduled time. The lab will be a mixture of theoretical problems (to aid firm understanding of each geophysical method), manual and computer-based approaches to data processing and interpretation. Students are expected to complete laboratory assignments within the laboratory hours, where necessary, submission may be extended till Monday. Students will use geophysical software available in the lab and other programs such as excel and MATLAB to complete their assignments. Carleton students can download MATLAB to their own computers for free by following the instructions at this website: <https://carleton.ca/its/all-services/computers/site-licensed-software/matlab-students/>

Any work submitted by a student must be their own and credit must be given to work of others, images or texts, consulted or used in one's write-up. Students must clearly attribute any quotations or copied figures (citing name(s) of author(s) + year + publication of the work and the web link as the case may be). it is not EVER permitted to copy another student's work. If a student is found to be in violation of copy right policy, there will be very serious consequences. Instructors *are required* to report all incidents (or suspected incidents) of plagiarism to the Dean.

Exam 1 will be a take-home exam and will consist of long answer questions. Exam 2 (the Final Exam) will also be long answer questions, take place within the formally scheduled exam time, and may/may not be a take-home exam depending on the situation at that time. For all labs and exams, *always* show your full working steps for mathematical problems and describe the terms and notations to attract full mark. Full mark will not be awarded if the logic and workflow of the answer is not very clear. Some words describing the mathematical steps can be very helpful. Make sure to properly highlight your final answer to each problem.

Some class time will be allotted to the discussion of some important research in Exploration Geophysics and some interesting case examples. All literature will be posted to Brightspace to allow students access them before class. You are strongly encouraged to read the materials prior to classes. Participation in class discussion will be noted and counts as part of 10%. Participation has nothing to do with being the most correct, or the most profound. It's really about encouraging students to ask questions, to make comments, and to think out loud about what they are reading and learning. Finally, each student will pick a geophysical exploration topic/technique and write a paper exploring the method. The last class of the semester will then be reserved for presentations and a general discussion of the chosen topics. More information will be given out during the semester.

### **Course Requirements:**

- Attendance in class is mandatory, either online or in-person. It is required that you email the instructor to advise of absences due to illness or emergencies within **two days** of missing an assignment deadline or an exam.
- Lab work must be handed in on time. Late labs will be accepted in the instance of illness, with a medical note, or in the instance of emergencies, by consultation with your TA and instructor.
- It is the student's responsibility to come to classes and labs prepared. Reading assignments are mandatory.
- It is your responsibility to refer regularly to the course website for lecture topics, reading assignments, laboratory topics and pre-lab review or homework.

- Regularly log onto the CU Learn/Brightspace to check for announcements, course information, laboratory assignments and lecture materials.
- Lab exercises will be posted on CU Learn/Brightspace.

**Due to the current COVID-19 restrictions, the class will start off online and change to face to face when situation permits.**

### **Grading Scheme**

Laboratory work and lab assignment -	30%
Exam 1 -	20%
Exam 2 –	25%
Final paper & presentation -	15%
Lecture participation and assignments, etc. –	10%
Total –	100%

### **Suggested References:**

Introduction to Applied Geophysics – Exploring the shallow subsurface  
 H. Robert Burger, Anne F. Sheehan and Craig H. Jones, 1992

An Introduction to Geophysical Exploration  
 P. Kearey, M. Brooks, I. Hill, 2002

Books available at the bookstore and the library.

### **Schedule of lectures**

**(To be updated later)**

### **Academic Integrity**

**It is your responsibility to review Carleton’s policy on Academic Integrity - Section 14 of the Calendar.**

<http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/acadregsuniv14/>

### **Plagiarism**

*The instructor is required to report all incidents (or suspected incidents) of plagiarism to the Dean. All work handed in must be your own.* Plagiarism and cheating are viewed as being particularly serious and the sanctions imposed are accordingly severe. Students are expected to familiarize themselves with and follow the Carleton University Student Academic Integrity Policy. The Policy is strictly enforced and is binding on all students. Plagiarism and cheating –

presenting another's ideas, arguments, words or images as your own, using unauthorized material, misrepresentation, fabricating or misrepresenting research data, unauthorized cooperation or collaboration or completing work for another student – weaken the quality of the graduate degree. Academic dishonesty in any form will not be tolerated. Students who infringe the Policy may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from full-time studies; a refusal of permission to continue or to register in a specific degree program; academic probation; or a grade of failure in the course.

## **Requests for academic accommodation**

**Please review the Carleton's Student Guide to Academic Accommodations at**

<http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf>, and the websites therein.

### **For Students with Disabilities:**

“The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your ***Letter of Accommodation*** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website ([www.carleton.ca/pmc](http://www.carleton.ca/pmc)) for the deadline to request accommodations for the formally-scheduled exam.

### **for religious observance:**

**1.** As soon as you receive your course syllabus, identify any potential conflicts between your religious obligations and course requirements. **2.** Make a formal written request to your instructor indicating the nature of the religious obligation and suggest possible alternative dates and/or means of satisfying the academic requirements. *NOTE: Such request should be made during the first two weeks of the term, or as soon as possible after a need for accommodation is known to exist, but in no case later than the second last week of classes for that term.* For detailed information on Religious Obligations please visit our website at: [carleton.ca/equity/accommodation/academic](http://carleton.ca/equity/accommodation/academic).

### **for pregnancy:**

**A.** For final exams, identify and discuss your needs for final examinations with your professors. When an agreement is reached fill out and submit the online **Pregnancy Accommodation Final Exam Request Form** at: [carleton.ca/equity/accommodation](http://carleton.ca/equity/accommodation). Equity Services will forward the request to Exam Services to coordinate the accommodation. **B.** For in-class accommodations ONLY. If you anticipate you will only require in-class accommodations, discuss them directly with your course instructor. This request should be made in the first two weeks of the academic term. For detailed information on pregnancy and parental leave policies please visit the website at: [carleton.ca/equity/accommodation/academic/](http://carleton.ca/equity/accommodation/academic/)

**Equity and PMC Contact information:**

- Department of Equity and Inclusive Communities

613-520-5622

3800 Carleton Technology & Training Centre

[equity@carleton.ca](mailto:equity@carleton.ca)

Website: [carleton.ca/equity](http://carleton.ca/equity)

- Paul Menton Centre for Students with Disabilities

613-520-6608

[pmc@carleton.ca](mailto:pmc@carleton.ca)

500 University Centre

Website: [carleton.ca/pmc](http://carleton.ca/pmc)