Carleton UNIVERSITY

Department of Earth Sciences

Course outline

ERTH 4804 Exploration Geophysics Winter 2023

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 host rocks is used to identify areas rich in Energy and mineral resource, groundwater, structures, etc.; to investigate and mitigate environmental hazard and pollution; and evaluate and monitor land fill and nuclear waste repositories, and for locating sites for the construction of dams, boreholes, and hydropower stations

ERTH 4804 – Exploration Geophysics teaches the fundamentals of geophysical methods of survey and the applications of the methods to the exploration of shallow. 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, ERTH 4804, this year, will concentrates on Magnetics 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 demonstrations, where necessary. The course is very interactive and engaging.

Course delivery: Course delivery is in-person lectures on Wednesdays and laboratory work on Fridays in HP 3120.

Professor: Wasiu O. Raji, Ph. D.
Office: 2249 Herzberg
Email: wasiuraji@cunet.carleton.ca
Office hours: by appointment

Teaching Assistant: Fateme Hormozzade Ghalati
Email: fatemehormozzadeghal@cmail.carleton.ca
Office Hours: By appointment.

Course Topics

- introduction & Revision on geophysical methods
- Gravity: Fundamental relationships, Measuring gravity, and data adjustments/corrections
- Gravity: Field procedure, analyses, and interpretation
- 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

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 are available at the bookstore and the library.

Aim of the course

The aim of the course is to give students sound knowledge of geophysical methods used in exploring the shallow subsurface. The course will provide solid grounding for future career, further study, and research in subsurface geophysical exploration.

Learning Outcomes

By the end of this course, students will be able to:

- Explain the fundamental principles behind different geophysical methods of survey
- understand the 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
- Interpret and discuss exploration survey results

Course Format, requirements, and policies.

The class will consist of two hours lecture and three hours laboratory work every week. Both lectures and labs will be held **in-person** in Herzberg **Laboratories HP 3120**. Lecture notes and other course materials will be posted on Brightspace ahead of the class. Attendance at lectures and labs is mandatory. Students who enrolled in this course are required to attend lectures and labs every week, read ahead of lectures, and submit lab work and assignment at scheduled time. It is students' responsibility to refer regularly to the course website for lecture topics, reading assignment, announcements, due dates, and other important information. Attendance in class and lab is in-person and mandatory, and will weight toward 5%. It is required that you email the instructor to advise of your absences due to illness or emergencies before lecture and within **two days** of missing an assignment deadline or an exam. Assessment will comprise assignments, laboratory exercises, project report writing and presentation, and final examination.

Assignment and Lab work: The **assignments** will be a combination of theoretical problems and practical applications solved on the computer. **There will be 3 lab assignments/lab tasks, one per month, in January, February, and March.** They will be posted on Brightspace and students will be required to.through Assignment module in Brightspace. Submission will not be accepted by email, except otherwise stated. The lab will be a mixture of demonstrations, theoretical problems (to aid firm understanding of the topics), and manual/computer-based approaches to data analyses and interpretation. Students are expected to complete laboratory tasks within the laboratory hours and submit at the end of the lab. Students will use geophysics software available in the lab and other programs such as excel and MATLAB to complete 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/**

Final Exam (the Final Exam) will be mathematical problems and long answer questions, take place **in-person digital** **within the formally scheduled final exam period**.
Project: There will be one large **project** focusing on application of geophysical method to exploration in a region of interest to you. This project will comprise the application of the concepts methods, data, interpretations of results. This project will be posted in February and due at the end of **March/first week of April,** and you will be guided to work progressively on various aspects of it throughout the semester. For all labs, assignments 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 the class. Participation in class discussion will be noted and counts as **part of 5%.** Participation has nothing to do with being the most correct, or the most profound. It's about encouraging students to ask questions, make comments, and to think out loud about what they are reading and learning.

Missed Deadlines

If you foresee you might miss a deadline, you must inform the professor before the deadline. If you miss the deadline for a task or exam due to unforeseen circumstances, then you must contact the course professor within 2 days of the deadline and provide appropriate documentation in order to obtain an extension. Where accommodation is not granted, **missed deadline attracts 5 marks deduction per day up to a maximum of 25 marks.** Submissions not received with two weeks will not graded and the student will be awarded a zero except they got accommodation.

Email policy: Email policy: All questions relating to this course should be sent to the Brightspace discussion board, not my email, to allow other students benefit from the question and responses. The TA and I will respond to questions on 'discussion board within 24 hours, except on weekends. Given the number of students on this course and the professor's workload, students are encouraged to use discussion board for all questions on the course and only email the professor when they are to discuss personal and confidential matters.

Grading Scheme

Laboratory exercises and assignments -	30%
Final paper & presentation -	25%
Final Exam – in-person Schedule	40%
Lecture attendance and participation –	5%
Total –	100%

Lecture: Wednesdays 8:35 - 10:25 @ HP 3120
Laboratory: Fridays 14:35 am - 17:25 @ HP 3120

Week #	Lecture date	Lecture Topic	Lab date	Lab activity
1	Jan 11	Introduction	Jan 13	No lab
2	Jan 18	Intro Geophy. processing	Jan 20	No lab
3	Jan 25	Gravity surveying	Jan 27	Lab 1 – Gravity
4	Feb 1	Gravity Surveying	Feb 3	Lab 2 – Gravity
5	Feb 8	Magnetic surveying	Feb 10	Lab 3 – Magnetic
6	Feb 15	Magnetic surveying	Feb 17	Lab 4 – Magnetic
7	Feb 22-24	Winter Break	Feb 22 - 24	Winter Break
8	Mar 1	Gravity/magnetic surveying activities	Mar 3	Lab 5 – Magnetic
9	Mar 8	Electromagnetic	Mar 10	Lab 6 - Electromagnetic
10	Mar 15	Electromagnetic surveying	Mar 17	Lab7 - Electromagnetic
11	Mar 22	Electromagnetic surveying	Mar 24	Lab 8 - Electromagnetic
12	Mar 29	Electromagnetic surveying	Mar 31	Lab 9- Paper prep
13	Apr 5	Project presentation	Apr 7	Project presentation
14	Apr 12	Exam period	Apr 14	Exam Period
15		Exam period		Exam Period

*Above schedule is subject to slight modifications

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/acadregsun iv14/

Plagiarism

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.

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 students – 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 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) 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.

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. 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/

Equity and PMC Contact information:

• Department of Equity and Inclusive Communities, 613-520-5622, 3800 Carleton Technology & Training Centre, equity@carleton.ca Website: carleton.ca/equity

• Paul Menton Centre for Students with Disabilities 613-520-6608 pmc@carleton.ca 500 University Centre. Website: carleton.ca/pmc

Statement on Student Mental Health

As a university student you may experience a range of mental health challenges that significantly impact your academic success and overall well-being. If you need help,

please speak to someone. There are numerous resources available both on- and off-campus to support you. Here is a list that may be helpful:

Emergency Resources (on and off campus): https://carleton.ca/health/emergencies-and-crisis/emergency-numbers/

Carleton Resources:
• Mental Health and Wellbeing: https://carleton.ca/wellness/
• Health & Counselling Services: https://carleton.ca/health/
• Paul Menton Centre: https://carleton.ca/pmc/
• Academic Advising Centre (AAC): https://carleton.ca/academicadvising/
• Centre for Student Academic Support (CSAS): https://carleton.ca/csas/
• Equity & Inclusivity Communities: https://carleton.ca/equity/

Off Campus Resources:
• Distress Centre of Ottawa and Region: (613) 238-3311 or TEXT: 343-306-5550, https://www.dcottawa.on.ca/
• Mental Health Crisis Service: (613) 722-6914, 1-866-996-0991, http://www.crisisline.ca/
• Empower Me: 1-844-741-6389, https://students.carleton.ca/services/empower-me-counselling-services/
• Good2Talk: 1-866-925-5454, https://good2talk.ca/
• The Walk-In Counselling Clinic: https://walkincounselling.com