

EARTH SCIENCES 3320B (GP 9520B)
ENVIRONMENTAL AND EXPLORATION GEOPHYSICS II
Winter Term January – April 2024

COURSE INFORMATION

Instructor:	Katsu Goda, BGS 1076 (Email: kgoda2@uwo.ca)
Teaching Assistant:	None
Office hours:	By appointment
Lectures:	Mondays and Wednesdays 10:30–11:30
Labs:	Mondays 14:30–17:30
Prerequisites:	Earth Sciences 2220A/B. NOTE: Unless you have either the requisites for this course or written special permission from your Dean 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.

CALENDAR DESCRIPTION

An advanced course covering the geophysical techniques used for subsurface sensing, with applications to environmental studies and resource exploration. Data analysis includes seismology, gravity, electromagnetic, and radiometric applications.

COURSE SYLLABUS

The aim of this course is to provide an overview of applied geophysical techniques that are used for geophysical prospecting. Techniques covered in this course are used for environmental studies, resource exploration (oil & gas, mineral deposits, water), and pure research. For students of geophysics, this will serve as a foundation for more advanced studies; for other science students, this course will provide a broad overview and appreciation of the potential applications and limitations of geophysical methods. The first half of the course will focus on passive methods, such as gravitational and geomagnetic surveys, which measure naturally occurring fields that do not require an artificial energy source. The second half will focus on active techniques, including electrical resistivity, induced polarization, and electromagnetic methods. Each of these techniques yields information on a specific physical attribute, such as density, magnetization, electrical conductivity, and electrical chargeability. The study of each technique will commence with a review of its underlying physical principles, followed by a discussion of the field data acquisition procedures, data processing, and computer aided interpretation techniques. Case histories will be used to illustrate the state-of-the-art as well as practical applications.

This is a lab-oriented course that will provide hands on computer-based numerical experience, particularly with the general-purpose program MATLAB. Geological and geophysical concepts will be emphasized but underlying mathematical principles will also be discussed to give a comprehensive understanding of the methods and their applications. This course is intended for students in Earth Sciences but is also relevant to students in other programs of studies including Environmental Science and Geotechnical Engineering.

COURSE MATERIALS:

Primary textbook:

- Pratt, R.G. and Smith, R. Applied Geophysics Course Notes – Theory and Practice of Geophysical Prospecting (Available to students in PDF format), 2020.

Suggested textbooks:

- Telford, W.M., Geldart, L.P., and Sheriff, R.E., *Applied Geophysics*, Cambridge University Press, 1990. (In the past this was a very complete reference textbook, but it is becoming somewhat dated. In sections it tends to be overly mathematical, but it does have many examples of geophysical data in a wide range of applications. For descriptions of the engineering principles of geophysical sensors it is very good.)
- Kearey and Brooks, *Introduction to Geophysical Exploration*, Blackwells, 1991.
- Sharma, P.V., *Environmental and Engineering Geophysics*. Cambridge University Press, 2007.
- Reynolds, John, M., *An Introduction to Applied and Environmental Geophysics*, Wiley, 2011.

Electronic Devices:

Non-programmable electronic calculator is strongly recommended for labs, tests, and examinations. Cameras or any recording devices are not allowed in the class.

MARK DISTRIBUTION:

	ES 3320	GP 9520
Labs/Projects	40%	40%
Mid-term Exam	20%	10%
Final Exam	40%	30%
Term project	N/A	20%

Projects: The projects will span several lab periods and will involve a written report (5 pages + figures). The purpose of the project reports is to provide technical writing experience. The report should have a title page, a maximum of 4 pages of text, and 4 to 5 single page figures. The report format will include Summary, Introduction, Study Area, Method, Discussion, Conclusions, and References.

Format for project reports: The *Summary* (or *Abstract*) should contain a concise synopsis of the project, not a rewording of the conclusions. The *Introduction* should summarize any previously published work in the area and state the objectives of the project. The *Study Area* section should describe the location and tectonic/geological characteristics of the study region. The *Methods* section should contain a brief description of the methods used, not a MATLAB program listing nor a duplication of material from the project handout. *Discussion* and *Conclusions* sections may be combined or separated. The *Discussion* should contain an interpretation of the results of the project, whereas the *Conclusions* may be in the form of a numbered list. Aside from the *Conclusions*, all other parts of the report text should be in full English sentences. The font should be 12-point Times New Roman, and the line spacing should be 1.5. The *Reference* format should follow the *Canadian Journal of Earth Sciences* formatting. Figures require concise captions and should be completely annotated. S.I. units should be used in the report, except where noted in the handout.

Labs: Labs are computer-based assignments. Lab reports are due the week after the lab, at the beginning of the next lab period.

Quizzes: Quizzes consist of one-two theoretical questions and/or simple calculations and will require no more than five minutes to complete.

Midterm Exam: will be scheduled during regular lecture time on February 14th, 2024.

The Midterm and Final examinations will be mixed format. They are intended to test for comprehension of the material, not memorization of definitions and formulas (a formula sheet will be provided). Students are permitted to bring a non-programmable calculator into both the midterm and final exams. Questions will focus on explaining concepts or making simple calculations.

CLASS TIMETABLE

Weeks	Dates	Lectures	Labs
Week 1	Jan. 8 / 10	Introduction, Gravity	MATLAB introduction
Week 2	Jan. 15 / 17	Gravity	Distribute Assignment 1
Week 3	Jan. 22 / 24	Gravity	[Continue work on Assignment 1]
Week 4	Jan. 29 / 31	Magnetic	Due for Assignment 1; Distribute Assignment 2
Week 5	Feb. 5 / 7	Magnetic	[Continue work on Assignment 2]
Week 6	Feb. 12 / 14	Magnetic / Review	Midterm exam (Gravity, Magnetic)
Reading Week	Feb. 17 - 25		
Week 7	Feb. 26 / 28	Electric	Due for Assignment 2; Distribute Assignment 3
Week 8	Mach 4 / 6	Electric	[Continue work on Assignment 3]
Week 9	March 11 / 13	Electric / Electromagnetic	[Continue work on Assignment 3]
Week 10	March 18 / 20	Electromagnetic	Due for Assignment 3; Distribute Assignment 4
Week 11	March 25 / 27	Electromagnetic	[Continue work on Assignment 4]
Week 12	April 1 / 3	Remote sensing	Due for Assignment 4

STUDENT ABSENCES

For work totaling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf.

The Student Medical Certificate is available at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

Regarding this course, if students miss the knowledge test (20%), this weight is transferred to the individual project (i.e., its weight will be changed from 40% to 60%).

Depending on the circumstances, extensions may be given for the submission of assignments I and II as well as the final project report.

ACCOMODATION AND ACCESSIBILITY

Religious Accommodation

When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of

Registration. Please consult University's list of recognized religious holidays (updated annually) at <https://multiculturalcalendar.com/ecal/index.php?s=c-univwo>.

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).

ACADEMIC POLICIES

The website for Registrarial Services is <http://www.registrar.uwo.ca>.

In accordance with policy,

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 e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

No electronic device is permitted during the knowledge test. It is a closed book test.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, 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 and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (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.

To connect with a case manager or set up an appointment, please contact 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. You may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (<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.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: <https://www.uwo.ca/se/digital/>.

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