ES4451/GP9509 Geophysical Field Techniques, Fall 2025

Course Description

This course provides an introduction to the practical application of various geophysical techniques (gravity, magnetics, electrical, electro-magnetics, seismics, or GPR). Geophysical surveys are used for site characterization in assessment of hazard mitigation, anthropological, environmental, and civil engineering studies, and resource exploration. Students will plan, acquire, process, and interpret geophysical field surveys.

Pre-requisites: ES2220 or permission of the Instructor/Department

Instructors: Dr. Sheri Molnar, BGS 1040, smolnar8@uwo.ca; Teaching Assistant, TBD

Industry Participants: Alex Bilson Darko (WSP, Mississauga); Dylan Klazinga (Sensors and Software)

Grad Student Guest Lecturer / Participants: Reid Perkins (Dept. Earth Sciences, LIDAR surveying); Junwei Zhu (Dept. Civil & Env. Engineering, Multi-Survey Applications)

Course Delivery

11 days total, from Sunday Aug. 24 to Wed. Sept. 3 2025.

- Aug 24, 25, 26: On-campus instruction days with classroom lectures, outdoor survey field survey training (students are taught to properly use the various sets of equipment), and computer lab tutorials (students are taught to use the various software, perform data analyses and interpretations).
- Aug 27: On-campus field preparation and planning day in assigned classrooms.
- The next 6 days involve two off-campus field days to perform planned field surveys (Aug 28, 29) followed by an on-campus day to process, interpret, and present about the field surveys results (Aug 30) that repeats again for the second off-campus field site (Aug 31, Sept 1, Sept 2). Schedule may be adjusted based on weather conditions.
- Sept. 3: Last course day is held on-campus, includes the oral examination and students completing all data analyses for their field reports.

All course material will be posted to OWL: https://westernu.brightspace.com/. Students are responsible for checking the course OWL site (https://westernu.brightspace.com/) regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class. If students need assistance with the course OWL site, they can seek support on the OWL Brightspace Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Start Date: Sunday, August 24 2025 @ 8:30 AM in the Biological and Geological Sciences (BGS) building (classroom to be announced)

Field Safety

A safety plan will be prepared by the instructor in consultation with the students prior to any field work.

Equipment

Students will make use of geophysical equipment belonging to the Earth Sciences department at Western

University. All of this equipment is expensive, repairs are costly and often take more time than the duration of the field school. Students are expected to **treat all equipment with the utmost care**. Students are allowed to sign out equipment for additional work, design projects, etc., only after they have received training through this course or equivalent.

Learning Outcomes: Students completing the course will be able to:

- operate proficiently basic geophysical instrumentation
- design and carry out geophysical surveys to meet industry needs in site assessments for hazard mitigation, resource exploration, anthropology, environmental or civil engineering
- reduce and interpret data arising from such surveys
- communicate the results of the surveys through professionally written reports and presentations

Evaluation

1: 15% Professional reports on field testing of geophysical instruments, small teams/pairs (first three days)
2: 10% Oral presentations of field survey design proposals and plans (team marks will be assigned)
3: 10% Participation, Professionalism, and Classroom Deliverables
4: 20% Oral presentations of field surveying outcomes & preliminary results (team marks will be assigned)
5: 15% Oral interview (Wed. Sept. 3rd)
6: 10% Executive Summary (short report) of the assigned "secondary site" (due Wed. Sept. 3rd)
7: 20% Field Site Report (professional report) of the assigned "primary site" (due Wed. Sept. 10th)

Special Note regarding Absences: Due to the compressed format of the course, **attendance each day is mandatory**. If a student is forced to miss more than one day (over 10% of the overall course grade) with valid documentation (e.g., academic considerations provided by their academic counsellors), they will be issued an INC and asked to complete the course with the next offering of the class. Course fees are non-refundable.

> For further information about Academic Considerations, please consult
> https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf

Course Deliverables

Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea, a graphical image, or a passage from another author, they must acknowledge their debt by using quotation marks where appropriate and by proper referencing such as footnotes or citations.

The use of generative AI tools (e.g., ChatGPT or similar platforms) is **not permitted** in the completion of any course assessments. We will collect and analyze our own data, using codes and software provided to you, such that there are no reasons known to the instructor to use AI tools. Using such AI tools for content generation, code writing, problem solving, translation, or summarization – when not explicitly allowed – will be treated as a **scholastic offence**.

> **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:
> https://uwo.ca/univsec//pdf/academic_policies/appeals/scholastic_offences.pdf

1. Field Instrument Testing Reports (5% per report, small teams/pairs)

The objective is produce a report on the proper functioning of each instrument, and to make recommendations for field procedures to be used in future surveys (i.e., the field sites). The field test data should be quantitatively compared with expected geology and anomalies in the area to document the correct instrument response. Reports on the following instruments are required:

- **Report 1:** Magnetics (with graphed Gravity measurements as Appendix)
- **Report 2:** Electrical Resistivity / IP (with graphed EM measurements as Appendix)
- **Report 3:** Seismics (with GPR processed image(s) as Appendix)

Note that the above report and appendix topics assumes all students are trained equally on the equipment in the allotted on-campus training. Sometimes it is necessary for the instructor to rebalance the report and appendix content/topics based on the equipment used by the student pair/teams.

Students must submit each report before they will be permitted to participate in the next field test exercise. Each student pair team prepares their own report, although collaboration with other student pairs on base maps and data plotting is encouraged. The field tests must be fully documented, all data must be **reduced*** and quantitative interpretations and/or conclusions must accompany the reports. A *brief* discussion of the instruments used (name and model), where and why the exercise was done, and how the data were collected is required. Conclusions should be written with regard to the functioning of the instrument and any recommended field procedures to be used.

*Note that **data reduction** is the process of correcting and transforming raw data to isolate the geophysical anomalies of interest, removing unwanted effects and distortions caused by factors other than the subsurface features being investigated. This process makes the data more interpretable for understanding geological structures and resources.

Field instrument testing reports are to be approximately 750 words per instrument used. Excessive length will be penalized. The field data should be clearly represented in the form of graphs, figures or tables, as appropriate. Base maps need to be detailed, legible and should clearly show the location of each survey, as well as be annotated with any anomalies located. Maps must have a legend, a scale, and a North arrow.

It is not necessary to reproduce all data in the form of tables, your graphs will be sufficient.

A *suggested* format for the field instrument testing reports is:

Objectives: Discussion of where and why survey was performed.
Instruments: Instruments used, operating principles and what exactly is measured (be brief).
Procedure: Brief review of survey procedure (specific to each geophysical method), including setup used.
Results: Show and describe your primary data (graphs, images, etc). Brief discussion of results, addressing sources and magnitude of errors and limitations.
Data Analysis and Interpretation: This is where you describe what you think your data mean (refer back to the Objectives).
Conclusions and Recommendations: I don't mind if this is very brief, but it must be suitable.
References: Include a list of consistently formatted references (I don't require a particular ASA or journal format, just make it consistent). References can/should be provided for instructor slides, equipment manuals, and any other source material you needed to cite in the report.

Standards/Assessment of Reports: Professional standards in written work are critical in this course.

- Your reports are expected to be clearly written to a high (aiming for professional) standard.
- Figures are expected to be annotated prior to inclusion in the report, inserted as an image of high quality, numbered and captioned below, and *included* within the text (images should not float around; captions should not be inserted text boxes).
- You must refer to each Figure at least once in the text to provide context. Figures should appear after they are referred to (do not start a section with a graph or image).
- Maps are essential: they must be legible, with a legend, scale, north arrow, etc.
- Appendices are allowed for presentation of large volumes of data, but must be mentioned (referred to) and summarized within the report text.
- A reference list is always required, and consistent referencing style is expected.

- Any formulas are to be treated as a part of the text, and punctuated accordingly *and numbered*.
- Formulas must be either derived or properly referenced, and any previous results (mathematical, geophysical, or geological) must be referenced.

2. Design Proposals for each field site (10%, student team oral presentations)

A "Request for Proposal" (RFP) will be issued by the "client" for two field sites. In response to the "Request for Proposal", students will be assigned to "field surveying design teams" to orally present one single proposal to the "client" for each of the two field sites. The proposals should consist of at least:

- Proposal of chosen field surveying methods (why necessary?) and their associated survey design (locations, layouts, equipment spacing, etc.).
- A preliminary itinerary with daily timetables and associated team assignments.

Careful attention must be paid to prepare a survey proposal that can be carried out in the time available. The resulting proposal will serve as a field guide/plan for the field sites. The instructor will discuss the proposal with each team as they are developing it - students should be prepared to defend the proposal or modify accordingly.

3. Participation, Professionalism and Classroom Deliverables (10%)

Participation and Professionalism will be assigned in consultation between all course instructors/guests, on the basis of:

- Initiative, enthusiasm, professionalism
- Respect for colleagues, instruments, and sites
- Safety consciousness
- Equipment management and cleanliness
- Field notebook

Classroom deliverables: As data are collected each day, students will be expected to help download data from the equipment, transcribe data from their field notes into digital form, prepare figures representing the data and representing the field layouts, and upload to the shared OneDrive folder using logical and unique file names and on a timely basis. Students need to be proactive to ensure that data is appropriately collected, managed, and analyzed, and not to rely solely on the course instructors.

4. Field surveying outcomes & prelim. results presentations (20%, student team oral presentations)

Each team presents an oral presentation of the field surveying outcomes and preliminary results for each site to the "client". This should include at least: visual summaries of the data collected (maps, survey layouts), preliminary evaluation of the data with regard to the fieldwork proposals (data reduction, initial results), and a detailed plan for follow-up work (geophysical modelling, additional surveys).

These are presentations to client management on the success (or otherwise) of the field excursion, and a specific proposal for data reduction, geophysical modelling and final reporting. A management board will be appointed, to be made up of instructors and industry /guest participants present. Student marks will consist of two components: presentation style and content.

5. Oral Interview (15%)

Students will be given an oral interview by the course instructors on the final day of the course, designed to test general levels of knowledge and insight into any of the methods covered by the course, and any of the field operations conducted.

6. Executive Summary (10%, due Wed., Sept 3rd @ 8pm)

A 600 word executive summary on the "secondary site" (to be assigned to the student) written for the "client" (see the earlier "Request for Proposals"), containing information on the number and type of surveys conducted, the quality of the data, any major difficulties encountered, the processing attempted, and a summary of the integrated interpretation with the major conclusions.

7. Field Site Report (20%, due Wed., Sept 10th @ 8pm)

A professional-level geophysical report prepared on your "primary site" (to be assigned to the student) written for the "client". Each student must prepare their written reports individually, although students are encouraged to organize the tasks of data processing, and data modelling in such a way as to equalize the workload amongst them. Nevertheless, ***all written work submitted will be considered to be the independent work of the student who submits it***.

The field site report should contain approximately 3000 words. Insufficient or excessive length will be penalized. It is suggested your reports follow this format:

Executive Summary (approx. < 200 words)
Table of Contents
Introduction
Geological Setting
Geophysical Survey Methods
Data Preparation and Reduction
{*Name of*} Survey Results – results of the individual surveys that are most important, less important results should be relegated to the Appendices
Integrated Interpretation – multi-method interpretation is expected (e.g., Figures with composite images, annotated maps, etc.), this section presents how you "*put all the pieces of the puzzle"* together to elucidate the subsurface
Conclusions and Recommendations
References
Appendices

Figures should appear within the body of the text. Appendices may be used to present large volumes of data without interrupting the flow of the report.

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.

When conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible but not later than two weeks prior to the writing or the examination (or one week prior to the writing of the test). Please visit the Diversity Calendars posted on our university's EDID website for the recognized religious holidays: https://www.edi.uwo.ca.

Academic Policies

The website for Registrar Services is https://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.

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:
https://uwo.ca/univsec//pdf/academic_policies/appeals/scholastic_offences.pdf

Procedures on Scholastic Offences (Undergraduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf

Procedures on Scholastic Offences (Graduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_scholastic_offence_procedure.pdf

Support Services

Please visit the Science & Basic Medical Sciences Academic Advising 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.
Additional student-run support services are offered by the USC, https://westernusc.ca/services/.

This course is supported by the Science Student Donation Fund. If you are a BSc or BMSc student registered in the Faculty of Science or Schulich School of Medicine and Dentistry, you pay the Science Student Donation Fee. This fee contributes to the Science Student Donation Fund, which is administered by the Science Students' Council (SSC). **One or more grants from the Fund have allowed for the purchase of equipment integral to teaching this course.** You may opt out of the Fee by the end of September of each academic year by completing the online form linked from the Faculty of Science's Academic Counselling site. For further information on the process of awarding grants from the Fund or how these grants have benefitted undergraduate education in this course, consult the Chair of the Department or email the Science Students' Council at ssc@uwo.ca.