University of Western Ontario – Department of Earth Sciences

Earth Science 4451Z: Geophysical Field Techniques, Fall 2021
(Offered together with GP 9509A)

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. Three on campus instruction days including four field days.

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

Instructors: Dr. Sheri Molnar, smolnar8@uwo.ca; Alex Bilson Darko, abilsond@uwo.ca; Alex Vanderhoeff, TA

Course delivery

Three on-campus instruction days with lectures in BGS 0153 lecture room, equipment testing outdoors on campus, and computer tutorials in BGS 0184. Followed by an on-campus planning day, two off-campus field days, an on-campus processing day, two field days, and two remaining days on campus.

Start Date: **Saturday, August 28, 2021 @ 8:30 AM** in **BGS 0153** lecture theatre

Field Safety

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

Equipment

Students will make use of Geophysical equipment belonging to 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 (subject to minor changes on site):
1: 10% Written lab reports on field testing of geophysical instruments, small teams/pairs (first three days)
2: 10% Oral presentations of survey plans and design for field sites (team marks will be assigned)
3: 10% Participation and professionalism during course
4: 5% Classroom deliverables, punctuality
5: 20% Final oral presentations (team marks will be assigned)
6: 15% Oral test
7: 10% Executive summary – secondary site (due Tues. Sept. 7th)
8: 20% Final fieldwork report – primary site (due one week after return on Tues. Sep 14th)

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 with valid documentation (e.g., either an SRA or 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.

Reporting

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 both by using quotation marks where appropriate and by proper referencing such as footnotes or citations.

1. Individual reports on field testing of instruments (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)

Students must submit each report before they will be permitted to participate in the next field test exercise. Each student pair 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.

Field test 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 test 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
Bibliography: Include a correctly formatted reference to the manual, and any other material you used.

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 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 summarized within the text.
- A bibliography is always required, and correct 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 fieldwork at the field sites (10%)

One single proposal is expected from each team for each of the two field sites, in response to a "Request for Proposal". Students are expected to organize themselves as a "design team" to prepare these proposals. The proposals should consist of at least:

ii) Proposed field layouts for each survey type (magnetic, EM, resistivity, seismics, …)
iii) A preliminary itinerary with daily timetables and team assignments

Careful attention must be paid to prepare a proposal that can be carried out in the time available. The resulting proposal will serve as a field guide on the field locations. We will discuss and build the proposal together - students should be prepared to defend the proposal and modify accordingly.

3. Participation and professionalism (10%)

This mark will be assigned in consultation between all course instructors, on the basis of:

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

4. Classroom deliverables (5%)

As data are collected each day, students will be expected to download data from the equipment and/or transcribe data from field notes into digital form, prepare figures representing the data and representing the field layouts, and upload to the OWL course site using logical and unique file names and on a timely basis.

5. Final oral presentations (20%)

Each team presents a final oral presentation for each site. This should include at least: visual summaries of the data collected (maps, representative profiles), preliminary evaluation of the data with regard to the fieldwork proposals and detailed plan for follow-up work (data reduction, geophysical modelling).

These are presentations to 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 present. Student marks will consist of two components: presentation and content.

6. Oral test (15%)

Students will be given an oral test 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.

7. Executive summary (10%) – deliverable due Tues., Sept 7th @ 10pm

A 600 word summary report on the secondary site 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.

8. Final fieldwork reports (20%) – deliverable due Tues., Sept 14th @ 10pm

One single report is required on your primary site, 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 final reports should contain approximately 3000 words. Insufficient or excessive length will be penalized. It is suggested your reports follow this format:

Abstract
Table of contents
Introduction
Geological setting
Geophysical survey methods
Data reduction
Results

Integrated interpretation
Conclusions / recommendations
Bibliography
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.

9. Academic Consideration for Student Absences
Students who experience an extenuating circumstance (illness, injury or other extenuating circumstance) sufficiently significant to temporarily render them unable to meet academic requirements may submit a request for academic consideration through the following routes:

(i) Submitting a Self-Reported Absence (SRA) form provided that the conditions for submission are met. To be eligible for a Self-Reported Absence:

- an absence must be no more than 48 hours
- the assessments must be worth no more than 30% of the student's final grade
- no more than two SRAs may be submitted during the Fall/Winter term

(ii) For medical absences, submitting a Student Medical Certificate (SMC) signed by a licensed medical or mental health practitioner to the Academic Counselling office of their Faculty of Registration.

(iii) Submitting appropriate documentation for non-medical absences to the Academic Counselling office in their Faculty of Registration.

Note that in all cases, students are required to contact their instructors within 24 hours of the end of the period covered, unless otherwise instructed in the course outline.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

For the policy on Academic Consideration for Student Absences – Undergraduate Students in First Entry Programs, see:

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

and for the Student Medical Certificate (SMC), see:

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

10. Accommodation Policies
Students with disabilities work with Accessible Education (formerly SSD), 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,

11. 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 his/her 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:

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

12. 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/.

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 (519) 661-2147 if you have any questions regarding accommodations.

Students who are in emotional/mental distress should refer to Mental Health@Western (http://www.health.uwo.ca/mentalhealth) for a complete list of options about how to obtain help.

Additional student-run support services are offered by the USC, http://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.