EARTH SCIENCES 3320B

Environmental and Exploration Geophysics II

Course Lecturer: Hadi Ghofrani, BGS 1012, hghofra@uwo.ca
Teaching Assistant: Yelena Kropivnitskaya, BGS 1073, ykropivn@uwo.ca

(Course material courtesy Professor Gerhard Pratt)

2 lecture hours, 3 lab/tutorial hours, 0.5 course
Lectures: Mon. and Wed. 12:30-1:30, WSC 240
Labs: Thr. 1:30-4:30, BGS 0184
Office hours: by appointment

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 gravity, magnetic, electric, and electromagnetic 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, geomagnetic and radiometric 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, abundance of radioactive minerals and electrical conductivity. 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 current state-of-the art as well as practical applications.

This is a lab oriented course that will provide hands on computer experience, particularly with the general purpose numerical analysis program Matlab. Geological 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 text:

Pratt, R.G. and Smith, R., 2012 **Applied Geophysics Course Notes – Theory and Practice of Geophysical Prospecting** (Available to ES3320B students on OWL in PDF format). Course notes will be modified and updated during the term – students should check frequently for these updates.

Suggested textbook:

Mussett, A.E. and Khan, M.A., 2000. **Looking into the Earth: An introduction to Geological Geophysics**, Cambridge University Press

Other recommended textbooks:

Burger, H.R., Sheehan, A.F. and Jones, C.H., 2006. **Introduction to applied geophysics: Exploring the shallow subsurface**, W.H. Norton & Company

Telford, W.M., Geldart, L.P., and Sheriff, R.E., **Applied Geophysics**, Cambridge University Press, 1990. (In the past this was considered to be 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, P., Brooks, M., and Hill, I., 1991. **Introduction to Geophysical Exploration**, Blackwells

Sharma, P.V., 2007. **Environmental and Engineering Geophysics**, Cambridge University Press

Reynolds, John, M., 1997. **An Introduction to Applied and Environmental Geophysics**, Wiley

Beck, A.E., 1991. **Physical Principles of Exploration Methods**, Wuerz Publishing Ltd., Second Edition

Blakely, R.J., 1995. **Potential theory in gravity and magnetic applications**, Cambridge University Press

Fowler, C.M.R., 1990. **The Solid Earth: An Introduction to Global Geophysics**, Cambridge University Press

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:

- Assignments: 10%
- Projects: 20%
- Labs: 20%
- Midterm Exam: 10%
- Final Exam: 35%
- Quizzes, class participations: 5%

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 4-5 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.

Assignments: Assignments are exam style questions and will be due one week after the lecture. Late submissions will be subject to a penalty at a rate of 10% reduction per day.

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

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

Midterm Exam: will be scheduled during regular lecture time, tentatively at the week of February 27th.

The Midterm and Final examinations will be short answer 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.

ACADEMIC HONESTY STATEMENTS:

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/handbook/appeals/scholastic_discipline_undergrad.pdf

Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea, 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. Plagiarism is a major academic offence).

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*). *Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.*

MEDICAL ISSUES:

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide

valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see: http://www.uwo.ca/univsec/handbook/appeals/medical.pdf

A student requiring academic accommodation due to illness, should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form (located in the Dean's Office) for visits to Student Health Services. The form can be found here:
https://studentservices.uwo.ca/secure/medical_document.pdf

ACCESSIBILITY STATEMENT:

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x.82147 for any specific question regarding an accommodation.