EARTH SCIENCES 3320A (GP 9520A)

ENVIRONMENTAL AND EXPLORATION GEOPHYSICS II

Course Instructor: Gerhard Pratt, BGS 1028 (Email: gpratt2@uwo.ca)
Teaching Assistant: Akbar Zuberi, BGS 0179, (Email: mzuberi5@uwo.ca)
Office hours: by appointment
Lectures: Mon and Wed 10:30-11:30, UCC 053
Labs: Wed 2:30-5:30, BGS 0184

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 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., 2015 **Applied Geophysics Course Notes – Theory and Practice of Geophysical Prospecting** (Available to ES 3320B students 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., Looking into the Earth: An introduction to Geological Geophysics. Cambridge University Press, 2000

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 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, 1997

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

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:

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

GP 9520:

Assignments: 10%
Projects: 15%
Labs: 15%
Midterm Exam: 10%
Final Exam: 25%
Quizzes, class participations: 5%
Term project: 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 4-5 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 October 19th.

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.

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.

Missed Course Components:

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or supporting documentation to the Academic Counselling Office of your home faculty as soon as possible.

If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in WSC 140, and can be contacted at 519-661-3040 or scibmsac@uwo.ca. Their website is http://www.uwo.ca/sci/undergrad/academic_counselling/index.html.

A student requiring academic accommodation due to illness must use the Student Medical Certificate (https://studentservices.uwo.ca/secure/medical_document.pdf) when visiting an off-campus medical facility.

For further information, please consult the university's medical illness policy at http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

If you miss the Final Exam, please contact your faculty's Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (the name given by the university to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

Accessibility Statement

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 Services for Students with Disabilities (SSD) at 661-2111 ext. 82147 if you have questions regarding accommodation.