APPLIED SCIENCE AND MANAGAMENT DIVISION
Introduction to Geophysics
3 Credit Course
Fall, 2014

INTRODUCTION TO GEOPHYSICS

INSTRUCTOR: Mark Shumelda

OFFICE LOCATION: A2303

CLASSROOM: C1511

E-MAIL: mshumelda@yukoncollege.yk.ca

TIME: Lecture: T/Th (9-10:30am)
Lab: M (1-4pm)

TELEPHONE: 456-8578

DATES: Sept. 5 – Dec. 19, 2014

OFFICE HOURS: Tuesday 1:00-3:00pm

Additional Drop-In Centre hours (A2309/A2311):
Monday: 11:00am - 12:30pm
Tuesday: 11:00am – 1:00pm
Wednesday: 10:00am -12:30pm
Thursday: 12:30pm – 2:00pm
Friday: 10:00am – 1:00pm

COURSE DESCRIPTION

This course provides an introduction to geophysics and a context for various geophysical field techniques such as electromagnetics, gravity, DC resistivity and induced polarization, magnetics, and ground penetrating radar surveys. The course will first introduce students to traditional physics topics fundamental to an understanding of geophysics as applied to earth systems. These topics include force, electricity, heat, magnetism, electromagnetism, and thermodynamics. Students will develop competencies using basic geophysical equations to address real-life geoscience problems and predicting the geophysical response to different rock types and structures. An emphasis will be placed on operating geophysical equipment and analysing data collected using a wide array of geophysical techniques. Geophysical case studies will focus on Yukon examples when possible.

PREREQUISITES

Mathematics 12 (OR Yukon College equivalent, MATH 060) and GEOL 105; OR permission from the course instructor.

EQUIVALENCY OR TRANSFERABILITY

In progress

LEARNING OUTCOMES

Upon successful completion of the course, students will have demonstrated the ability to

- demonstrate understanding of fundamental physics concepts such as thermodynamics, electricity, magnetism, work, and force
- describe basic geophysical aspects of the Earth (magnetic fields, gravitational fields, isostatic equilibrium, etc.), using northern examples when appropriate
- apply fundamental physics knowledge and basic geophysical equations to solve geoscience problems on a variety of scales
- predict the characteristic geophysical signatures of different rock types and structures for a number of geophysical methods; choose appropriate geophysical techniques for a given geologic environment and problem
- apply the appropriate methodology and practical procedures for a variety of ground geophysical methods, including electromagnetic (EM), induced polarization, DC resistivity, gravity and magnetic surveys
- identify lithologic units, determine rock properties, and interpret the economic potential of geologic zones using a variety of borehole geophysical logs (e.g. electromagnetic, gamma ray, and density logging).

DELIVERY METHODS

This course consists of two 90-minute lectures/tutorial sessions and one three-hour lab period per week. Lab exercises will be conducted in classroom, computer lab, and field settings.

COURSE REQUIREMENTS

Attendance and Participation

Students are strongly encouraged to attend all lectures and lab exercises. Lab exercises can be completed only during lab periods and materials may not be available outside these hours. Off-campus field exercises must be completed during the allocated time with the instructor present.

Assignments

There will be six problem sets due throughout the term – three on theoretical physics in the first half of the course (before the midterm) and three on applied geophysics in the second half of the course.

There will be weekly lab exercises. These lab exercises will be due at the start of the following lab class unless otherwise indicated by the lab instructor. There is no term paper assigned in this course.

Tests/Exams

There will be two exams in this course, a midterm lecture exam, and a final lecture exam. Students must pass the lecture final exam to achieve an overall passing grade.

EVALUATION

Tests and Assignments	*Weight*	*Dates*
Problem Sets	25%	September 18 October 2 October 16 November 6 November 20 December 4
Midterm Test	20%	October 21, 2014
Lab Assignments	30%	Work accomplished during lab sessions
Final Lecture Exam	25%	During the final exam period: December 8 – 19, 2014
Total	100%	

The letter-grading scheme used in this course is the standard Yukon College scheme. Final grades will be rounded up to the nearest decimal place and assigned a letter grade.

TEXTBOOKS AND MATERIALS

There is no required text for this course. The books listed here, as well as the internet sites provided during lectures, will provide useful background reading.

Milsom JJ, Eriksen A. 2011. Field Geophysics. 4th ed. Chichester, West Sussex, UK: John Wiley and Sons, Ltd. 288 p.

Walker, JS. 2002. Physics. Upper Saddle River, NJ: Prentice Hall. 1087 p.

Fowler, C.M.R. 2005. The Solid Earth: An Introduction to Global Geophysics. Cambridge: CUP. 685p.

Lillie, R. Whole Earth Geophysics: An Introductory Textbook for Geologists and Geophysicists. Upper Saddle River, NJ: Prentice Hall. 361 p.

PLAGIARISM

Plagiarism is a serious academic offence. Plagiarism occurs when students present the words of someone else as their own. Plagiarism can be the deliberate use of a whole piece of another person's writing, but more frequently it occurs when students fail to acknowledge and document sources from which they have taken material. Whenever the words, research or ideas of others are directly quoted or paraphrased, they must be documented according to an accepted manuscript style (e.g., APA, CSE, MLA, etc.). Resubmitting a paper which has previously received credit is also considered plagiarism. Students who plagiarize material for assignments will receive a mark of zero (F) on the assignment and may fail the course. Plagiarism may also result in dismissal from a program of study or the College.

ACADEMIC ACCOMMODATION

Reasonable accommodations are available for students requiring an academic accommodation to fully participate in this class. These accommodations are available for students with a documented disability, chronic condition or any other grounds specified in Section 8.0 of the Yukon College Academic Regulations (available on the Yukon College website). It is the student's responsibility to seek these accommodations. If a student requires an academic accommodation, he/she should contact the Learning Assistance Centre (LAC) at (867) 668-8785 or lassist@yukoncollege.yk.ca.

COURSE TOPIC OUTLINE

DATE	Topic
Sept 4	**SI units and significant figures**: accuracy and precision, experimental error, and uncertainty
Sept 9	**Geophysics introduction I**: Big Bang, planets, gravity, angular momentum
Sept 11	**Geophysics introduction II:** Earth's differentiation, Earth's heat and geothermal gradient, radioactive decay, seismic waves
Sept 16/18	**Work and force**: fundamental forces, vectors, laws of motion, superposition, 1D kinematics **Problem Set #1 due September 18**
Sept 23/25	**Electricity**: Electrostatic force, Ohm's Law, resistors, ideal conductors, equipotential fields
Sept 30/ Oct 2	**Magnetism and electromagnetism**: Earth's magnetic field, types of magnetism, Curie temperature, electromagnetic waves **Problem Set #2 due October 2**
Oct 7	**Heat**: sources, forms of transfer, heat flow, heat capacity, convection, adiabatic gradients
Oct 9/14	**Thermodynamics**: laws of thermodynamics, standard state, entropy, enthalpy and Gibb's Free Energy, redox reactions
Oct 16	**MIDTERM REVIEW** **Problem Set #3 due October 16**
Oct 21	**MIDTERM DURING LECTURE TIME**
Oct 23	**Introduction to geophysical field techniques**: application of different geophysical methods, inverse and forward modelling
Oct 28/30	**Seismic reflection and refraction techniques**: applications, seismic wave propagation, bulk and shear moduli, geophones
Nov 4/6	**Gravitational field techniques**: applications, geoid and reference ellipsoid, isostatic equilibrium and isostasy, data corrections and reduction **Problem Set #4 due November 6**
Nov 13	**Gamma ray and GPR techniques**: applications, radioactive decay, electromagnetic spectrum, environmental considerations
Nov 18	**Magnetic field techniques**: applications, magnetic moment, Curie temperature, rock magnetism, magnetic profiles
Nov 20	**Electromagnetic (EM) field techniques**: applications, electromagnetic theory, currents, CWEM and TEM systems **Problem Set #5 due November 20**
Nov 25/27	**DC resistivity and induced polarization (IP) field techniques**: applications, natural and induced currents, common arrays, electrode and membrane polarization
Dec 2	**Borehole geophysics**: applications, instrumentation, log literacy and log types, common borehole geophysical methods; spontaneous potential (SP)
Dec 4	**REVIEW FOR FINAL EXAM** **Problem Set #6 due December 4**