APPLIED SCIENCE AND MANAGEMENT DIVISION
SCHOOL OF SCIENCE
FALL, 2016

COURSE OUTLINE

GEOL 213

INTRODUCTION TO GEOPHYSICS

81 **HOURS**
3 **CREDITS**

PREPARED BY: Ewan Webster, Instructor DATE: 17/08/2016

APPROVED BY: Margaret Dumkee, Dean DATE: 18/08/2016

APPROVED BY ACADEMIC COUNCIL: September 2014

APPLIED SCIENCE AND MANAGEMENT DIVISION
Introduction to Geophysics
3 Credit Course
Fall, 2016

INTRODUCTION TO GEOPHYSICS

INSTRUCTOR: Dr. Ewan Webster

OFFICE HOURS: Thu 1:00 – 3:00

OFFICE LOCATION: A2806

CLASSROOM: TBD

E-MAIL: ewebster@yukoncollege.yk.ca

TIME: T/Th 9-10:30 am (Lecture)
M 1:00 – 4:00 pm (Laboratory

TELEPHONE: 403-805-2515

DATES: Sept 7 – Dec 20, 2016

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 be able 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).

COURSE FORMAT:

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.

ASSESSMENTS

Attendance & 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 four problem sets due throughout the term – two on theoretical physics in the first half of the course (before the midterm) and two 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

There will be three exams in this course: a midterm lecture exam, a final lab exam (oral), and a final lecture exam. Students must pass the lecture final exam to achieve an overall passing grade.

EVALUATION

Lab Assignments	30 %
Midterm Exam	15 %
Problem Sets	20 % (5% per set)
Final Lecture Exam	25 %
Laboratory Oral Exam	10 %
Total	100%

REQUIRED 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.

ACADEMIC AND STUDENT CONDUCT

Information on academic standing and student rights and responsibilities can be found in the current Academic Regulations that are posted on the Student Services/ Admissions & Registration web page.

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.

YUKON FIRST NATIONS CORE COMPETENCY

Yukon College recognizes that a greater understanding and awareness of Yukon First Nations history, culture and journey towards self-determination will help to build positive relationships among all Yukon citizens. As a result, to graduate

from ANY Yukon College program, you will be required to achieve core competency in knowledge of Yukon First Nations. For details, please see www.yukoncollege.yk.ca/yfnccr.

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.

TOPIC OUTLINE

Module		Topic
1	**Introduction to physics**	**SI units and significant figures**: accuracy and precision, experimental error, and uncertainty
2		**Work and force**: fundamental forces, vectors, laws of motion, superposition, 1D kinematics
3		**Electricity**: Electrostatic force, Ohm's Law, resistors, ideal conductors, equipotential fields
4		**Magnetism and electromagnetism**: Earth's magnetic field, types of magnetism, Curie temperature, electromagnetic waves
5		**Heat**: sources, forms of transfer, heat flow, heat capacity, convection, adiabatic gradients
6		**Thermodynamics**: laws of thermodynamics, standard state, entropy, enthalpy and Gibb's Free Energy, redox reactions
7	**Geophysical applications**	**Geophysics introduction I**: Big Bang, planets, gravity, angular momentum
8		**Geophysics introduction II:** Earth's differentiation, Earth's heat and geothermal gradient, radioactive decay, seismic waves
9		**Introduction to geophysical field techniques**: application of different geophysical methods, inverse and forward modelling
10		**Seismic reflection and refraction techniques**: applications, seismic wave propagation, bulk and shear moduli, geophones
11		**Gravitational field techniques**: applications, geoid and reference ellipsoid, isostatic equilibrium and isostasy, data corrections and reduction
12		**Gamma ray and GPR techniques**: applications, radioactive decay, electromagnetic spectrum, environmental considerations
13		**Magnetic field techniques**: applications, magnetic moment, Curie temperature, rock magnetism, magnetic profiles
14		**DC resistivity and induced polarization (IP) field techniques**: applications, natural and induced currents, common arrays, electrode and membrane polarization
15		**Borehole geophysics**: applications, instrumentation, log literacy and log types, common borehole geophysical

		methods; spontaneous potential (SP)