APPLIED SCIENCE AND MANAGEMENT DIVISION
School of Science
Winter, 2017

COURSE OUTLINE

GEOL205

ROCK MECHANICS

45 HOURS
3 CREDITS

PREPARED BY: Joel Cubley, Instructor DATE: December 29, 2016

APPROVED BY: Margaret Dumkee, Dean DATE: December 29, 2016

APPROVED BY ACADEMIC COUNCIL: May 20, 2014

APPLIED SCIENCE AND MANAGEMENT DIVISION
GEOL205
3 Credit Course
Winter, 2016

ROCK MECHANICS

INSTRUCTOR: Dr. Joel Cubley

OFFICE HOURS: M/W 10:30 am -12 pm

OFFICE LOCATION: T1090

CLASSROOM: CNIM Building #1

E-MAIL: jcubley@yukoncollege.yk.ca

TIME: T/F 1-2:30 pm

TELEPHONE: (867) 456-8605

DATES: Jan. 4 – Apr. 21, 2017

COURSE DESCRIPTION

GEOL205 provides an introduction to the theory of rock mechanics and its applications in mine construction and operation. Students are presented with the fundamental concepts of stress and strain in isotropic and anisotropic rocks and conduct stress analyses using data collected in the laboratory and the field. Rock mass structures and classification schemes are introduced, and students learn how these govern rock slope stability and underground rock excavation methods in a given stress environment. Rock control and support systems utilized in underground and surface excavations and their related safety requirements are discussed.

In-class exercises focus on introducing rock engineering properties through laboratory testing, as well as building a foundation in geotechnical data collection, data presentation, and core logging. A field trip to a local open-pit excavation will give students experience in rock face mapping and geotechnical testing.

PREREQUISITES

Academic mathematics 12 (OR Yukon College equivalent, MATH 060) and GEOL 111 (Structural Geology) OR permission from the instructor.

EQUIVALENCY OR TRANSFERABILITY

In Progress.

LEARNING OUTCOMES

Upon successful completion of the course, students will be able to

- identify the objectives of geotechnical data collection and rock mass classification methods, and successfully collect and analyze a range of geotechnical datasets for design purposes

- describe the theory and analysis of *in situ* and induced stresses in a rock mass and structurally controlled failure

- apply the principles of rock mechanics and excavation design to develop excavation proposals for given geologic environments (e.g. stratified, massive, blocky, or faulted lithologies)

- explain the principles and techniques of reinforcement design for the primary failure modes in underground rock excavations, and apply these principles and techniques to inform design for tunnels and large excavations

- describe the theory, analysis, and control of rock and soil slope stability and rockfall hazards. Calculate the Factor of Safety of rock slopes and underground excavations

COURSE FORMAT:

This course consists of two 1.5-hour lectures per week. Instruction will be conducted primarily in the classroom setting but will also utilize the Geological Technology laboratory facilities for geotechnical testing. A full-day field exercise will be conducted in the Whitehorse area in late March to apply techniques to characterize the stability of a series of road cuts in the Copper Ridge subdivision.

ASSESSMENTS

Attendance & Participation

Students are strongly encouraged to attend all lectures. Hands-on exercises conducted during class time cannot be completed outside these hours unless prior permission from the instructor is obtained. Off-campus field exercises *must* be completed during the allocated time *with the instructor present*.

Assignments

The main assessment mechanism for this course is a suite of biweekly take-home assignments. These assignments are due one week from their distribution date unless otherwise indicated by the instructor. Successful completion of these assignments is critical for understanding and reinforcing course material.

Students will spend a full day in late March characterizing a series of road cuts along Hamilton Boulevard in Whitehorse to assess stability and fully characterize the rock mass (e.g. calculate rock mass ratings) at each site. The formal report produced from this exercise is worth 20% of the final course grade.

Tests

There are two exams in this course, a midterm lecture exam delivered during class time halfway through the course, and a final lecture theory exam delivered during the final exam period. Competencies in hands-on laboratory work (geotechnical testing) will be assessed throughout the course and are not measured during the formal exam.

EVALUATION

Tests and Assignments	***Weight***	***Dates***
Biweekly lecture assignments	40% (8 assignments, 5% apiece)	Each assignment is due one week after distribution.
Midterm lecture exam	20%	During scheduled class time.
Final lecture exam	20%	During the final exam period.
Hamilton Boulevard rock stability project	20%	Due during the last week of classes prior to the final exam period.
Total	100%	

REQUIRED TEXTBOOKS AND MATERIALS

There are no required textbooks for this course. The Brady and Brown textbook (below) is highly recommended, however, as lecture instruction closely follows the textbook structure and content. A copy is available on reserve at the Yukon College library.

Brady BHG, Brown ET. 2004. Rock mechanics for underground mining. 3rd ed. AZ Dordrecht, The Netherlands: Kluwer Academic Publishers. 626 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.

COURSE TOPIC OUTLINE

Module	Topic
1	**Stress and strain:** force and stress; principal stresses and stress invariants; plane problems and biaxial stress; displacement and strain; geomechanics conventions.
2	**Rock mass structure and characterization:** types of structural features; geomechanical properties of discontinuities; structural data collection and presentation; rock mass classification.
3	**Rock strength and deformability:** concepts and definitions; isotropic and anisotropic rock behaviour (uniaxial and multiaxial); behaviour of discontinuous rock masses; shear strength of discontinuities.
4	**Pre-mining state of stress**: tectonic stress; factors influencing the in situ state of stress; in situ stress determination and presentation of results.
5	**Methods of stress analysis**: principles of classical stress analysis; closed-form solutions for simple excavation shapes; boundary element, finite element, distinct element, and finite difference analysis methods for continuous rock.
6	**Excavation design in massive elastic rock:** general principles of excavation design; zone of influence; excavation shape and boundary stresses; delineation of rock failure zones.
7	**Excavation design in (1) stratified rock:** design factors; rock mass response to mining; roof bed deformation mechanics; roof beam deflection; **and (2) blocky rock:** design factors; Block Theory; triangular roof prisms; tetrahedral block roofs; stope wall design.
8	**Energy, mine stability, mine seismicity, and rockbursts:** mechanical relevance of energy changes; energy transmission in rock; characterization of seismic events; instability due to fault slip.
9	**Rock support and reinforcement:** support and reinforcement principles and design; rock-support interaction analysis; materials and techniques.
10	**Underground mining methods and related rock mechanics considerations:** rock mass response to stoping activity; pillar-supported methods; artificial support techniques; longwall and caving methods.
11	**Surface mining methods and related rock mechanics considerations:** rock slope failure; bench analysis for failure geometries; methods for bench face angle prediction; rock fabric data reduction.