APPLIED SCIENCE AND MANAGEMENT DIVISION
SCHOOL OF SCIENCE
GEOL 215
3 Credit Course
Winter, 2019

COURSE OUTLINE

GEOL 215

Mineral Processing

3 CREDITS

PREPARED BY: Siobhan McGoldrick, Instructor DATE: 3/12/2018

APPROVED BY: Margaret Dumkee, Dean DATE: 3/12/2018

APPROVED BY ACADEMIC COUNCIL: May 2014

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3 Credit Course
Winter, 2019

Mineral Processing

INSTRUCTOR: Siobhan McGoldrick (lecture)
Dr. Joel Cubley (lab)

OFFICE HOURS: Tuesday 2-4 pm

OFFICE LOCATION: CNIM M105 (McGoldrick)
T1090 (Cubley)

CLASSROOM: CNIM M111 (lecture)
T1090 (lab)

E-MAIL: smcgoldrick@yukoncollege.yk.ca
jcubley@yukoncollege.yk.ca

TIME: F 8:30-10 am/T 1:00-2:30 pm
M 1:00-4:00 pm (lab)

TELEPHONE: 456-6958 (McGoldrick)
456-8605 (Cubley)

DATES: Jan. 3 – Apr 10, 2019

COURSE DESCRIPTION

An increasing demand for metals in a growing global economy is being met with decreasing ore grades, requiring more efficient mineral extraction and recovery techniques. This course reviews the fundamental principles, conventions, and terminology of mineral processing and metallurgy. At the start of the course, students learn how to assess the mineral properties utilized in separation of ore from gangue. The stages of processing are then examined in detail from initial classification, crushing, and grinding to dewatering and tailings disposal. The student is presented with an introduction to current operating issues and circuit design considerations, as well as the efficiency of different concentration approaches. Students will gain an understanding of the suitability of processing techniques for particular deposit types and individual commodities. The environmental implications and sustainability issues surrounding individual processing techniques will be discussed, as well as specific safety requirements.

PREREQUISITES

Mathematics 12 (OR Yukon College equivalent, MATH 060), CHEM 110 (The Structure of Matter), and GEOL 105 (Physical Geology) 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:

- Explain the implications of mineralogical characteristics for mineral processing requirements, and link these characteristics to the properties of individual metals based on their electronic structure and their position within the periodic table
- Identify key sustainability issues in mineral processing and explain their impact on mineral processing decision-making
- Provide an overview of major classes of mineral processing equipment, their typical applications, and the types of projects in which they are used
- Describe basic flowsheets for physical separation processes in various industries, including mineral sands, coal, iron ore, and base metal processing
- Demonstrate competencies in basic laboratory-scale processing and metallurgical testing, including froth flotation testing, crushing, grinding, screening and classification, and particle size analysis
- Calculate, compile, and interpret grade and recovery information

COURSE FORMAT:

This course consists of two 90-minute lectures and one 3-hour lab period per week. The schedule included in this course outline details the major topics covered and when those topics will be presented throughout the course. 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 classes. Hands-on exercises conducted during class time cannot be completed after-hours unless prior permission from the instructor is obtained.

Assignments

The main assessments for this course are weekly lab assignments. These assignments will be due at the start of the next lab class unless otherwise indicated by the instructor. Successful completion of these lab assignments is critical for understanding and reinforcing course material. Lab assignments typically require 2-3 hours a week outside of class to complete.

Tests

There will be two lecture theory exams in this course: a midterm lecture exam delivered during lecture time approximately halfway through the course, and a final lecture exam administered during the final exam period. Competencies in hands-on laboratory work will be assessed throughout the course and are not targeted during a formal exam. A student must pass both the lab and lecture components to receive course credit.

EVALUATION

Tests and Assignments	Weight	Due Dates
Weekly Lab Assignments	50%	Each assignment is due at the start of the following lab period.
Midterm Lecture Exam	20%	Scheduled during regular lecture time.
Final Lecture Exam	30%	During the final exam period.
Total	100%	

REQUIRED TEXTBOOKS AND MATERIALS

There is one required textbook for this course, as well as recommended textbooks that will be utilized on a limited basis throughout the course. All texts are available on reserve at the Yukon College Library.

Required textbook
Wills BA, Finch JA. 2015. Wills' mineral processing technology. 8th ed. New York: Elsevier. 512 p.

Recommended textbooks
Darling P. 2011. SME mining engineering handbook. 3rd ed. United States of America: Society for Mining, Metallurgy, and Exploration, Inc. 1839 p.

Fuerstenau MC, Han KN (eds.). 2003. Principles of mineral processing. United States of America: Society for Mining, Metallurgy, and Exploration, Inc. 573 p.

Fuerstenau MC, Jameson G, Yoon, RH (eds.). 2007. Froth flotation: A century of innovation. United States of America: Society for Mining, Metallurgy, and Exploration, Inc. 891 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	Required Readings
1	**Introduction to mineral processing:** mineral properties utilized in separation; importance of concentrating operations; mineral processing methods; typical flowsheets; environmental consequences of mineral processing.	Wills p. 4-29
2	**Ore handling:** ore transportation and storage; feeding; mechanical and pneumatic conveying systems; removal of harmful materials.	Wills p. 30-38
3	**Particle size analysis:** methods of particle size measurement and shape classification; mathematical and graphical treatment of particle distributions.	Wills p. 90-106
4	**Comminution:** principles of comminution and comminution theory; grindability; comminution equipment; simulation of processes and circuits.	Wills p. 107-117
5	**Crushing and grinding:** primary and secondary crushers; crushing circuits and controls; tumbling and stirred mills; grinding circuits.	Wills p. 118-145 (crushing); Wills p. 146-185 (grinding)
6	**Screening and classification:** types of screens; factors affecting screen performance; principles of classification; classifier types.	Wills p. 186-224

7	**Gravity concentration:** principles of gravity separation; types of separators and concentrators; free settling; particle acceleration and particle shape.	Wills p. 225-245
8	**Dense medium separation:** dense medium compositions; heavy liquid testing; partition curves; centrifugal separators and DMS circuits.	Wills p. 246-266
9	**Froth flotation:** principles of flotation; collectors, frothers and regulators; reagents and conditioning; typical flotation separations.	Wills p. 267-352
10	**Solid-liquid separation:** separation of slurries into solid and liquid fractions by thickening, filtration and drying; separation equipment; major influences on solid-liquid separation.	Wills p. 378-399
11	**Magnetic and electrical separation, ore sorting:** magnetic and electronic separation principles.	Wills p. 353-377
12	**Hydrometallurgy:** principles of hydrometallurgy; factors influencing leaching rates; bacterial leaching; methods of solution purification and recovery of metals from solution; reaction kinetics.	Fuerstenau & Han p. 431-490
13	**Tailings disposal:** methods of tailings disposal and contaminant control	Wills p. 400-408
14	**Metallurgical accounting, control and simulation**: sampling and weighing ore; slurry streams; circuit design and optimization; mass balancing methods.	Wills p. 40-89

Laboratory topic outline

Module	Topic
1	Laboratory safety and respirator fit testing
2	Stage Crushing and Sample Splitting
3	Particle size analysis and determination of P80 grain sizes
4	Ball mill grind calibrations
5	Bond ball mill work index (BBMWI) testing
6	Gravity separation of dense minerals using a Wilfley table
7	Froth floatation testing (Cu-sulphide ore)
8	Geochemical analysis of concentrates and recovery determination; kinetic modelling
9	Mill convergence and cleaner circuit floatation
10	Solid-liquid separation and dewatering: settling tests
11	Heap leach testing for Cu-oxide ore