A POLYTECHNIC INSTITUTION

Course Outline

School of Manufacturing, Electronics and Industrial Processes
Program: Chemical Sciences, Mining Technology
Option: Industrial

CHSC 4414
Mineral Processing 2

Start Date:	January, 2006					**End Date:**	6		
Total Hours:	66.5	**Total Weeks:**	19			**Term/Level:**	4	**Course Credits:**	4.0
Hours/Week:	3.5	**Lecture:**	2	**Lab:**	1.5	**Shop:**		**Seminar:**	**Other:**

Prerequisites		**CHSC 4414 is a Prerequisite for:**	
Course No.	**Course Name**	**Course No.**	**Course Name**
CHSC 3314	Mineral Processing 1	None	

■ Course Description

Solid/liquid separation; froth flotation; classification and concentration by gravity methods; filtration; introduction to hydrometallurgy. Laboratory work and reports in the above topics.

■ Detailed Course Description

Separation of slurries into solid and liquid fractions by thickening, filtration and drying. Separation of economic minerals from gangue minerals by froth flotation. Classification and concentration of minerals according to their mass, shape and hydrophobicity. Introduction to the essential unit operations and processes encountered in hydrometallurgy.

■ Evaluation

Laboratory	30%	Comments: None.
Midterms (2)	30%	
Final Exam	40%	
TOTAL	100%	

■ Course Learning Outcomes/Competencies

Upon successful completion, the student will be able to:

1.0 Solid/Liquid Separation

Separation of slurries into solid and liquid fractions by thickening, filtration and drying.

1.1 Describe a solid/liquid separation flowsheet, including typical water balances.
1.2 Describe typical equipment utilized during thickening of metallurgical slurries.
1.3 Describe the area principle for settling of solids in a slurry.
1.4 Perform laboratory batch thickening tests of slurries.
1.5 From batch settling data, calculate unit area and height of compression zone in a continuously operating, full scale thickener according to standard methods.
1.6 Describe various types of industrial pressure and vacuum filters.

■ **Course Learning Outcomes/Competencies (cont'd.)**

1.7 Perform bench scale vacuum filtration tests in order to define variables such as form filtration rate, dewatering rate, wash rate and drying rate.
1.8 Combine various bench scale filtration rates to obtain an overall filtration rate for a commercial size filtration station.

2.0 Flotation

Separation of economic minerals from gangue minerals by froth flotation.

2.1 Describe surface chemical phenomena as applicable to mineral separation by froth flotation.
2.2 Describe zeta potential and electrical double layer effect.
2.3 Describe the effect of pH on the surface charge of small mineral particles in a slurry.
2.4 Describe the effect of slimes on sulfide flotation.
2.5 Describe the action of surfactants such as collectors, frothers and modifiers.
2.6 Describe flotation circuits and equipment used for simple and complex ores.
2.7 Perform bench and pilot scale flotation experiments including overall and component material balances.

3.0 Gravity Separation Methods

Classification and concentration of minerals according to their mass, shape and hydrophobicity.

3.1 Classification; separation of minerals according to size differences.

3.1.1 Describe the operation of mechanical classifiers, settling cones and hydrocyclones.
3.1.2 Describe the operating principles in hydrocyclones.
3.1.3 Differentiate between corrected and uncorrected classification curves in hydrocyclones.
3.1.4 Describe the effect of design and operating variables in hydrocyclones.
3.1.5 Experimentally classify a finely ground rock sample by a Warman cyclosizer.

3.2 Concentration; separation of minerals according to differences in densitites.

3.2.1 Describe the basic principles of mineral separation in a slurry under the influence of gravity.
3.2.2 Describe the application of heavy medium separation in a mineral processing flowsheet.
3.2.3 Describe the beneficiation of coal, galena, gold, diamonds, etc., by the unit operations of jigging and flowing film concentrators such as shaking tables, pinched slurries, Reichert cones, etc.

4.0 Hydrometallurgy

4.1 Describe the essential unit operations and processes for hydrometallurgical flowsheets.
4.2 List the advantages and disadvantages of hydrometallurgy for metals recovery.
4.3 Describe leaching agents and methods.
4.4 Describe the importance of solid/liquid separation in hydrometallurgy.
4.5 Describe the factors influencing leaching rates.
4.6 Describe methods of solution purification and recovery of metals from solution.
4.7 Describe bacteria leaching of pyritic ores.

■ Course Learning Outcomes/Competencies (cont'd.)

4.8 Recovery of gold from free milling and refractory ores.
4.9 Discuss hydrometallurgical recovery of copper and nickel from ores and concentrates.

5.0 Laboratory Exercises

5.1 Flotation I
- simulation of a copper flotation flowsheet
- addition of flotation reagents
- calculation of reagent consumption

5.2 Flotation III
- operation of a pilot scale flotation column

5.3 Hydrocyclone Classification
- classification of a sample of ground rock utilizing a Warman cyclosizer

5.4 Gravity Separation
- use the jigs and shaking tables to separate valuable minerals from gangue

5.5 Separation Techniques
- separation of minerals of differing specific gravities by the use of a high density pseudo-fluid
- magnetic separation

5.6 Thickening
- calculation of unit area and height of compression zone from batch settling data by the use of the Coe – Clevenger or Kynch methods

5.7 Vacuum Filtration
- investigation of form filtration rate, dewatering rate, washing rate
- correlation of data and scale-up techniques

■ Verification

I verify that the content of this course outline is current.

F. Gloffani — Authoring Instructor
Dec 06/05 — Date

I verify that this course outline has been reviewed.

M McDonald — Program Head/Chief Instructor
Dec 6/05 — Date

I verify that this course outline complies with BCIT policy.

Dean/Associate Dean
2005/12/08 — Date

Note: Should changes be required to the content of this course outline, students will be given reasonable notice.

■ Instructor(s)

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■ Learning Resources

Required:

B.A. Wills. (1977). *Mineral Processing Technology*. Butterworth-Heinemann.

Recommended:

None.

■ Information for Students

The following statements are in accordance with the **BCIT Student Regulations Policy 5002**. To review the full policy, please refer to: http://www.bcit.ca/~presoff/5002.pdf.

Attendance/Illness:
In case of illness or other unavoidable cause of absence, the student must communicate as soon as possible with his/her instructor or Program Head or Chief Instructor, indicating the reason for the absence. Prolonged illness of three or more consecutive days must have a BCIT medical certificate sent to the department. Excessive absence may result in failure or immediate withdrawal from the course or program.

Academic Misconduct:
Violations of academic integrity, including dishonesty in assignments, examinations, or other academic performances are prohibited and will be handled in accordance with the 'Violations of Standards of Conduct' section of **Policy 5002**.

Attempts:
Students must successfully complete a course within a maximum of three attempts at the course. Students with two attempts in a single course will be allowed to repeat the course only upon special written permission from the Associate Dean. Students who have not successfully completed a course within three attempts will not be eligible to graduate from their respective program.

Course Outline Changes:
The material or schedule specified in this course outline may be changed by the instructor. If changes are required, they will be announced in class.

■ Assignment Details

Laboratory reports are due one week after completion of laboratory session.