A POLYTECHNIC INSTITUTION

Course Outline

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

CHSC 3314
Mineral Processing 1

Start Date:	September, 2006					**End Date:**	December, 2006		
Total Hours:	52.5	**Total Weeks:**	15			**Term/Level:**	3	**Course Credits:**	3.5
Hours/Week:	3.5	**Lecture:**	2	**Lab:**	1.5	**Shop:**		**Seminar:**	**Other:**

Prerequisites		**CHSC 3314 is a Prerequisite for:**	
Course No.	**Course Name**	**Course No.**	**Course Name**
Terms 1 & 2		CHSC 4414	Mineral Processing 2

■ Course Description

Efficiency of concentrating operations, particle size measurement and size distribution data, crushing and screening, comminution theory, size reduction by grinding, sedimentation theory and application. Emphasis on numerical solution of operating design problems. Laboratory work and reports in the above topics.

■ Evaluation

Laboratory	25%	Comments:
Midterms (2)	25%	
Final Exam	35%	
Quizzes	10%	
Presentation	5%	
TOTAL	100%	

■ Course Learning Outcomes/Competencies

Upon successful completion, the student will be able to:

1.0 Introduction to Mineral Processing (3 hours)

1.1 Define mineral processing and state why concentrating operations are necessary in recovering metals from ore deposits.
1.2 Recognize and interpret typical mineral processing flowsheets.
1.3 Describe mineral properties utilized in the separation of gangue and economic minerals.
1.4 Derive and utilize two product formulas for calculating recovery and ratio of concentration from stream assays.

2.0 Particle Size Measurement (4 hours)

2.1 Recognize that reported irregular-shaped particle sizes depend upon method of measurement and definition of size.
2.2 Describe methods of particle size measurement.
2.3 Describe the standard Tyler and other sieve series.
2.4 Perform solids sample size distributions by sieve analysis.
2.5 Analyze size distribution data graphically and in tabular formats.

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

3.0 Crushing (4 hours)

3.1 Define crushing, angle of nip, and crusher classifications.
3.2 Describe various types of crushing mechanisms.
3.3 Describe the types of primary crushers.
3.4 Describe secondary, tertiary, and quaternary types of crushers.
3.5 Utilize standard crusher performance charts to determine capacities of crushers.
3.6 Utilize standard graphical size distribution data to determine crusher product characteristics.
3.7 Describe types of screens utilized in closed circuit crushing.
3.8 Perform crushing and industrial screening experiments.

4.0 Comminution Theory (5 hours)

4.1 Describe methods utilized to determine mineral liberation size.
4.2 Describe rock breakage according to F.C. Bond.
4.3 Describe how applied mechanical energy is utilized during comminution.
4.4 State the empirical proposition between energy and size reduction of rock.
4.5 State the comminution laws of Rittinger, Kirk, and Bond.
4.6 Define Bond's work index.
4.7 Utilize Bond's law to determine energy required to achieve size reduction of rocks.

5.0 Grinding (6 hours)

5.1 Describe the grinding mechanisms encountered in tumbling mills.
5.2 Define critical speed during grinding in tumbling mills.
5.3 Utilize derived formulas to calculate critical speed.
5.4 Describe types of grinding media and mill liners.
5.5 Describe the importance of circulating loads during grinding.
5.6 Describe typical characteristics of rod mills, ball mills, pebble mills, and SAG mills.
5.7 Utilize standard formulas for scaling tumbling mills.
5.8 Experimentally determine the Bond work index for ores.
5.9 Determine rod and ball mill power draws utilizing standard formulas and tabulations.
5.10 Apply standard efficiency factors to the Bond equation when sizing rod and ball mills.

6.0 Sedimentation Theory (6 hours)

6.1 State Newton's laws of motion.
6.2 Describe the free settling concept utilized in sedimentation theory.
6.3 Recognize the mechanical mineral separation techniques that are based on fluid mechanics.
6.4 Recognize the importance of the force of gravity, the buoyant force, and the drag force acting on a mineral particle immersed in a fluid.
6.5 Utilize standard charts of drag coefficient versus Reynolds' number in terminal velocity calculations.
6.6 Utilize Stokes' law for calculating terminal velocity of particles in laminar flow.
6.7 Experimentally determine the size distribution of a sub sieve size solids sample utilizing an Andreasen pipet.

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

7.0 Laboratory Exercises

7.1 Sampling of Broken Rock
- development of sampling techniques from large bulk sample.
- screening tests and presentation of data in tabular and graphical forms.

7.2 Screen Analysis
- experimental determination of differences between wet and dry screening techniques as applied to a sample containing fine material.
- presentation of data in tabular and graphical forms.

7.3 Bond's Work Index
- estimation of Bond's Work Index by measurement of energy required to crush various ores. Screen efficiency experiment included in this section.

7.4 Sedimentation
- sizing of fine particles according to Stokes' law by the use of the Andreasen sedimentation pipet.

7.5 Heavy Media Separation
- separation of minerals of different specific gravities by the use of a high density pseudo-liquid.

■ Verification

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

F. Gfaffani — Authoring Instructor

Aug 28/06 — Date

I verify that this course outline has been reviewed.

Mark McDonald — Program Head/Chief Instructor

Aug. 28, 2006 — Date

I verify that this course outline complies with BCIT policy.

Dean/Associate Dean

2006/08/28 — 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, *Mineral Processing Technology*, Butterworth-Heinemann, 1997.

Recommended:

None.

■ Information for Students

(Information below can be adapted and supplemented as necessary.)

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.

■ Assignment Details

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