Design of Particulate Systems

EMET 2330
Instructor: Dr. C.A. Young
Office Hours, ELC 208A, Fall
Lecture: ELC 202; TR 9:30-10:50
METE 2350 Lab: ELC 108; Time/Date TBD

2010-11 Catalog Description:
Size reduction processes of crushing and grinding, particle sizing methods of screening and classifying, and solid/liquid separations of thickening and filtering are detailed. Types of equipment, methods for sizing equipment, prediction of energy requirements, flowsheet development, and safety considerations are examined.

Credits: 2 Credit-Hours (Lecture)

Designation: Required (Metallurgical & Materials Engineering)

Prerequisites: METE 2320 or Consent of Instructor

Lab: Students must register for METE 2350 (Co-requisite). This 'hands-on' experience with is provided without which the lecture material cannot be completely understood.

Textbook: Handouts from notes and references are provided on-line via Blackboard.

References:

Relationship of Course to Metallurgical & Materials Engineering Program Outcomes:
The course is intended to build on the foundation established in MetE 2320 and thereby further the students’ knowledge of unit operations and flowsheet design but additionally follows procedures and calculations to design and size thickeners, screens, crushers, grinding mills, and hydrocyclones. In this regard, the course serves as the first major course in MetE for the design experience.

Objectives:
Because this course is the students’ first major exposure to the design experience, it provides students with an understanding and capability of determining type and size of equipment from basic measurements and, in this regard, the student also acquires the capability of specifying and evaluating equipment and performance. The topics listed on the next page are discussed in detail in close conjunction with labs conducted in a separate course. Laboratory exercises require that the student develop an understanding of some fundamental operations and proficiency in carrying out such test work.

Outcomes: Graduates of this course will or will be able to:
1. Understand and describe separation processes and unit operations not covered in MetE 2320
2. Conduct calculations to size equipment (crushers, screens, thickeners, grinding mills and hydrocyclones)
3. Gain further appreciation for spreadsheet calculations and flowsheet design
4. Succeed in subsequent process metallurgy courses
5. Meet ABET Outcomes c and k (consult the Course Catalog and Department Guidelines)
6. Initiate ABET Outcomes d, m and n (consult the Course Catalog and Department Guidelines)

Topics:
1. Lab Orientation & Safety (See MetE 2340 Laboratory Exercises)
2. Conclude Uncovered Topics in MetE 2320 (6 classes)
3. Movement of Solids in Fluids (2 classes)
4. Flocculation and Coagulation (2 classes)
5. Thickener Types (1 class)
6. Thickener Sizing (2 classes)
7. Counter Current Decantation Washing (2 classes)
8. Crusher Types, Designs, and Capacities (2 classes)
9. Industrial Screening, Types, Efficiency (2 classes)
10. Screen Design Selection and Sizing (2 classes)
11. Crushing Circuits, Product Gradation Curves (1 class)
12. Comminution Laws: Kick, Rittinger, Bond, Charles (short review)
13. Breakage and Selection Functions (1 class)
15. Hydrocyclone Principles, Operation and Design (2 classes)
16. Classifier Design (1 class)
17. Partition Curves (1 class)

Homeworks: Normally, projects are required weekly and are due one week after they are given but can be difficult and take as long as three weeks to complete. Most homeworks/assignments will be team efforts and will include developing spreadsheets to calculate equipment sizes and mass balances.

Computer Usage: Spreadsheet development of simple and complex design problems including mass balances are required.

Attendance Policy: Roll is taken periodically and counted as approximately 10% of your grade. Excessive absence will result in lowering of the final grade.

Examinations: This course does not have tests or quizzes; however, if attendance is poor or, as discussed below, classes are disrupted or academic integrity is ignored, the scheduled final on Fri., Dec. 17, from 8-10am will be required along with other tests and quizzes as needed.

Major Project: Students will design a flowsheet and then calculate mass-balances and size each unit operation in it. Preference will be given to SME Student Design Competition.

Disruptions: The pop quiz frequency correlates directly to the occurrence of classroom disruptions during lecture. Potential disruptions include but are not necessarily limited to: late arrivals or early departures by students, extraneous conversations, cell phone usage, text messaging, use of extraneous electronic devices (see below), etc. If given, each quiz question will be graded on a 10-point basis and there is no limit to the number that may be given during the semester.

Academic Integrity: Students enrolled in the Metallurgical and Materials Engineering courses are expected to maintain an integrity standard that is consistent with the applicable fundamental canons of the NSPE Code of Ethics for Engineers. Specifically, students are expected to conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

Academic dishonesty or cheating will not be tolerated. Acts of academic dishonesty include (but are not limited to):
• Plagiarism including on homework assignments and lab reports
• Copying from another student’s paper while taking a quiz or examination
• Using unlawful aids (books, notes, cell phones or other electronic devices, etc.) to pass an examination (unless the instructor has clearly stated that it is an open notes or open book exam)
• Assisting another student in an act of academic dishonesty

If it is determined that a student has deliberately cheated on a quiz, examination, or assignment, he or she will be dropped from the course with an “F” grade. In compliance with Montana Tech policy, cases of academic dishonesty will also be reported to the Office of the Vice Chancellor for Academic Affairs.

With one exception, the Department policy is that electronic devices are not to be activated or evident during lectures and examinations. This restriction includes but is not limited to programmable calculators, cell phones, I-pods, or entertainment devices. The exception is that students are permitted to use a calculator from the following list during lectures, quizzes, and exams:

- Casio – any model fx-115 calculator
- Hewlett-Packard – the HP33s and 35s models
- Texas Instruments – all TI-30X or TI-36X models

Students that possess unapproved calculators or other electronic devices during a quiz or exam are subject to dismissal from the classroom. Penalties for disregarding the policy during lecture will be enforced at the instructor’s discretion.

**Grading Policy:** The final grade will be weighted from the above course elements approximately as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework Assignments</td>
<td>40%</td>
</tr>
<tr>
<td>Major Project</td>
<td>30%</td>
</tr>
<tr>
<td>Spreadsheets</td>
<td>20%</td>
</tr>
<tr>
<td>Attendance</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Professional Component:**

- Engineering Topics – 100%
- Engineering Design – Yes
- Computer Usage – spreadsheets
- Ethics – Yes (some - environmental)
- Statistics – Yes (some)
- Safety – Yes (industrial and laboratory)

**ABET Outcomes Covered:** c, d, k, m and n

**Prepared by:** C.A. Young
**Date:** August 22, 2010