EMAT 402 – ELEVATED TEMPERATURE PROCESS SYSTEMS
FALL 2011 SYLLABUS

INSTRUCTOR
Dr. Jerry Downey
Office: ELC 215
Office Hours: TBD

COURSE DESCRIPTION – Basic engineering principles are used to explain the production of metals from ores by high temperature processes. Topics include drying, calcining, roasting, sintering, agglomeration, smelting, converting, and refining. Applications to lime and cement manufacturing are covered. Waste production, waste treatment, and environmental controls are illustrated and discussed.

CREDITS AND CLASS MEETINGS – 3 lecture credit hours. Class meets from 9:30 to 10:45 am, Tuesdays and Thursdays, in Room ELC 329.

DESIGNATION – required for the B.Sc. degree in Metallurgical and Materials Engineering.

PREREQUISITES – EMAT 307 or Consent of Instructor

TEXTBOOK AND REFERENCES
No textbook. Selected reading from supplemental literature may be assigned in class and/or posted on Moodle. Students may find the following references to be valuable resources:

- Pyrometallurgy, A modular, tutorial course designed for self-paced learning, L.G. Twidwell, sponsored by the National Science Foundation, circa 1980.

COURSE RELATIONSHIP TO M&ME PROGRAM OUTCOMES
EMAT 402 examines the application of thermal processing technologies in metallurgical and materials engineering. The focus is the chemical and thermodynamic basis for selected high temperature unit operations. Current industrial operations are studied, including both large scale extractive operations and smaller-scale materials synthesis and coating processes. The subject matter also includes the design aspects of commercial environmental control technologies and the application of conventional metallurgical technologies to waste treatment and recycling.

TOPICS – the planned lecture topics include but are not limited to:

1. Course introduction and overview
2. Flowsheets and material balances
3. Thermodynamics review and heat balances
4. Drying and calcination
5. Roasting and sintering
6. Slags, molten salts, and refractories
7. Ferrous metal smelting and refining
8. Nonferrous metal smelting and refining
9. Environmental control technologies
10. Material synthesis
OBJECTIVES AND OUTCOME – the course is designed to acquaint students with the theory, design, and applications of thermal processes that are common to the practice of Metallurgical and Materials Engineering. Course graduates will have demonstrated their proficiency in:

1. Calculating mass and heat balances for industrial applications
2. Applying thermodynamic principles to solve thermal processing problems
3. Conceptualizing potential processing schemes based on the physical and chemical characteristics of the feed materials
4. Selecting and sizing process equipment

The objectives and outcome are responsive to the following (ABET a-k Criteria) skills, knowledge, and behaviors:

(a) ability to apply knowledge of mathematics, science, and engineering
(b) design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
(c) broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

In concert with the stated Metallurgical and Materials Engineering Department outcomes, graduates of this course will also:

(l.) be able to apply advanced math, science (chemistry and physics), and engineering principles to metallurgical and mineral systems, and

(m.) have an integrated understanding of the scientific and engineering principles underlying the major elements of the field, which include structure, properties, processing, and performance related to metallurgical and materials systems.

EVALUATION AND GRADING CRITERIA

Grades will be determined according to a curve based on the cumulative point totals for the students who complete the course. Each student is credited with 1,000 points at the beginning of the semester. Thereafter, points are deducted from the student’s “account” based on his/her performance relative to the grading criteria outlined below. As examples, a student who receives a score of 90 on a typical 100-point exam will have 10 points deducted from his/her account and a student who receives a score of 17 on a typical 20-point homework assignment will have 3 points deducted from his/her account.

The number of points that the student retains at the end of the semester determines the student’s grade for the course. Students with 920.0 or more points remaining in their accounts as of December 9, 2011 are exempt from the final examination and receive an “A” for the course. Students with less than 600.0 total points after the final exam receive an “F” regardless of where the final curve falls. With these exceptions, individual grades (A, B, C, D, and F) are decided according to the natural breaks in the curve.

Each student receives feedback on his or her current class standing when the graded examinations are returned. The feedback includes the student’s exam score, the class average for the exam, the student’s point total, the class average point total, and the student’s current rank in the class. For example, the student with the 3rd highest point total in a class of 60 students is ranked as 3/60, while the student with the 45th highest point total in the same class is ranked at 45/60.

Attendance: Students are expected to attend at least 90% of the lectures. Role is taken at the beginning of class. Fifteen (15) points are deducted from the student’s point total on the fifth absence and on each subsequent absence. Students who arrive after role has been taken or depart prior to dismissal are considered absent and points are deducted accordingly.
**Examinations:** Students are required to sit for four 50-minute examinations. The examinations are each graded on a 100-point maximum basis. Unless otherwise specified by the instructor, the examinations are closed book and closed notes. In general, the examinations cover the subject matter presented in class and the reading assignments for the period subsequent to the preceding exam.

The 50-minute examinations are tentatively scheduled for September 20, October 13, November 8, and December 6. The instructor reserves the right to alter the examination schedule by providing at least one week advance notice to the class. The final is a comprehensive, 2-hour examination, and it is graded on a 150-point basis. The date and time of the final examination will be posted after the Registrar’s Office releases the final examination schedule.

**Homework:** Reading, design, and problem-solving assignments, are distributed in class and/or posted on Blackboard. The course includes approximately 10 homework assignments, and each assignment is graded on a 25-point basis. The homework cover sheets (posted on Blackboard and/or distributed in class) specify the due date. Homework must be submitted prior to the start of class on the due date. Late work is not accepted and receives the grade of zero.

Students are encouraged to work in groups, but each is personally responsible for completing and submitting the assignments. In order to receive full or partial credit, problem solutions that involve computations and/or derivations must show all steps, state assumptions, express the answers using proper engineering units, and clearly indicate the final answer.

Take the time necessary to make your homework papers presentable. Homework is expected to be neat and well-organized with correct spelling and grammar. Illegible or incomplete work is returned with a score of zero. Additional guidelines are provided at the first class meeting of the semester.

**Quizzes:** generally intended to reinforce the learning process, quizzes may be given with or without (i.e. a “pop quiz”) advance notice. Subject matter covered during the previous and present lecture and/or the associated readings is considered fair game. 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, etc. Each quiz question is graded on a 10-point basis and there is no limit to the number of quizzes that may be given during the semester.

**Notebook:** Students are expected to organize their lecture notes, supplemental reading and reference materials, graded homework and examinations, and other course materials in a three-ring binder. Students are required to submit their notebooks for grading during class on Wednesday, December 7. Notebooks are graded on a 50-point basis.

**Absence:** Montana Tech policy dictates that “faculty should make reasonable accommodation for students to make-up work missed (or the equivalent) because of an excused absence. Excused absences include official Montana Tech events or activities, or personal matters deemed appropriate by the instructor.” Official Montana Tech Events or activities include:
- NAIA sanctioned sporting events
- Academic Team competitions
- Travel for professional meetings related to major
- Class field trips
- Others as approved by the Chancellor

Students must submit their assignments in advance of field trips, athletics, or other school-sanctioned events that cause them to miss class the day that the assignment is due. The student is responsible for notifying the instructor and submitting homework assignments prior to the absence. Following an absence, students should arrange to obtain class notes from another student. Under no circumstances will students be granted access to the instructor's lecture notes or grading keys.

It is the student’s responsibility to sit for the examinations at the scheduled dates and times. If a student misses one of the scheduled 50-minute examinations for any reason, the sole recourse is make arrangements with the instructor to sit for a make-up exam. The instructor must receive the written request for the make-up examination at least one week prior to the make-up examination.
date. The make-up examinations will begin promptly at 8:00 a.m. on Wednesday, November 23 and at 2:00 p.m. on Friday, December 16, 2011. Students are cautioned to arrive early as those who arrive after the designated starting time will not be allowed to take the examination. Each student is allowed one (1) make-up examination due to absence. An examination missed without make-up is assigned the grade of zero (0).

The date and time of the final examination will be scheduled by the Registrar’s Office. Students are expected to sit for the examination at the scheduled time and date.

**Academic Dishonesty:** Academic dishonesty or cheating will not be tolerated. Acts of academic dishonesty include but are not limited to:

- Plagiarism
- 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
- 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/she will be dropped from the course with an “F” grade. In compliance with Montana Tech policy, cases of academic dishonesty must be reported to the Office of the Vice Chancellor for Academic Affairs.

**Disability Accommodations:** Students that require academic accommodation because of disabilities must:

1. Register with and provide documentation to the Student Disability Coordinator (Joyce O’Neill, Engineering Hall Room 104; 406-496-4429; joneill@mtech.edu)
2. Provide the instructor with a letter that states the need and type of accommodation. This should be done during the first week of class.

**PROFESSIONAL COMPONENT**

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<tr>
<th>Engineering Topics:</th>
<th>100%</th>
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<tbody>
<tr>
<td>Design Component:</td>
<td>Yes (Mass &amp; energy balances; equipment selection and sizing)</td>
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<tr>
<td>Computer Usage:</td>
<td>Yes (Excel spreadsheets; thermodynamic process models)</td>
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<tr>
<td>Ethics:</td>
<td>Yes (Sustainability; personal &amp; professional ethics stressed)</td>
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<tr>
<td>Statistics:</td>
<td>No</td>
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<tr>
<td>Safety:</td>
<td>Yes (Relevant safety aspects discussed in selected lectures)</td>
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**PREPARED BY**

J. Downey July 19, 2011