MONTANA TECH
Metallurgical & Materials Engineering Department

M&ME 3220 (EMAT 307) – M&ME Thermodynamics
Spring 2011 Syllabus

Instructor: Dr. Jerry Downey (ELC 215; 496-4578) Office hours: 9:30-11:00 a.m., TR
RA/TA: Tyler Salisbury (ELC 104) Office hours: 1:30-3:00 p.m., TR

Course Description: Basic thermodynamic principles are introduced and the application of thermodynamics and physical chemistry to metallurgical and environmental processes is illustrated. Industrial examples are presented.

Credits and Class Meetings: The 3 credit (lecture) course meets in ELC 202 from 11:00 to 11:50 MWF.

Designation: required for the Bachelor of Science degree in Metallurgical and Materials Engineering.

Prerequisites: CHMY 143 (formerly CHEM 1066) or consent of instructor.

Textbook and References: no textbook is required. Supplemental reading may be assigned in class and/or posted on Blackboard (or Moodle). Course information and thermodynamic data will be drawn from multiple references, which include:


Topics: the planned lecture topics include:

1. Course introduction and overview
2. Thermodynamic fundamentals
3. Heat capacity and enthalpy
4. Entropy
5. Free energy
6. Ellingham diagrams
7. Activity and the relationship with free energy
8. Equilibrium yield
9. Phase stability diagrams
10. Binary phase diagrams
11. Application of different forms of thermodynamic data
12. Application of thermodynamic principles to metallurgical and materials systems
   a. Thermal processes
   b. Aqueous processes
   c. Electrolytic processes
Objectives and Outcomes: The course focuses on the application of chemical thermodynamics to metallurgical and materials engineering problems. Following presentation and review of the fundamental thermodynamic principles, the course emphasizes problem solving relative to applications that involve thermal, aqueous, and/or electrolytic systems.

The course is designed to acquaint students with the fundamentals of chemical thermodynamics and enable them to become proficient in performing thermodynamic calculations that include determination of process heat requirements (excess or deficit), heat balances, reaction feasibility, and equilibrium yield. Students will also learn how to construct phase stability diagrams for condensed systems. Industrial examples are selected to illustrate how the theory is applied to practical engineering problems and decision making.

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

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(e) an ability to identify, formulate, and solve engineering problems

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
(o.) have the ability to utilize experimental, statistical and computational methods that are consistent with the educational objectives of the metallurgical and materials engineering program.

Evaluation and Grading Criteria: 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 on May 6, 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. The 1,000 point maximum is distributed as follows:

- Attendance and quizzes (variable, depending on student compliance)
- Notebook (50 points)
- Homework (250 points)
- 50-minute examinations (4 x 100 = 400 points)
- 2-hr Final Examination (200 points)

Each student receives feedback on his or her current class standing when graded examinations are returned. The feedback includes the student’s exam score, the class average for the exam, the student’s current point total, the current 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 16 students is ranked as 3/16, while the student with the 15th highest point total in the same class is ranked at 15/16.

Attendance: Students are expected to attend at least 90% of the lectures. Role is taken at the beginning of class. Ten (10) 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.

Students must submit their assignments in advance of field trips, athletics, or other school-sanctioned events that force them to miss class. The student is responsible for notifying the instructor, submitting homework assignments, and sitting for examinations prior to the absence. Students should arrange to obtain class notes from another student. Do not ask to borrow the instructor’s lecture notes or grading keys.
Examinations: Students are required to sit for four 50-minute examinations. Each examination is graded on a 100-point 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 February 9, March 7, April 6, and May 2. 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 that is graded on a 200-point basis. The Registrar’s Office has scheduled the final examination time for this course to take place from 3:00 to 5:00 pm on Monday, May 9, 2011.

It is the student’s responsibility to sit for the examinations at the scheduled dates and times. As a general rule, make-up examinations are not given for unexcused absences. Exceptions are decided on a case-by-case basis for unavoidable absences resulting from sudden illness or other extreme emergencies.

Homework: Reading, design, and problem-solving assignments, are distributed in class and/or posted on Blackboard. The course includes approximately 25 homework assignments; each assignment is graded on a 10-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 student is personally responsible for completing and submitting the completed 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 posted on Blackboard.

Quizzes: Generally intended to reinforce the learning process, quizzes may be given with or without advance notice (i.e. a “pop quiz”). Subject matter covered during previous and present lectures 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 on May 2. The notebooks are graded on a 50-point basis.

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
- 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 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, ipods, or entertainment devices. The exception is that students may be permitted to use a nonprogrammable calculator during lectures, quizzes, and exams; calculators will not necessarily be permitted for all exams.

Students that employ 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.

Disability Accommodations: Students that need 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:

Engineering Topics: 100%
Design Component: Yes (application of thermodynamic principles to design of experiments and development of fundamental process design criteria)
Computer Usage: No
Ethics: Yes (importance of thermodynamic evaluations to due diligence)
Statistics: No
Safety: No

Prepared by:
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January 10, 2011