MTSI 511/EMET 523 – Thermodynamics of Materials

Catalog Description:

MTSI 511 (Cross-listed with EMET 523): Thermodynamics of Materials: 3 credits (LEC 3) Advanced thermodynamic principles are presented in the context of materials science and processing. The course focuses on the application of thermodynamic principles to materials structure, properties and processing. Subject matter includes elements of solution thermodynamics and application to equilibrium diagrams.

Instructor:

Dr. Jerry Downey
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Office Hours: as posted

Textbook:

No textbook is required. Supplemental reading assignments and the thermodynamic data used in class examples and homework assignments are drawn from multiple references, which include:

- Introduction to the Thermodynamics of Materials (fifth edition), David R. Gaskell, Taylor & Francis, 2008
- Phase Equilibria, Phase Diagrams and Phase Transformations – Their Thermodynamic Basis, Mats Hillert, Cambridge University Press, 2008
- Thermodynamics in Materials Science (2nd Edition), Robert DeHoff, CRC Press, 2006
- Thermodynamics of Materials – A Classical and Statistical Synthesis, John B. Hudson, John Wiley & Sons, 1996
- Thermodynamic Data for Mineral Technology, L.B. Pankratz, et al, USBM Bul. 677, 1984
- Introduction to Phase Equilibria in Ceramic Systems, Floyd A. Hummel, Marcel Dekker 1984
- Thermodynamic Properties of Elements and Oxides, L.B. Pankratz, USBM Bul 672, 1982
- Metallurgical Thermochemistry (Fifth Edition), O. Kubaschewski and C.B. Alcock, Pergamon Press, 1979
- Phase Diagrams -- Materials Science and Technology Volume I, Allen M. Alper, Ed., Academic Press, Inc., 1970
- Principles of Phase Diagrams in Materials Systems, Paul Gordon, McGraw-Hill, 1968

Course Objectives:

Advanced thermodynamic principles are conveyed in the context of materials science with detailed analysis of solution thermodynamics, multi-phase mixing, entropy, and equilibria. Also covered are concepts of state functions and free energies. The statistical thermodynamics component includes relationships between microscopic and macroscopic particles.

Course Outcomes:

The course objectives and outcomes are responsive to ABET criteria b, e, and k. Upon successful completion of the course, students will have demonstrated their ability to:

- apply fundamental principles of classical thermodynamics to a variety of practical applications
- construct, interpret and effectively utilize phase diagrams for unary, binary and ternary phase systems

Assessment and Evaluation:

Homework assignments (5 – 10) are each graded on a 100-point maximum basis. Homework must be electronically submitted by the specified due date – except for cases of excused absence, late work is not accepted and receives the grade of zero. Students are encouraged to work in groups but each student is responsible for personally completing and submitting the assignments.

Students must complete three examinations, which may be in-class, take home, or a combination of both formats. Students must not collaborate on exams or solicit information, advice, or clarification from anyone except the course instructor. Each exam is graded on a 100-point maximum basis. Each exams covers subject matter presented in class, plus supplemental reading assigned for the period subsequent to the preceding exam (or the beginning of the semester in the case of the first exam). The exams are tentatively scheduled to take place on or about the last scheduled lecture periods in September, October, and November. The instructor reserves the right to alter the examination schedule by providing the class with advance notice of at least one week.

To be eligible for full or partial credit, problem solutions that involve computations and/or derivations must clearly indicate all significant steps, state assumptions, express answers with proper units, and clearly indicate the final answer. Homework is expected to be well-organized and legible with correct spelling and grammar.

In lieu of a comprehensive final examination, students will each select and critically evaluate three recent (published within the past 7 years) journal publications that pertain to a common and relevant thermodynamics topic of the student's choice. Students must select the publications and obtain instructor approval of the selected topic. Students will prepare a written analysis and critical evaluation of the papers, which are due at 4 p.m. on the day of the last scheduled class meeting in November. Topic selections must be made and approved by October 15.

Grading:

- Homework 20% or 0.2 x homework average
- Examinations: 60% or 0.6 x examination average
- Critical review/final presentation: 20% or 0.2 x numerical score

Student Conduct:

Students are expected to comply with the student conduct standards published for the respective universities. Acts of academic dishonesty, which include but are not necessarily limited to plagiarism, replicating all or a portion of another student's examination, using unapproved aids or assistance to pass an exam, or assisting another student in an act of academic dishonesty, will be reported to the graduate dean or other responsible party at the student's home university. Recording lectures or portions of lectures is forbidden without express written permission from the instructor.

Disability Accommodations:

Students that require academic accommodation because of disabilities must register with the Student ADA Coordinator (or equivalent) at their university and provide the course instructor with a letter that states the need and type of accommodation. The letter should be provided to the instructor during the first week of class.