

EMA-4314 Section 8797, Energetics and Kinetics in Materials Science

1. Catalog Description: Foundations of energetics and kinetic theory with applications to processes in materials science. (3 Credits)
2. Prerequisites: EMA 3010
Corequisites: None
3. Course Objectives:

The objective of this course is to develop and understanding of the foundations of thermodynamics and kinetics of materials, including both the underlying physical principles and problem solving for materials problems.
4. Contribution of course to meeting the professional component; 2 credits associated with mathematics or basic science, 1 credit associated with engineering. Course does not contain a significant design component.
5. Relationship of course to program outcomes:

This course addresses the following MSE Program outcomes:

 - (1) Ability to apply knowledge of mathematics, science, and engineering to materials systems (high coverage).
 - (6) Ability to identify, formulate and solve engineering problems (high coverage).
6. Instructor: Dr. Brij M. Moudgil
 - A. Office location: 205E Particle Science Building (PST Building)
 - B. Telephone: 352-846-1194
 - C. E-mail address: bmoudgil@perc.ufl.edu
 - D. Class Web site: e-learning <https://lss.at.ufl.edu/>
 - E. Office hours: TBA or by appointment (for appointment, contact Ms. Hollie Starr, Sr. Secretary at hstarr@ufl.edu; Ph: 352-846-1194)
7. Teaching Assistant: Juan Tanquero
 - A. Office location: 205 Particle Science Building
 - B. Telephone : 786-423-3708
 - C. E-mail address: jgt2292@ufl.edu
 - D. Office hours: TBA
8. Meeting Times: T 6, R 5-6
9. Class schedule: Meeting twice a week
10. Meeting Location: 205 Rolf Hall
11. Material and Supply Fees: None
12. Textbooks and Software Required:
 - a. Title: Physical Chemistry
 - b. Author P. W. Atkins and J. de Paula,
 - c. Publication date and edition: Oxford, *Part I. 9th Edition*
 - d. ISBN number: 1-4292-3127-0
13. Recommended reading:
 - A. *Thermodynamics, Statistical Thermodynamics and Kinetics*, 2nd Edition, T. Engel and P. Reid, Prentice Hall, 2010 (ISBN—10: 0-321-61503-4).
 - B. *Introduction to the Thermodynamics of Materials*, D. R. Gaskell, 4th Edition, Taylor and Francis, 2003 (ISBN 1-56032-992-0).
 - C. *Thermodynamics in Materials Science*, R. T. DeHoff, McGraw Hill (either 1st

or 2nd Edition).

D.

14. Course Outline (tentative):

(Note: Section selection may change, some sections may be emphasized more than others)

Class# 1-5

Topics:

Class overview, perfect gas laws, kinetic model, mixtures,
Van der Waals and law of corresponding states
(Sections: 1.1-1.4)

Class# 6-11

Topics:

Work, heat energy and internal energy
Expansion work, heat transactions, Enthalpy, Adiabatic processes
Standard enthalpy changes, Standard enthalpies of formation;
T dependence
(Sections: 2.1 – 2.11)

Class# 12-20

Topics:

Dispersal of Energy, entropy
Entropy changes, Third Law, Gibbs and Helmholtz energies
Standard molar Gibbs free energies
Combined 1st and 2nd Laws, Properties of Gibbs Free energy
(Sections: 3.1 – 3.9)

Class# 21- 30

Topics:

Phase diagrams, phase boundaries, phase rule, representative unary
phase diagrams, phase stability, Phase boundaries, Ehrenfest classification.
(Sections: 4.1 – 4.6)

Mixtures: partial molar quantities, thermodynamics of mixing, chemical
potentials

Liquid mixtures; Phase diagrams, Activity, Chemical equilibrium
(Sections: 5.1 – 5.13)

Class# 31-43

Gibbs free energy, Temperature and pressure effects
Electrochemistry: half reactions and cells;
cell potential, standard electrodes, Applications of cells
(Sections: 6.1-6.9)

Diffusion

(Sections: 20.8-20.10)

Homeworks will be assigned weekly.

Tentative Exam schedule is as follows: Exam 1 – Week of September 14; Exam 2 – Week of October 14; Exam 3 – Week of November 30.

15. Attendance and Expectations:

Attendance in class is important. Material covered in class will follow the book closely in some areas and will deviate from it in others; in a few cases class notes will be used exclusively. In addition, there may be assignments to be completed in class that will count towards your grade. Those students not in class for any reason are responsible for the material covered in class, and the homework assigned.

Correct behavior in class is always important. Making noise, talking, reading the paper, leaving your cell phone on, leaving early or arriving late can be very distracting. Occasionally, your schedule will demand that you arrive late or leave early - in these cases please minimize class disruption.

Homework will be assigned and is due on the dates indicated on the course schedule; no late homework will be accepted. Talking with others is encouraged, but all turned in problem solutions must be your own work. All homework problems and solutions may be downloaded from the Sakai site.

Exams: will closely follow the material covered in class, in your assigned reading and in homework problems. These will be closed book and without notes and will be given during a regular class period. A one page equation/formulae etc. will be allowed. Requests for re-grading of exams must be made within one week after an assignment has been returned. Only exams completed in pen will be considered for re-grading.

Final Exam: There will be no final exam.

On the Web: This course will use Sakai (<https://lss.at.ufl.edu>). All class handouts, homework problem sets, homework solutions, exam solutions, and grades will be available throughout the semester.

16. Grading:

The course grade is based on numerical scores that include homework and exams:

| | |
|---------------------|----------|
| Homework | 10 % |
| Best of three exams | 50% |
| Next two best exams | 20% each |
| Total | 100% |

(Optional: Unannounced tests may be given in class that could add up to 5 extra points to above total)

17. Grading Scale:

This class will be graded on the following scale:

92-100 A (GPA points = 4.0)

88-91 A- (3.67)
84-87 B+ (3.33)
80-83 B (3.0)
76-79 B- (2.67)
72-75 C+ (2.33)
68-71 C (2.0)
65-67 C- (1.67)
62-64 D+ (1.33)
59-61 D (1.0)
56-58 D- (0.67)
< 56 E (0)

A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

18. Make-up Exam Policy: If you miss an exam through documented illness or for an excused absence, you may take a make-up exam. If you miss a test for any other reason, you will receive a zero on that test.
19. Honesty Policy – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.
20. Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.
21. UF Counseling Services –Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
 UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
 Career Resource Center, Reitz Union, 392-1601, career and job search services.
22. Software Use – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.