EMA 4224 Physical Metallurgy II
Spring Semester 2014
Instructor: G.E. Fuchs

1. Catalog Description: An in-depth discussion of fundamentals of physical metallurgy, microstructure evolution and alloy selection/design. Credits: 3 hours.

2. Pre-requisites: EMA4120 - Physical Metallurgy I and EMA 4223 – Mechanical Behavior

3. Course Objectives:
    a. to familiarize the student with those terms, concepts, and definitions (i.e. jargon) used to describe the properties and processes of common engineering metals.
    b. to learn how mechanical properties are measured and to develop an understanding of how testing parameters affect these properties.
    c. to develop a fundamental understanding of the relationships between material composition, structure, and properties resulting from synthesis, processing or service.
    d. to develop an understanding of the testing procedures used to characterize some of the more common physical properties for engineering metals, and how these properties should be used when specifying conditions where optimum performance without failure can be expected.
    e. to develop an understanding of the solidification processes, and how they result in the microstructure and influence the properties of metals.
    f. to develop an understanding of the processes occurring in metals during heating and plastic forming that influence the microstructure and properties of alloys.
    g. to develop an understanding of the effects of alloying of metals upon the microstructure and properties.
4. Contribution of course to meeting the professional component - This is a 3 credit course. It provides 3 credits towards engineering sciences and includes a design component.

5. Relationship of course to program outcomes - This course addresses the following MSE Program outcomes (note: Numbers refer to the list of MSE Program outcomes):
    1. Ability to apply knowledge of mathematics, science, and engineering to materials systems. (Low coverage)
    4. Ability to apply and integrate knowledge of structure, properties, processing, and performance to solve materials selection and design problems within realistic constraints. (High coverage)
    6. Ability to identify, formulate, and solve engineering problems. (Medium coverage)

8. Ability to communicate effectively in both oral and written form.(Medium coverage)
9. Understanding of the economic impact of engineering solutions.(Low coverage)
10. Understanding of the global, societal, and environmental impact of engineering solutions.(Low coverage)
12. Knowledge of contemporary issues.(Medium coverage)
13. Ability to use the techniques, skills, and tools needed for practice as a materials engineer.(Low coverage)

6. Instructor: G.E. Fuchs
    a. Office location: 116 Rhines Hall
    b. Telephone: 352-846-3317
    c. E-mail address: gfuch@mse.ufl.edu
    d. Office hours: TBD or by appointment

7. Class Times: T Period 4/R Periods 5-6

8. Class Location: MAEB 2012/WEIM1084

9. Textbooks Required
    a. Title: *Physical Metallurgy Principles,3rd Edition*
    b. Authors: R.E. Reid-Hill and R. Abbaschian,
    c. Publisher: PWS-Kent Pub. Co., Boston, MA
    d. Publication date and edition: 1992, Third Edition
    e. ISBN number: 10:0-534-92173-6

10. Recommended Supplemental Textbooks
    Title: *Heat Treatment, Structure and Properties of Non-Ferrous Alloys,* Charlie R Brooks, ASM International, metals Park Ohio, out-of-print.
    Title: *Metals Handbook, Volumes 1 & 2,* (ASM International, Metals Park, OH).

11. Course Outline
    a. Diffusion in Substitutional Solid Solutions (Chapter 12)
    b. Interstitial Diffusion (Chapter 13)
    c. Solidification of Metals (Chapter 14)
    d. Nucleation and Growth Kinetics (Chapter 15)
    e. Review of Solid Solution Strengthening (Chapter 9)
    f. Strengthening in multi-phase alloys (Chapter 16)
    g. Thermally activated plastic deformation (Chapter 23)
    h. Deformation twinning and Martensitic reactions (Chapter 17)
    i. The Iron-Carbon alloy system (Chapter 18)
    j. The Hardening of steel (Chapter 19)
    k. Fracture and fracture mechanics
    l. Fatigue
    m. Failure analysis
    n. Selection of alloys

Tentative schedule:

Week #	Week of:	Tuesday	Thursday
1	1/6		
2	1/13		
3	1/20		
4	1/27		
5	2/3		
6	2/10	Midterm #1	
7	2/17		
8	2/24		
9	3/3	*Spring*	*Break*
10	3/10		
11	3/17		Midterm #2
12	3/24		
13	3/31		
14	4/7		
15	4/14	Midterm #3	
16	4/21		
17	4/28	Finals	Week

12. Attendance and Expectations: Attendance is strongly encouraged, but will not be recorded. While attendance is not mandatory, experience has shown those who attend lectures learn more and earn higher grades in the course. Arrival on time is expected. Turn off all telephones before entering classroom.

13. Grading –
    a. Homework given approximately bi-weekly, due within 1 week of assignment. Late homework accepted until solutions handed-out, but penalized 10% per day after due date. All work must be shown for full/partial credit.
    b. Exams: 3 mid-terms
    c. 1 final – Optional – Monday April 28th, 5:50-7:30pm
    d. All work must be shown for full/partial credit.
    e. Questions require thought/common-sense.
    f. Oral presentation during last week of class on some aspect of physical metallurgy of interest to them. The topics for the projects will be selected by the students and approved by the instructor before Spring Break (March 1st). The students will be required to give a 15 minute presentation. Students can form groups.
    g. No extra credit accepted.
    h. All grading based on curve.

i. Grading Distribution:
    i. Without Optional Final:
        1. Homework – 20%
        2. 3 Midterms – 20% each
        3. Final Project – 20%
    ii. With Optional Final:
        1. Homework – 15%
        2. 3 Midterms – 15%
        3. Final Exam – 20%
        4. Final Project – 20%

14. Grading Scale: 90-100 A, 88-89 A^-, 85-87 B^+, 81-84 B, 78-80 B^-, 75-77 C^+, 71-74 C, 68-70 C^-, 65-67 D^+, 61-64 D, 58-60 D^-, <57 E). Top person in class adjusted to 96%. Balance of grades awarded based on above scale. Information on current UF grading policies for assigning grade points may be found at http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html.

15. Make-up Exam Policy: No exam make-up without prior approval of instructor.

16. 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

17. 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.

18. UF Counseling Services – Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
    - University Counseling Center, 301 Peabody Hall, 392-1575; personal and career counseling.
    - SHCC Mental Health, Student Health Care Center, 392-1171; personal and career counseling.
    - Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161; sexual assault counseling.
    - Career Resource Center, Reitz Union, 392-1601; career development assistance and counseling.

19. 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.