EMA 4623 – Process Metallurgy
EMA 6625 – Advanced Metals Processing
MWF: 4th Period
Fall 2017
CSE E107

Instructor: G.E. Fuchs
116 Rhines Hall
846-3317
gfuch@mse.ufl.edu

Office Hours: TBD

Text: *Manufacturing Processes for Engineering Materials – 5th Edition*
S. Kalpakjian and S.R. Schmid
Addison-Welsey Publishing, Co., Reading, PA

Additional References (not required):

Engineering Design
G.E. Dieter
McGraw-Hill, New York, NY, 1991

Physical Metallurgy Principles, Third Edition
R.E. Reed-Hill and R. Abbaschian
PWS-Kent Pub. Co., Boston, MA, (1992)

Modern Physical Metallurgy & Materials Engineering – 6th Edition
R.E. Smallman and R.J. Bishop
Butterworth-Heinemann, Boston, MA, 1999

Selection of Engineering Materials
G. Lewis
Prentice-Hall, Englewood Cliffs, NJ, 1990

Co-requisite: EMA 4120 (Phys. Met I)

Description: Engineering aspects of metals processing. Science and Technology of metal and manufacturing processing. Materials and process selection are also addressed and related to numerous applications for specific ferrous and non-ferrous metals.

Objective: To introduce the student to processing of structural materials and materials selection for structural applications.

Approach: Demonstrate connections between processing, microstructures and properties in metals. Use examples to illustrate effect of processing on microstructures and properties. Use examples of materials process selection for a variety of applications to reinforce subjects.

Contribution of Course to Meeting the Professional Component: This is a 4 credits course. It provides 2 credits towards engineering sciences and 2 credits towards design.

Relationship of Course to Program Outcomes: This course addresses the following MSE Program outcomes (Note: Numbers refer to the list of MSE Program Outcomes)

4.) Ability to apply and integrate knowledge of structure, properties, processing, and performance to solve materials selection and design problems within realistic constraints. The problems involve designing/selecting a process to produce a part or a product. The effort includes several steps (but not limited to) defining the product application, materials selection, comparison between different processing options based on the product specifications, material selected, the process parameters, and environmental impact, as well as cost analysis. The course also includes field trips to materials processing facilities in the area. (High Coverage)

6.) Ability to identify, formulate and solve engineering problems. The course lectures include examples of various processing technologies and their applications in different practical situations. The project involves identifying the product specifications needed to meet its application requirements. The students select the processing methodology. They ask themselves several questions such as: What is the most appropriate casting process? What is the most appropriate alloy to use in the casting, considering both the performance and the manufacturability (castability and machinability)? Thus, they learn how to formulate the problem and how to solve it. (High coverage)

9.) Understanding of the economic impact of engineering solutions.(low coverage) As part of the design project, students are asked to consider economic factors, such as production costs and marketing.

Grading:

1.) 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.

2.) Exams: 3 mid-terms tentatively scheduled in table below
Optional final – Friday, December 16th, 7:30-9:30am
All work must be shown for full/partial credit.
Questions require thought/common-sense.

	Without Optional Final	With Optional Final
3 Midterm Exams	25% each	20% each
Bi-weekly Homework	25%	20%
Optional Final Exam	N/A	20%
Total	100%	100%

Grading Scale: 93-100 A, 90-92 A-, 87-89 B+, 83-87 B, 80-82 B-, 77-79 C+, 73-77 C, 70-72 C-, 67-69 D+, 63-67 D, 60-62 D-, < 60 E

3.) Extra credit will be included in each midterm.
4.) Review sessions before each exam.
5.) All grading based on curve.

For EMA-6625 Only: All students will be required to complete a paper on Process Metallurgy. The subject, which is to be selected by the student, should be identified prior to Friday, October 27th and approved by the instructor. The report, homework, midterms (and optional final, if taken) will all be worth equal amounts of the overall grade. A hardcopy of the report will be due on last day of class (December 6th). This report will be worth the same amount as a midterm exam. The report must utilize a 12-point font, single spacing with 1" margins and be 10-12 pages of text (figures, tables and references are not counted in the page count). At least 80% of the references must be open literature journals, proceedings, books, etc. No more than 20% of the references can come from the web. The paper must be original work and the paper will be evaluated for any evidence of plagiarism. All reports will be submitted and reviewed by TurnItIn.com. If there is any evidence of plagiarism, the paper will be given an "F" and zero-points on the project. This is an individual project and any evidence of students working in a group or copying each other's work will also results in an "F" and zero-points on the project for all of the students involved.

The UF definition of plagiarism can be found at:
http://flexible.dce.ufl.edu/media/flexibledceufledu/documents/uf_policy_student_conduct.pdf

For EDGE Students Only: Due dates for all assignments and tests will be provided. However, in general, all EDGE students should attempt to turn in all assignments within 1 week of in-class due dates. The EDGE students who can not meet these due dates, should contact the professor immediately and establish an appropriate due date.

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.

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.

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 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.

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.

Subjects to be Covered:

1.) Introduction to Manufacturing Processes
   a. Discussion inter-relationship of materials and processing with manufacturing
   b. Introduce materials selection criterion
   c. Introduce materials process selection criterion
2.) Properties of Metals and Alloys
   a. Briefly discuss important physical and mechanical properties of metals and alloys.
   b. Crystal structure
   c. Grains and grain boundaries
   d. Deformation, recovery, recrystallization and grain growth.
   e. Examples of structural alloys (e.g., ferrous, non-ferrous, refractory metals, superalloys).
3.) Surfaces
   a. Introduce surface finish, wear and lubrication
   b. Surface finish measurement
   c. Wear
   d. Lubrication
4.) Casting Processes
   a. Introduce solidification processing of metals and alloys
   b. Solidification
   c. Melting of engineering alloys
   d. Casting of ingot and shapes
   e. Common casting techniques (e.g., mold, centrifugal, squeeze, etc)
   f. Advanced casting techniques (e.g., directional solidification, etc)
5.) Wrought Processing
   a. Discuss deformation processing and it's effect(s) on microstructures and properties
   b. Forging
   c. Rolling
   d. Extrusion
   e. Drawing and swaging
   f. Sheet fabrication
6.) Powder metallurgy processes
   a. Discuss design criterion, limitations and advantages of P/M processing
   b. Powder making techniques
   c. Consolidation
   d. Hot working and fabrication
   e. Near-net and net-shape processing
7.) Coatings
   a. Discuss coatings for improved surface properties
   b. Wear resistance
   c. Environmental resistance
8.) Hybrid processes
   a. Spray forming

b. Composites

9.) Joining
   a. Introduce welding, fastening and other methods of joining

10.) Modeling of processes
   a. Deform
   b. Procast
   c. ThermoCalc

11.) Additive Manufacturing/3-D printing
   a. Metallic systems
   b. Casting
   c. Pros and cons

12.) Manufacturing Economics
   a. Examine the economics of materials and process selection for industrial application
   b. Cost of materials
   c. Cost of processing
   d. Selection criterion

Tentative Schedule

Week	Monday	Wednesday	Friday	Chapter
1	Intro	Basic Props	Basic Props	1 & 2
2	Basic Props	Mat'ls Selection	Proc. Sel.	2
3	***Holiday***	Props. of metals/alloys	Props.	3
4	Props	Surfaces	Solidification	4 & 5
5	Solidification	Solidification	***Midterm #1***	5
6	Melting	Melting	Casting	5
7	Casting	Casting Proc.	Wrought Processing	5 & 6
8	Wrought Processing	Forging	***Holiday***	6
9	Rolling	Extrusion	Drawing	7
10	Drawing	***Midterm #2***	PM	11
11	PM	PM	PM	11
12	PM	PM	***Holiday***	--
13	Coatings	Coatings	Hybrid Processing	--
14	Additive Manufacturing	***Holiday***	***Holiday***	--
15	Modeling	Modeling	Mfg Economics	15
16	***Midterm #3***	Mfg Economics	***Reading Day***	16
17	***Final Exam: Thursday, December 14th, 12:30-2:30pm***			