

EMA 4623 – Process Metallurgy (4623/4624)
EMA 6625 – Advanced Metals Processing (1FE2/2FED/CAMP)

T/TH: Periods 8 and 9/9

NEB102

Spring 2021

Instructor: G.E. Fuchs
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Office Hours: TBD

Course 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.

Course Pre-requisite:

EMA 4120 (Phys. Met I)

Course Objective:

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

Course 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 3 credits course. It provides 2 credits towards engineering sciences and 1 credit towards design.

Required Textbooks and Software:

Manufacturing Processes for Engineering Materials – 6th Edition

S. Kalpakjian and S.R. Schmid

Addison-Welse Publishing, Co., Reading, PA

ISBN-13: 978-0134290553

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

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 its 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	Tuesday	Thursday	Chapter
1	Intro	Basic Props	1 & 2
2	Mat'ls Selection	Proc. Sel.	2
3	Props of metals/alloys	Props.	3
4	Surfaces/Solidification	Solidification/Melting	4 & 5
5	Melting/Casting	Midterm #1	5
6	Melting/Casting	Casting/Processing	5
7	Casting Processing	Wrought Processing	5 & 6
8	Forging/Rolling	Extrusion/Drawing	6
9	Rolling/Extrusion	Drawing	7
10	Powder Metallurgy	Midterm #2	11
11	Powder Metallurgy	Additive Manufacturing	--
12	Additive Manufacturing	Coatings	--
13	Hybrid Processing	Modelling	15
14	Modelling	Mfg Economics	15
15	Midterm #3	Reading Day	16
16	Final Exam: Thursday, April 29th, 5:30-7:30pm		

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.

Online Course Recording

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance Policy, Class Expectations, and Make-Up Policy

State whether attendance is required and if so, how will it be monitored? What are the penalties for absence, tardiness, cell phone policy, laptop policy, etc. What are the arrangements for missed homework, missed quizzes, and missed exams? This statement is required: Excused absences must be in compliance with university policies

- 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 above
 Optional final – Thursday, April 29th, 5:30-7:30pm.
 All work must be shown for full/partial credit.
 Questions require thought/common-sense.
 - 3.) Attendance will not be taken during the semester, but if the number of students attending classes during the semesters decreases significantly, pop-quizzes will be given and provide extra credit points to the student attending classes.
 - 4.) Cell phone/laptop use during classes is not permitted unless it is related to the topic being discussed in class. The student will be advised by the instructor the first time excessive use of cell phone/laptops occurs. If the student continues to use their cell phone/laptop during classes, no additional warnings will be given and the student's total score will be reduced 1% for each time it occurs.

	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

- 5.) Extra credit will be included in each midterm.
- 6.) Review sessions before each exam.
- 7.) 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 Sunday, February 28th 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 and/or an electronic copy of the report will be due on last day of class (April 20th). 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 student will be prosecuted for plagiarism and 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 result in an “F” and zero-points on the project for all of the students involved. For graduate students, your course grade will be made up equally of homework (20%), midterms (20% each) and paper (20%). If a grad student takes the optional final exam, the total course grade will be made up equally of homework, midterms, final exam and the paper.

The UF definition of plagiarism can be found at:

http://flexible.dce.ufl.edu/media/flexible.dceufl.edu/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.

More information on UF grading policy may be found at:
<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluer.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest

standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students 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.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.