January 3, 2021

Course Syllabus
EMA 6136 Sections 1FE2, 2FED, CAMP, OVER:
Diffusion, Kinetics, and Transport Phenomena
Spring 2021

Instructor:
Dr. Wolfgang Sigmund
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Telephone: 352-846-3343
Office hours: Fri 10:00 am- 11:00 am and via email.

Teaching Assistant:
Zhuang Wu, wu.zh@ufl.edu, 352-871-1664, https://ufl.zoom.us/j/94142710752 and via Microsoft teams.
Office hours: Wd and Thursdays from 10 am to 11 am.

Course Description: Credits: 3, Physical basis, equation, and theories of diffusion, tracer, chemical, multicomponent, and multiphase diffusion in general force fields.

Prerequisites: EMA 4125 or equivalent.

Course Objectives: Kinetics describes both the phenomenological and microscopic aspects of material behaviors. These include the initiation, evolution, and approach of materials toward thermodynamic equilibrium. It is an extremely broad technical subject that encompasses elements of energy and mass transport, solid mechanics, interfacial science, phase transition theory, and defect structure.

Materials and Supplies Fees
None

Required Textbooks and Software:
D.A. Porter, K.E. Easterling, and M.Y. Sherif, "*Phase Transformations in Metals and Alloys*," 3rd Edition, CRC Press, Boca Raton, FL (2004). [ISBN 978-1-4200-6210-6] Reference later cited as 'P&E.'
M.E. Glicksman, "*Diffusion in Solids: Field Theory, Solid-State Principles and Applications*," John Wiley & Sons, New York (2000). [ISBN 0-471-23972-0]. Reference later cited as 'MEG.'

Recommended Materials
D. Readey, Kinetics in Materials Science and Engineering, 1st edition, CRC Press, Boca Raton, FL, 2017, ISBN 978-1-4822-3566-1. Reference later cited as 'KMSE'.

Course Schedule:

Topics	Reading Material	Lecture estimate/ Exam
1. Introduction: Purpose of the course, policies.		1

2. Thermodynamics and kinetics: Gibbs free energy; chemical potentials; thermal, mechanical, and chemical equilibria. Process driving forces and equilibrium; polymorphism; P-T diagrams; binary phase diagrams. Types of transitions in unary systems: Gibbs Phase rule, phase diagrams. Types of transitions: allotropic; order-disorder, etc. First-order phase transitions; bulk vs. interfacial considerations; rates of transition; kinetic resistances; metastability.	(P&E Ch. 1) and (KMSE Ch. 1-5)	2-7 Exam 1
3.Diffusion: Gradients in composition, mass flux; Fick's 1st law: component fluxes; diffusivity; solutions to the diffusion equation; Fick's 2nd law; mass conservation; divergence of fluxes; boundary conditions; error function solution. Diffusional penetration: applications, diffusivity in isotropic and non-isotropic solids. Planar sources: thin film solution; tracer diffusion; solutions for infinite and semi-infinite systems; growth & dissolution of precipitates; quasi-static approximations: supersaturation. Boundary layers, and diffusion mechanisms in solids; interstitial and substitutional diffusion; vacancy diffusion. Dependences of diffusivity, defects and correlation.	(P&E Ch.2), class notes and (KSME Ch. 8-12) or (MEG Ch. 1-4)	8-19 Exam 2
4. Crystal Interfaces • Surface energy and surface stress • Interfaces and crystal growth • Grain boundaries & interfaces • Normal grain growth	(P&E Ch. 3-4) , class notes and (KSME Ch. 6-7) or (MEG Ch. 3)	20-26 Exam 3
5. Solidification-Phase nucleation • Precipitation and growth kinetics • Grain mobility 6. Diffusional Transformations in solids.	(P&E Ch. 4-5), class notes and (KSME Ch. 13-16) or (MEG Ch.7, 9)	27-36 Exam 4

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: This is an online class and can be studied at any time. Many sessions are pre-recorded and some sessions are live (while being recorded) and will be available to watch at any time later in the semester. Attendance in class is important but is not being monitored. Excused absences must be in compliance with university policies in the Graduate Catalog

(http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance) and require appropriate documentation.
Students are responsible for material presented in lectures, reading assignments, homework, and special distributed notes. Textbooks are available for purchase at the Reitz Union Bookstore and on-line sources.

Homework: Four sets of homework will be assigned and are usually due back two weeks later. The purpose of homework is to give students an opportunity to evaluate and apply their knowledge. Students may collaborate on homework; however, the actual submitted assignment must represent their own work and preparation.
Note: Homework in its entirety must be word processed on your computer. For some problems you will require a suitable math package with graphing capability (*e.g., Excel, MatLab, or others*). Picture files (jpg, etc.) are not accepted. Files have to pdf, doc, docx, or pptx.
Homework needs to be submitted online on e-learning. Email is not acceptable for submission of homework. Hard copies are also not accepted.

Homework will be evaluated on the following basis:
Excellent work: 100
Assignment acceptable: 85
Homework submitted (showing effort): 70
Homework submitted no or small effort: 0
Note - late homework will be accepted with a deduction of 10 points per day late.

Grading:
Four exams are tentatively planned. Exams usually consist of short answer questions to evaluate your familiarity with the course content and some longer problems designed to test your ability to apply concepts to new situations, i.e. to promote critical thinking. Unless otherwise informed, one sheet of prepared personal notes may be used to assist you in completing examinations. In some cases, open-book or take-home exams may be given, and the students will be informed ahead of time. Exam work must be individual; collaboration is never allowed. Observations of cheating will be promptly reported by the exam proctor. Please see UF's statement on academic honesty.
https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/

4 Sets of Homework	20% (5% each)
Term Paper	20%
4 Exams	60% (15% each)

There is no final exam in this class. Exam dates are scheduled (changes possible) at the end of each calendar month.

This course follows current UF grading policies for assigning grade points.

Grading Policy:

Percentage	≥92	≥88	≥84	≥80	≥76	≥72	≥68	≥65	≥62	≥59	≥56	<56
Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E

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

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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.bluera.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.
- HWCOE, Director of Human Resources, 352-392-0903
- 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

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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 suppor*t*, 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.

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Syllabus Changes: I reserve the right to make changes in the syllabus as needed. Any changes will be clearly announced on e-learning and in class.