

## **Materials of Chemical Engineering**

ECH 4824 Section NS01

**Location:** MAEB 0211

**Class Periods:** T, Period 2~3 (8:30 AM ~ 10:25 AM)

**Academic Term:** Fall 2023

### ***Instructor:***

Prof. Peng Jiang

[pjiang@che.ufl.edu](mailto:pjiang@che.ufl.edu)

(352) 392-2189

Chemical Engineering Building, Room 319

Office Hours: R, 1:00 PM ~ 3:00 PM.

### ***Teaching Assistant/Peer Mentor/Supervised Teaching Student:***

None.

### ***Course Description***

Relations between microscopic structure and macroscopic mechanical, thermal and electrical properties of organic and inorganic solids. Engineering applications, including corrosion. (Credits: 2)

### ***Course Pre-Requisites / Co-Requisites***

ECH 3023 (Material and Energy Balances) and ECH 4123 (Phase and Chemical Equilibria)

### ***Course Objectives***

Upon completion of this course, a student should be able to:

- a. Have a broad technical understanding of material properties, behavior, and processing
- b. Define the mathematical expressions that define material behavior such as electrical conductivity, stress, strain, Young's modulus
- c. Qualitatively describe how material performance can be enhanced by controlling the atomic and molecular structure of the material
- d. Apply chemical engineering science (e.g., thermodynamics, transport, and kinetics) to understanding of materials processing, properties, and failure
- e. Estimate how much force can be applied before a specific material fails
- f. Identify modes of failure and conditions conducive to material failure
- g. Describe methods for characterizing the structure and properties of materials
- h. Give examples of the importance of material properties as they benefit mankind
- i. Give examples of the role material failure has played in technological disasters
- j. Select materials of construction appropriate to specific operating environments
- k. Work ethically with other students, both engaging in discussions and group reports and working independently.

### ***Materials and Supply Fees***

None

### ***Professional Component (ABET):***

The contribution of the course to meeting the professional components of the ABET-accredited degree is as follow.

- A. To instill technical competence in mathematics, science, and engineering
- B. To develop problem solving skills
- C. To develop an ability to apply knowledge to practice
- D. To instill an ability to design a component, unit, or process that meets performance specifications
- E. To develop an ability to design and to conduct experiments, as well as to analyze and interpret the data
- F. To instill an ability to use the techniques, skills, and modern engineering tools necessary for chemical engineering practice

- G. To develop communication skills
- H. To instill an ability to work well with others, including coworkers of different disciplines and coworkers of different nationality or cultural background
- I. To instill professional ethics
- J. To provide opportunities to obtain the broad background, including contemporary issues, necessary to understand the impact of engineering solutions in a global and societal context.
- K. To instill an ability to engage in life-long learning

**Relation to Program Outcomes (ABET):**

Program Objectives →	A	B	C	D	E	F	G	H	I	J	K
↓ Course Objectives											
a	×					×					
b	×	×				×					
c	×	×	×	×		×					
d	×	×	×			×					
e	×	×	×	×		×					
f	×	×	×	×		×					
g	×	×	×	×	×	×					
h	×					×			×	×	×
i	×					×	×	×	×	×	×
j	×		×	×		×					
k							×	×	×		

**Required Textbooks and Software**

- Title: Foundations of Materials Science and Engineering
- Author: William F. Smith and Javad Hashemi
- Publication date and edition: 2010 and 5th edition
- ISBN number: 978-0-07-352924-0

**Recommended Materials**

- Title: Introduction of Materials Science and Engineering
- Author: James F. Shackelford
- Publication date and edition: 2000 and 5<sup>th</sup> edition
- ISBN number: 0-13-011287-9

**Course Schedule**

Wk	Date	Topics	Reading
1	Aug 29	Introduction and course overview Chap 3: Unit cells, Crystal systems Chap 3: Principal metallic crystal structures, Atomic positions	3.1 ~ 3.2 3.3 ~ 3.4
2	Sept 5	Chap 3: Direction indices, Miller indices, Polymorphism Chap 3: Crystal structure analysis, Amorphous materials HW#1 Assigned (Chapter 3)	3.5, 3.6, 3.8, 3.10 3.11 ~ 3.12
3	Sept 12	Chap 4: Solidification of metals Chap 4: Solidification of single crystals, Metallic solid solutions <b>Quiz #1 (Covering Chapter 3), HW#1 due</b>	4.1 4.2 ~ 4.3
4	Sept 19	Chap 4: Crystalline imperfections Chap 5: Rate processes in solids HW#2 Assigned (Chapter 4)	4.4 5.1

5	Sept 26	Chap 5: Atomic diffusion in solids Chap 5: Applications of diffusion processes, Effects of temperature on diffusion in solids <b>HW#2</b> due, HW #3 Assigned (Chapter 5)	5.2 5.3 ~ 5.4
6	Oct 3	Chap 6: Processing of metals and alloys Chap 6: Stress and strain, Tensile test, Hardness and testing <b>Quiz #2</b> (Covering Chap 4 & 5), <b>HW #3</b> due	6.1 6.2 ~ 6.4
7	Oct 10	Chap 6: Plastic deformation of single and polycrystalline metals Chap 6: Strengthening, recovery and recrystallization HW #4 Assigned (Chapter 6)	6.5 ~ 6.6 6.7 ~ 6.8
8	Oct 17	Chap 13: Electrochemical corrosion, Galvanic cells <b>Mid-term Exam</b> (Covering Chapters 3-6), <b>HW #4</b> due	13.1 ~ 13.3
9	Oct 24	Chap 13: Corrosion rates, Types of corrosion, Oxidation of metals, Corrosion control HW #5 Assigned (Chapter 13)	13.4 ~ 13.7
10	Oct 31	Chap 10: Polymerization reactions, Polymerization methods, Solidification of thermoplastics, Processing of polymer <b>Quiz #3</b> (Covering Chap 13), <b>HW #5</b> due	10.1 ~ 10.5
11	Nov 7	Chap 10: Thermoplastics, Thermosetting plastics, Elastomers, Deformation of plastic materials HW #6 Assigned (Chapter 10)	10.6 ~ 10.10
12	Nov 14	Chap 14: Electrical conduction in metals, Energy band model, Intrinsic and extrinsic semiconductors <b>Quiz #4</b> (Covering Chap 10), <b>HW #6</b> due	14.1 ~ 14.4
13	Nov 21	Chap 14: Semiconductor devices, Microelectronics HW#7 Assigned (Chapter 14)	14.5 ~ 14.6
14	Nov 28	Chap 14: Microfabrication and Nanofabrication <b>HW #7</b> due	
15	Dec 5	Advanced topics of materials	
16	Dec 15 (10:00 AM ~ 12:00 PM)	<b>Final Exam</b> (Covering Chapters 3-6, 10, 13, and 14)	

### ***Attendance Policy, Class Expectations, and Make-Up Policy***

Attendance of all lectures is highly recommended. It is the student's responsibility to obtain any notes, assignments, etc. that they may have missed during their absence. Repeated absences may lead to a lower grade in the class. Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

As a courtesy to the other students and to the instructor, the students should turn off the ringers for all cell phones during lecture and they should not answer incoming calls. If a student is expecting an emergency call, please notify the instructor prior to class.

Makeup exams and quizzes will be given only in case of an emergency – documentation of the emergency has to be provided. It is required that, whenever possible, the student notifies the instructor about the situation prior to the exam, preferably at least two weeks in advance.

### ***Evaluation of Grades***

<b>Assignment</b>	<b>Total Points</b>	<b>Percentage of Final Grade</b>
Homework Sets (7)	100 each	0%
Quizzes (4)	100 each	20%
Mid-term Exam	100	40%
Final Exam	100	40%
<b>Total</b>		<b>100%</b>

Homework sets: 7 homework sets will be assigned throughout the semester. Homework will not be graded. The homework solutions will be posted on the class website 1 week after the assignment date.

Quizzes: 4 quizzes (15 minutes each) are equally weighted. All quizzes will be closed book and closed notes, and will be closely proctored by the instructor and the teaching assistant.

Mid-term and final exams: The two-hour mid-term exam and two-hour final exam will be closed book and closed notes. You will be allowed to bring one sheet of paper (8.5×11 inch, one side only) for formulas. Partial credit will be assigned, and no credit will be given for problems that have a solution but all the work leading to this solution is not shown. All online exams will be closely proctored by the instructor and the teaching assistant.

### ***Grading Policy***

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
100 - 90	A	4.00
85 - 89	A-	3.67
80 - 84	B+	3.33
75 - 79	B	3.00
70 - 74	B-	2.67
65 - 69	C+	2.33
60 - 64	C	2.00
55 - 59	C-	1.67
50 - 54	D+	1.33
45 - 49	D	1.00
40 - 44	D-	0.67
0 - 39	E	0.00

More information on UF grading policy may be found at:

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

### ***Students Requiring Accommodations***

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure 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.ua.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.ua.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://www.dso.ufl.edu/sccr/process/student-conduct-honor-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](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

All class sessions will be 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.

### ***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](mailto: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](mailto: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](mailto: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://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

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