

## Materials of Chemical Engineering

ECH 4824 Section 24170

**Class Periods:** T | Period 2 – 3 (8:30 AM – 10:25 AM)

**Location:** MAEB 211

**Academic Term:** Fall 2021

### **Instructor:**

Kirk Ziegler

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421 ChE

Office Hours: W 3 – 5 PM

### **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 the student should be able to:

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

### **Materials and Supply Fees**

None

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

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

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Medium
3. An ability to communicate effectively with a range of audiences	

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	High

\*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

### **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 5th edition  
ISBN number: 0-13-011287-9

### **Tentative Course Schedule**

<b>Week</b>	<b>Date</b>	<b>Topics</b>	<b>Reading</b>
1	Aug 24	Introduction to Materials Science Atomic Structure	Sections 1.1 – 1.7; Sections 2.1 – 2.10
2	Aug 31	Crystal and Amorphous Structure	Sections 3.1 – 3.6
3	Sept 7	Crystal and Amorphous Structure	Sections 3.7 – 3.13
4	Sept 14	Solidification and Crystalline Imperfections	Sections 4.1 – 4.6
5	Sept 21	Thermally Activated Processes and Diffusion	Sections 5.1 – 5.5
6	Sept 28	Instrumentation Mechanical Properties of Metals I Mechanical Properties of Metals II	Sections 6.1 – 6.4; Sections 7.1 – 7.8
7	Oct 5	Polymeric Materials	Sections 10.1 – 10.6
8	Oct 12	Polymeric Materials	Sections 10.7 – 10.13
9	Oct 19	Composite Materials	Sections 12.1 – 12.12
10	Oct 26	Self-repair of Materials (Corrosion)	Sections 13.1 – 13.8
11	Nov 2	Top-down and bottom-up assembly of transistors (Electrical Properties of Materials)	Sections 14.1 – 14.10
12	Nov 9	AICHE Conference (NO Class)	
13	Nov 16	Photonics/Lasers/LEDs (Optical Properties of Materials)	Sections 15.1 – 15.7
14	Nov 23	Solar Cells	
15	Nov 30	Batteries & Supercapacitors	
16	Dec 7	Thermoelectrics	
<b>Final</b>	<b>Dec 16</b>	<b>Final Exam</b>	<b>7:30 – 9:30 AM</b>

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

Attendance of all online 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/UGRD/academic-regulations/attendance-policies/>) 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 class and they should not answer incoming calls. If a student is expecting an emergency call, please notify the instructor prior to class.

Students who do not attend an exam at the scheduled time will receive a score of zero for that exam. Exceptions will be made only in extraordinary circumstances, such as religious holidays or emergencies. 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>Percentage of Final Grade</b>
Homework	0%
Quizzes	35%
Final Exam	30%
Short Project	35%
	100%

**Homework:** Homework will be assigned throughout the semester but will not be graded. The homework solutions will be posted on the class website after the assignment due date but before any quizzes.

**Quizzes:** Quizzes will be assigned throughout the semester. The material on quizzes will cover problems closely related to the previous homework assignment. No make-up quizzes will be given. Excused absences will not count against the final grade. Each quiz is equally weighted. All quizzes will be approximately 15 – 20 min and be closed book and closed notes.

**Final exam:** The final exam will be closed book and closed notes. No credit will be given for problems that have a solution but all the work leading to this solution is not shown.

**Short Project:** Students must choose to complete a short project on either instrumentation, polymers, advanced materials, or energy. All project reports should be single spaced and include (as appropriate) figures, equations, and references to support the ideas and conclusions. *NOTE: Internet references are not acceptable or reliable resources.* A page limit of 10 pages needs to be adhered to strictly. Project reports that go over the page limits will not be graded. All ideas and concepts that are not your own should be referenced or it is considered plagiarism, as discussed separately below. The reference section is not included in the page limit. Each project report will be submitted electronically through the E-learning website.

### **Grading Policy**

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00

70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	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 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/>.

### ***In-Class Recording***

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***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.

### ***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.

A non-passing letter grade will be assigned to students who violate academic honesty standards, regardless of the violator's performance on exams, quizzes, and homework assignments. Official sanctions issued by the Office of Student Judicial Affairs will become permanently noted in the student's official transcript.

### ***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
- Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@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: <https://registrar.ufl.edu/ferpa.html>

### ***Campus Resources:***

#### ***Health and Wellness***

- The University expects you to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF

Student Health Care Center at 352-392-1161 (or email [covid@shcc.ufl.edu](mailto:covid@shcc.ufl.edu)) to be evaluated for testing and to receive further instructions about returning to campus.

- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

**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:** <https://counseling.ufl.edu>, 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://career.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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

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