# Materials of Chemical Engineering

ECH 4824 Section 18417
***Location:*** WEIM 1064
***Class Periods:*** Thursdays, Periods 8,9 (3:00 PM - 4:55 PM)
***Academic Term:*** Fall 2025

***Instructor:***
Prof. Dmitry Kopelevich
dkopelevich@che.ufl.edu
(352) 392-4422
CHE Admin Building 110
Office Hours: Wednesdays, 3:00 - 5:00 PM.
- Please book appointments outside this time via email

***Teaching Assistant/Peer Mentor/Supervised Teaching Student:***
Aniela Nozka
Email: anozka@ufl.edu
Office Hours: TBA

***Course Description***
2 credit hours. Relations between microscopic structure and macroscopic mechanical, thermal and electrical properties of organic and inorganic solids. Engineering applications, including corrosion.

***Course Pre-Requisites***
ECH 3264 Elementary Transport Phenomena

***Required Textbooks and Software***
- Title: Foundations of Materials Science and Engineering
- Author: William F. Smith and Javad Hashemi
- Publication date and edition: 7th edition (2023)
- ISBN number: 978-1-260-72149-2

***Materials and Supply Fees***
None

***Course Objectives***
1. Upon completion of this course, a student should be able to:
2. Explain material properties, behavior, and processing.
3. Formulate mathematical expressions that define material behavior such as electrical conductivity, stress, strain, Young's modulus.
4. Qualitatively describe how material performance can be enhanced by controlling the atomic and molecular structure of the material.
5. Apply chemical engineering science (e.g., thermodynamics, transport, and kinetics) to understand materials processing, properties, and failure.
6. Estimate how much force can be applied before a specific material fails.
7. Identify modes of failure and conditions conducive to material failure.
8. Describe methods for characterizing structure and properties of materials.
9. Give examples of the importance of material properties as they benefit mankind.
10. Give examples of the role material failure has played in technological disasters.
11. Select materials of construction appropriate to specific operating environments.
12. Work ethically with other students, both engaging in discussions and working independently.

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

| 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 | Medium |

***Course Schedule***

| Week | Date | Topics | Reading |
|---|---|---|---|
| 1 | 8/21/2025 | Introduction and course overview<br>Unit cells, Crystal systems<br>Principal metallic crystal structures<br>Atomic positions | <br>3.1 - 3.2<br>3.3<br>3.4 |
| 2 | 9/4/2025 | Direction indices<br>Miller indices<br>Polymorphism<br>Crystal structure analysis<br>Amorphous materials<br>HW#1 Assigned (Chapter 3) | 3.5<br>3.6<br>3.8, 3.10<br>3.11<br>3.12 |
| 3 | 9/11/2025 | Chap 4:Solidification of metals<br>Chap 4: Solidification of single crystals<br>Metallic solid solutions<br>**Quiz #1 (Covering Chapter 3)** | 4.1<br>4.2<br>4.3 |
| 4 | 9/18/2025 | Crystalline imperfections<br>Rate processes in solids<br>HW#2 Assigned (Chapter 4) | 4.4<br>5.1 |
| 5 | 9/25/2025 | Atomic diffusion in solids<br>Industrial applications of diffusion processes<br>Effects of temperature on diffusion in solids<br>HW #3 Assigned (Chapter 5) | 5.2<br>5.3<br>5.4 |
| 6 | 10/2/2025 | Processing of metals and alloys<br>Stress and strain in metals<br>Tensile test; stress-strain diagram<br>Hardness and hardness testing | 6.1<br>6.2<br>6.3<br>6.4 |

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|---|---|---|---|
| | | **Quiz #2 (Covering Chapters 4 & 5)** | |
| 7 | 10/9/2025 | Plastic deformation of single and polycrystalline metals<br>Strengthening, recovery and recrystallization<br>HW #4 Assigned (Chapter 6) | 6.5 - 6.6<br>6.7 - 6.8 |
| 8 | | **Mid-term Exam (Covering Chapters 3-6)** | |
| | 10/16/2025 | Electrochemical corrosion, Galvanic cells | 13.1 - 13.3 |
| 9 | 10/23/2025 | Corrosion rates<br>Types of corrosion<br>Oxidation of metals<br>Corrosion control<br>HW #5 Assigned (Chapter 13) | 13.4<br>13.5<br>13.6<br>13.7 |
| 10 | 10/30/2025 | Polymerization reactions<br>Industrial polymerization methods<br>Solidification of thermoplastics<br>Processing of polymers<br>**Quiz #3 (Covering Chapter 13)** | 10.1 - 10.2<br>10.3<br>10.4<br>10.5 |
| 11 | 11/6/2025 | Thermoplastics<br>Thermosetting plastics<br>Elastomers<br>Deformation and strengthening of plastic materials<br>HW #6 Assigned (Chapter 10) | 10.6 - 10.7<br>10.8<br>10.9<br>10.10 |
| 12 | 11/13/2025 | Electrical conduction in metals<br>Energy band model for electrical conduction<br>Intrinsic and extrinsic semiconductors<br>**Quiz #4 (Covering Chapter 10)** | 14.1<br>14.2<br>14.3 - 14.4 |
| 13 | 11/20/2025 | Semiconductor devices<br>Microelectronics<br>HW#7 Assigned (Chapter 14) | 14.5<br>14.6 |
| | 12/9/2025<br>3 - 5 pm | **Final Exam (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/UGRD/academic-regulations/attendance-policies/) and require appropriate documentation.
- Exams and quizzes will be rescheduled only for those students who missed them due to an acceptable reason, such as illness, serious family emergencies, military obligation, religious holidays, participation in official university activities, travel to a student conference or a job interview. Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/
- Students arriving late for a quiz/exam will be given only the balance of time remaining to complete their work unless an acceptable reason (see above) is provided.
- HOW TO SEND A REQUEST FOR AN EXCUSED ABSENCE:
  - Email Dr. Kopelevich at dkopelevich@che.ufl.edu
  - Please inform the instructor about a planned absence at least 24 hours ahead of time.

***Evaluation of Grades***

| Assignment | Total Points | Percentage of Final Grade |
|---|---|---|
| Homework Sets (7) | 100 each | 10% |
| Quizzes (4) | 100 each | 20% |
| Mid-term Exam | 100 | 35% |
| Final Exam | 100 | 35% |
| **Total** | | 100% |

- **Homework sets:** 7 homework sets will be assigned throughout the semester. Homework solutions will be posted on the class website after the due assignment date. Late submissions will incur a penalty of 10% per day unless there is a justifiable reason consistent with the University policy.
- **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.
- **Mid-term and final exams:** The two-hour mid-term exam and two-hour final exam will be closed book and closed notes. 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 exams will be closely proctored by the instructor.

***Grading Scale***

- These percentages will earn you a letter grade of *at least*

| Percent | Grade | Grade Points |
|---|---|---|
| 90.0 - 100 | A | 4.00 |
| 85.0 – 89.9 | A- | 3.67 |
| 80.0 - 84.9 | B+ | 3.33 |
| 75.0 - 79.9 | B | 3.00 |
| 70.0 - 74.9 | B- | 2.67 |
| 65.0 – 69.9 | C+ | 2.33 |
| 60.0 – 64.9 | C | 2.00 |
| 55.0 - 59.9 | C- | 1.67 |
| 50.0 - 54.9 | D+ | 1.33 |
| 45.0 - 49.9 | D | 1.00 |
| 40.0 - 44.9 | D- | 0.67 |
| 0 - 39.9 | E | 0.00 |

- The instructor guarantees these grades if you earn the posted percentages.
- The instructor may decide to *lower* the thresholds for the grades listed, based upon a curve. The instructor may employ a curve only to lower these thresholds.
- In borderline cases, class attendance and participation will be considered.
- **Note that academic honesty violations will result in a severe grade penalty, including assignment of an E in the course.**
- More information on UF grading policy may be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

***Commitment to a Positive Learning Environment***

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values.

If you feel like your performance in class is being impacted, please contact your instructor or any of the following:
- Your academic advisor or Undergraduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu

***Academic Policies & Resources***

More information on UF academic policies and campus resources is available at https://go.ufl.edu/syllabuspolicies.