

ChE 375 – Structure, Properties and Processing of Materials Fall 2017

Instructor: Dr. Kathleen McEnnis **Office:** 382 Tiernan Hall **Email:** mcennis@njit.edu

Office Hours: **Monday:** 1:00 – 2:00 PM; **Thursday:** 10:30 AM – 11:30 AM.
Other hours by appointment only

Text: Fundamentals of Materials Science and Engineering: An Integrated Approach, 5th Edition, W.D. Callister, Jr., and D.G. Rethwisch, John Wiley and Sons, Inc. (2016).
ISBN 978-1-119-175483

Class: Tuesday 8:30-9:55 AM Room CKB 317
Thursday 8:30-9:55 AM Room CKB 317

Course: Tailoring materials properties by engineering their microscopic/macroscopic structures via processing is central to product design and development in the chemical industry. This course introduces the principles of materials engineering from the perspective of structure-property-processing relationships. Instead of covering different types of materials separately, this course will use the principles common to engineering of all important materials as an underlying theme. These are atomic/molecular structure, nanoscale, morphology, principles of phase transformation, structure development during processing, and property dependence on structure. All these topics will be introduced through the paradigm of comparing metals, ceramics and polymers. Besides single component systems, advanced materials such as multiphase and/or multi component systems, (e.g. composites and gels) and nanomaterials will be discussed based on these principles. An integral part of this course will be the criteria for selection of materials for the chemical process industry.

Prerequisites: Chem 236 or Chem 235

Withdraw Deadline: November 6, 2017

Homework: Homework assignments will be given. The assignments will be emailed to the class or posted on Moodle. Solutions to the problems will be emailed or posted on Moodle. After the homework assignments have been given, similar problems will be assigned in class (closed book) as a quiz.

Exams: There will be three exams and one final exam.

GRADING

3 Exams [closed or open book]	60%
Final	30%
Assignments and Quizzes	<u>10%</u>
	100%

Grades will be based on:

A: 90 – 100%
B+: 85 – 89%
B: 80 – 84%
C+: 70 – 79%
C: 60 – 69%
D: 50 – 59%
F: 0 – 49%

Note: NJIT Honor Code will be upheld and any violations will be brought to the attention of the Dean of Students. Students will be informed regarding modifications or deviations from the syllabus.

Course Objectives: Students will be able to:

- Identify the different properties and applications of metals, ceramics, polymers and composites.
- Describe the differences in atomic/molecular structure between crystalline and noncrystalline materials
- Describe the general types of polymer molecular structures and how they relate to properties.
- Identify and describe imperfections including defect structures and grain boundaries and dislocations of materials.
- Explain diffusion properties, thermal properties, mechanical properties, and failure mechanisms in different materials.
- Apply principles of phase diagrams and phase transformations to design and control engineering problems.
- Select materials for various applications.
- Explain the role of processing on materials properties.
- Explain the mechanism of corrosion of materials as well as methods for control and prevention of corrosion.

Topics

Section I:

Structure and Morphology

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| 1. Introduction | Chapter 1 |
| | Chapter 2 |
| 2. Metallic/Ceramic Structures | From Chapter 3 |

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| 3. Polymer Structures | From Chapter 4 |
| 4. Imperfections in Solids | From Chapter 5 |
| 5. Diffusion | Chapter 6 |

Exam 1 Thursday, October 5

Section II: Properties-Phase Transitions

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| 6. Mechanical Properties | Chapter 7 |
| Deformation/Strengthening Mechanism | Chapter 8 |
| 7. Phase Diagrams | Chapter 10 |
| 8. Phase Transformations | Chapter 11 |

Exam 2 Thursday, November 2

Section III: Types and Fabrication of Materials

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| 9. Types and application of materials | Chapter 13 |
| 10. Introduction to fabrication of materials- | Chapter 14 |
| Synthesis and fabrication of Polymers | |
| Property modification with composite materials | Chapter 15 |

Section IV: Material Selection for Product Design

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| 11. Corrosion in metals and ceramics- | Chapter 16 |
| Polymer Degradation | |
| 12. Thermal Properties | Chapter 17 |

Exam 3 Thursday, November 30

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| 13. Economic, Environmental and Social Issues | Chapter 20 |
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Final Exam TBA (will take place during the December 15 - December 21 Final Exam period)

Exam dates and topics may be subject to change.

If you need accommodations due to a disability please contact Chantonette Lyles, Associate Director of Disability Support Services, Fenster Hall Room 260 to discuss your specific needs. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.