**Course Syllabi:**

**ChE 375 – Structure, Properties and Processing of Materials**

**Fall 2018**

**Instructor**

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**Course Description**

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.

**Teaching Assistant(s): NA**

**Prerequisites**

Chem 236 and Chem 235

**Text Book**

* 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)

**Course Objectives**

1. Identify the different properties and applications of metals, ceramics, polymers and composites.
2. Describe the differences in atomic/molecular structure between crystalline and noncrystalline materials
3. Describe the general types of polymer molecular structures and how they relate to properties.
4. Identify and describe imperfections including defect structures and grain boundaries and dislocations of materials.
5. Explain diffusion properties, thermal properties, mechanical properties, and failure mechanisms in different materials.
6. Apply principles of phase diagrams and phase transformations to design and control engineering problems.
7. Select materials for various applications.
8. Explain the role of processing on materials properties.
9. Explain the mechanism of corrosion of materials as well as methods for control and prevention of corrosion.
10. Develop presentation skills and foster team work
11. Develop ability to search literature and learn critical reading
12. Identify economic, environmental and societal Issues in Materials Sci. and Eng

**Target Enrollment**

35 students

**Grading Criteria**

* Assignments and Quizzes 10%
* 3 Exams 57%
	+ Exam 1 19%
	+ Exam 2 19%
	+ Exam 3 19%
* Group Presentation 3%
* Final Exam 30%

Grading 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%

* Students are expected to come to class having read the assigned material, completed the assignment, and well prepared to engage in dialogue regarding the assigned material. All reading and other preparatory assignments must be completed by their due date(s).
* The **total number** of Quizzes and the **format and scheduling of each** **QUIZ** will be determined by the Instructor, and **could vary** (e.g., **announced** **and/or unannounced**).
* There will be **NO MAKE-UP,** if you miss a Quiz or Assignment, an Exam or the Group Presentation. You will receive a **ZERO**.
* **The Final Exam** will take place during the **NJIT Final Exam Period (**December 15 - December 21). Students are expected to be present during this period and should make their travel plans accordingly. There will be **NO MAKE-UP** for the Final Exam

**Disability Support Services**

NJIT provides disability support services in the campus. 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.

**Course Format**

The course will be lecture with extensive participation between students and the instructor. The following is the tentative Course Schedule.

**Note that the actual course content for each week will be subject to alterations to accommodate scheduling needs.**

**Course Schedule (SUBJECT TO CHANGE)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Month** | **Day** | **Chapters** | **Topics** | **Quiz** |
| Sept | 3 | Labor Day  | **No Class** |  |
| Sept | 5 | Chp 1 & 2 | Introduction + Atomic Structure and Interatomic Bonding |  |
| Sept | 10 | Chp 3 | Structures of Metals and Ceramics | Quiz 1 (Chp 1&2) |
| Sept | 12 | Chp 3 | Structures of Metals and Ceramics |  |
| Sept | 17 | Chp 4 | Polymer Structures | Quiz 2 (Chp 3) |
| Sept | 19 | Chp 4 & 11 | Polym. Struc. + Cryst, Melting and Tg  |  |
| Sept | 24 | Chp 5 | Imps in Solids | Quiz 3 (Chp 4+11) |
| Sept | 27 | Chp 5 | Imps in Solids + Sample Questions |  |
| Oct | 1 | **EXAM I** | From Chp 1 - 5 |  |
| Oct | 3 | Chp 7 | Mechanical Properties |  |
| Oct | 8 | Chp 7 | Mechanical Properties |  |
| Oct | 10 | Chp 9 (9.2-8) | Failure: Fracture | Quiz 4 (Chp 7) |
| Oct | 15 | Chp 8 | Deformation and Strengthening Mech. |  |
| Oct | 17 | Chp 8 | Deformation and Strengthening Mech. | Quiz 5 (Chp 9) |
| Oct | 22 | Chp 10 | Phase Diagrams |  |
| Oct | 24 | Chp 10 | Phase Diagrams | Quiz 6 (Chp 8) |
| Oct | 29 |   | video lecture + Sample Questions |   |
| Oct | 31 | **EXAM 2** | From Chp 7 - 10 |   |
| Nov | 5 | Chp 11 | Phase Transformations |  |
| Nov | 7 | Chp 11 | Phase Transformations |  |
| Nov | 12 | Chp 13 | **Student Group Presentations**  |  |
| Nov | 14 | Chp 14 & 15 | Synth, Fab and Proc of Mat +Comp. | Quiz 7 (Chp 11) |
| Nov | 19 | Chp 15 | Composites |  |
| Nov | 21 |  | **Friday Classes Meet - No Class** |  |
| Nov | 26 | Chp 16 | Corrosion and Degradation of Materials | Quiz 8 (Chp 14&15) |
| Nov | 28 | Chp 17 | Thermal Properties |  |
| Dec | 3 | **EXAM 3** |  |  |
| Dec | 5 | Chp 18 & 19 | Mag. and Opt. Properties of Materials |  |
| Dec | 10 | Chp 18 & 19 | Mag. and Opt. Properties of Materials | Quiz 9 (Chp 17, 18, 19) |
| Dec | 12 | Chp 20 | Economic, Environmental and Societal Issues in Materials Science and Engineering | Quiz 9 (Chp 17, 18, 19) |