EGN 3365 MATERIALS in ENGINEERING
Fall 2017, Session U01 (83590)

Basic Information

Instructor: Dr. Zhe Cheng Phone: 305-348-1973 Email: zhcheng@fiu.edu
Office: **EC3441** Office Hours: Tue, Thu 9:00-11:00 or by appointment
Class Hours & Classroom: Wed, Fri, 13:00-14:50 in EC1115
Prerequisites: CHEM1045 General Chemistry I; MAC 2311 Calculus I; PHY 2048 Physics with Calculus I
Course website: https://ac.fiu.edu/teaching/egn3365/
Whatsapp chat group link: https://chat.whatsapp.com/KPGswjJSbpR2A3yQWjQH1H

Course Description

A general introductory course to basic concepts and methods in materials engineering, covering fundamental concepts including crystal structure, defects, diffusion, phase diagram and phase transformation, corrosion as well as properties (focusing on mechanical properties) and practical processing and applications of major categories of engineering materials including metals and alloys, ceramics and glass, polymers, and composites.

Course Objective

The main objective of EGN3365 Materials in Engineering is to introduce the basic concepts and methods in materials engineering to undergraduate engineering students and help students develop preliminary understanding of the inter-relationships between composition, processing, structure, properties, and performance for common solid-state engineering materials.

Textbook & Other Course Materials

- Materials Science and Engineering An Introduction, by William D. Callister, Jr. and David G Rethwisch, John Wiley & Sons Inc, 9th ed. (2014) (**other editions are also OK**)
  Wiley links for book purchase/rental (9th ed):
  http://www.wiley.com/WileyCDA/WileyTitle/productCd-EHEP002505.html
  CourseSmart online e-text rental (9th ed): http://www.coursesmart.com//9781118324578

Grading

- ❑ Homework (10 points)
- ❑ Attendance (8 points; in the form of class exercises)
- ❑ Group presentation (7 points)
- ❑ Three exams (25 points for each)
- ❑ Overall grade: A:>=90; A-:87-89.9; B+:84-86.9; B:80-83.9; B-:77-79.9; C+:74-76.9; C:67-73.9; D: 60-66.9; F: <60
- ❑ No rounding-up or curving

Course Policy

- ❑ Attendance required; Cell phones and other device on silent mode
- ❑ Students can discuss homework problems, but must independently finish it
- ❑ Quizzes will be given for evaluation purpose only and will not count towards final grades
- ❑ Exams will be closed-book. No electronic device. 1 page formula/concept sheet allowed

- ❑ Grade discrepancies – resolve within the next business day
- ❑ Request for "make-up" exams will NOT be accepted unless *convincing, life-threatening* emergency occurred and an official note of the life-threatening condition will be needed.
  - Excuses based on doctor's notes for symptoms such as (not limited to) cold, flu, headache, panic strike, or traffic accident, or family issues will NOT be accepted – It has to be life-threatening emergency with convincing evidence.
- ❑ Accommodate disability (http://drc.fiu.edu/) or religious holidays
- ❑ NO cheating or plagiarizing in ANY form (Check with me if questions)
  - No excuses will be accepted
  - Will be reported and handled according to FIU policy
  - FIU policy at https://ugrad.fiu.edu/academic_misconduct/Pages/Home.aspx

Specific Learning Objectives for the Course

Specifically, through this course, the students are expected to (adapted from syllabuses by Dr. Kinzy Jones and Dr. Jiuhua Chen):

- Describe briefly ionic, covalent, metallic *bonds*; understand the general use of the periodic table and how it relates to electron states.
- Understand the concept of *crystal structure* of crystalline materials. Be able to draw unit-cell structures and derive relationships unit-cell length and atomic radius, compute densities based on cell structure, and specify Miller indices for planes within unit cells for simple crystalline structures.
- Describe briefly *defects* in crystals including point defects, dislocations, and planar defects. Understand how defects influence mechanical properties of metallic materials.
- Understand *diffusion* phenomena and be able to use Fick's first and second laws for simple cases and define all parameters and simple applications.
- Understand the meaning and use of common *mechanical properties* of materials including yield strength, ultimate tensile strength, Poisson's ratio, ductility and elongation.
- Understand the meaning and use of *phase diagrams* for binary systems and be able to determine phases present, the composition of the phases, and the mass fraction of the phases.
- Understand the effect of *kinetics* on the phase transformation and materials *microstructure* and the resulting mechanical properties
- Understand the basic properties of *metals* and their processing and applications
- Understand the basic properties of *ceramic and glass* materials and their processing and applications.
- Understand the basic properties of *polymer* materials and their processing and applications. Understand the difference of thermoplastics and thermosets and methods of polymer formation
- Understand the basic concepts in composites and the major types of *composite* materials and their properties and applications
- Understand basic concepts involving metal *corrosion* and be able to use standard electrode potential provided to solve simple corrosion problems.

ME Program Educational Objectives

- Broad and in-depth knowledge of engineering science and principles in the major fields of Mechanical Engineering for effective engineering practice, professional growth, and as a base for life-long learning
- The ability to communicate effectively and to articulate technical matters using verbal, written, and graphic techniques
- The ability to utilize analytical and experimental methods and modern computer technology for decision making, engineering design, and to solve realistic engineering problems
- A sense of professional and social responsibility, including a commitment to protect both occupational and public health and safety, developed through consideration of moral, social, and ethical paradigms related to the engineering profession and practice.

MME Program Outcomes

A. Ability to apply knowledge of mathematics, science, and engineering**.**
E. Ability to identify, formulate, and solve engineering problems.
G. Ability to communicate effectively.
I. Recognition of the need for, and an ability to engage in, lifelong learning.
K. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
M. Knowledge of mathematics and of basic and engineering science necessary to carry out analysis and design appropriate to Mechanical Engineering.

Group Presentation

- ❑ A 12 min max presentation (~12 slides) about materials evolution/development **of interest to you**
  - It should be based on one of the two formats below:
    - **The evolution/development of a SPECIFIC MATERIAL (e.g., man-made diamond), or**
    - **The evolution of materials used for a SPECIFIC APPLICATION (e.g., materials for solar cell light absorber)**
  - It should have most of the following (but NOT necessary all)
    - ✓ Introduction
    - ✓ Materials development (may have multiple generations)
      - The original material and/or application and its limitations
      - New materials or processing used in practice (i.e., in manufacturing) and how and why it exceed original materials
      - Limitations with the new materials/processing, if any
    - ✓ Conclusions and/or directions for future R&D for that material or application
    - ✓ Contribution of each member (e.g., literature survey, PowerPoint file preparation, others)
- ❑ Dates:
  - **11/09/2017** class: Group presentation topics due
  - **12/06/2017** and **12/09/2017** classes: oral presentation
- ❑ Grouping: **each group should have 3 or 4 students,** form group on your own
- ❑ Grading: 7 points maximum and all group members get the same grades

- **IMPORTANT**: The group presentation needs to be at the **college level**, quantitative, and showing the concepts/knowledge learned in this class and not remaining at the middle-school or even primary school level!!

Tentative Schedule & Key Dates

Week	Date	Day	Hour	Cumulative hour	Textbook Section(s)	Content
1	8/23	W	1.83	1.83	Chapter 1, 2	Introduction; Atomic structure
1	8/25	F	1.83	3.66	Chapter 3	Structure of crystalline solids (1)
2	8/30	W	1.83	5.49	Chapter 3	Structure of crystalline solids (2)
2	9/1	F	1.83	7.32	Chapter 4	Imperfections in solids (1)
3	9/6	W	0	7.32		Hurrican Irma
3	9/8	F	0	7.32		Hurrican Irma
4	9/13	W	0	7.32		Hurrican Irma
4	9/15	F	0	7.32		Hurrican Irma
5	9/20	W	1.83	9.15	Review, Chapter 5	Review of chapter 1-4, Diffusion (1)
5	9/22	F	1.83	10.98	Chapter 5	Diffusion (2)
6	9/27	W	1.83	12.81	Chapter 6, 7, 8	Mechanical properties (1)
6	9/29	F	1.83	14.64		**EXAM #1 on Chapter 1-5**
7	10/4	W	1.83	16.47	Chapter 6, 7, 8	Mechanical properties (2)
7	10/6	F	1.83	18.30	Chapter 6, 7, 8	Mechanical properties (3);
8	10/11	W	1.83	20.13	Chapter 6, 7, 8	Mechanical properties (4); Review of chapter 6-8
8	10/13	F	1.83	21.96	Chapter 9	Phase diagram (1)
9	10/18	W	1.83	23.79	Chapter 9	Phase diagram (2)
9	10/20	F	1.83	25.62	Chapter 9	Phase diagram (3)
10	10/25	W	1.83	27.45		Review of chapter 6-9
10	10/27	F	1.83	29.28	Chapter 11	Metals & Alloys
11	11/1	W	1.83	31.11		**EXAM #2 on Chapter 6-9**
11	11/3	F	1.83	32.94	Chapter 12, 13	Ceramics and glass (1)
12	11/9	W	1.83	34.77	Chapter 12, 13	Ceramics and glass (2); **Group presentation topic due**
12	11/10	F	0	34.77	NO class	Veteran day
13	11/15	W	1.83	36.60	Chapter 14, 15	Polymer (1);
13	11/17	F	1.83	38.43	Chapter 14, 15	Polymer (2); Review of chapter 11-15
14	11/22	W	1.83	40.26	Chapter 16, 17	Composites; Corrosion & materials degradation (1)
14	11/24	F	0	40.26	NO class	Thanksgiving
15	11/29	W	1.83	42.09	Chapter 17	Corrosion & materials degradation (2)
15	12/1	F	1.83	43.92		Review/Flexible
16	12/6	W	1.83	45.75		**Group Presentation (1)**
16	12/9	F	1.83	47.58		**Group Presentation (2)**
17						**FINAL EXAM (date TBD) on all focusing Chapter 11-17**