MSE 2001: Principles and Applications of Engineering Materials (required)

Catalog Description: (3-0-3)
Prerequisites: CHEM 1310 General Chemistry I or CHEM 1211K Chemical Principles I
The structure-property-processing-performance relationships of engineering materials are described. Materials selection is treated as a part of engineering design.

Textbook: James P. Schaffer, Ashok Saxena, Stephen D. Antolovich, Thomas H. Sanders, Jr. and Steven B. Warner, *The Science and Design of Engineering Materials,* Irwin, Chicago, IL. Any edition of the textbook can be used

Prepared by: Christopher Muhlstein

Topics Covered:

1. Atomic bonding
2. Crystal structures
3. Imperfections in solids (point, linear, planar, and volume)
4. Diffusion
5. Non-crystalline and semi-crystalline solids
6. Phase equilibria and phase diagrams
7. Kinetics of microstructure and phase transformations
8. Phase transformations
9. Ductile and brittle fracture
10. Fracture mechanics
11. Fatigue and creep behavior
12. Electrical properties of materials
13. Semiconductor physics and devices

Course Outcomes:

Outcome 1: The student will possess the fundamental knowledge and skills to function effectively in materials science and engineering- related positions in industry and government, or to successfully pursue advanced studies.

1.1 The student will demonstrate a basic understanding of the five microstructural elements- atomic/molecular structure, defects, solute, precipitates, and grain boundaries and how they manifest themselves in each class of material.

1.2 The student will demonstrate a basic understanding of how the key microstructural elements are controlled by composition, temperature, time and deformation.

1.3 The student will demonstrate a basic understanding of how material structure relates to mechanical and electrical performance.

Outcome 2: The student will demonstrate technical competence using current engineering techniques, skills and tools.

2.1 The student will demonstrate the ability to calculate parameters that describe the structure, chemistry, and phase fractions in solids

2.2 The student will demonstrate the ability to calculate materials properties from empirical data.

Correlation between Course Outcomes and Student Outcomes:

Course Outcomes	Student Outcomes										
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
Course Outcome 1.1	x				x						
Course Outcome 1.2	x				x						
Course Outcome 1.3	x				x						
Course Outcome 2.1	x				x						x
Course Outcome 2.2	x				x						x
Entire Course	**3**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**1**
0 = None or insignificant; 1 = Some; 2 = Moderate; 3 = Strong											

School of Materials Science and Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice