MSE 2001: Principles and Applications of Engineering Materials

Course Description:
This course explores the foundational principles of materials science and engineering, focusing on the relationship between the structure, properties, and processing of materials. Students will learn to describe and quantify material structures and understand how these structures influence material properties. The course will relate these structures to material properties and explore how processing parameters such as temperature and deformation can modify material performance.

Instructor: Dr. Phuong Vuong
Email: pvuong@georgiatech-metz.fr (Please include "MSE-2001" in the subject line.)

Office: GTE 103

Prerequisites: Chem 1310 or Chem 1211K

Course Websites:
http://canvas.gatech.edu/

Additional Textbooks:
- Materials: Engineering, Science, Processing, and Design by Ashby, et al. .
- Engineering Materials Science by Ohring (1995).
- Materials Science and Engineering: An Introduction by Callister and Rethwisch

Course Objectives:
By the end of this course, students should be able to:
- ✓ Use an understanding of material properties to discuss and predict material performance upon subjection to external stimuli including mechanical stress, heat, electrical voltage, electrochemical potentials, magnetic fields, and/or optical illumination.
- ✓ Describe the structure of materials at the atomic and microstructural levels and explain how different structural features impact material properties.
- ✓ Describe and predict how defects will alter the properties of a material.
- ✓ Apply thermodynamic and kinetic principles to design materials processing schemes to achieve desired materials structures using tools such as phase diagrams and TTT diagrams.

Tentative Course Outline

I. Introduction to Materials Science
History / How does materials science fit in with other disciplines?

II. Properties of Materials
General Classifications of Properties
Mechanical Properties
Thermal Properties

Electronic / Magnetic Properties
Optical Properties
Chemical Properties / Materials Degradation
Price/Cost of Materials
Classifying Materials

III. Structure of Materials

Structure of an Atom
Atomic Bonding in Materials
Crystalline Solids / Crystal Structure
- Close Packing
- Lattice + Basis
- Miller Indices
- X-ray diffraction

Amorphous Solids
Structure of Polymers (amorphous & crystalline)

IV. Defects in Materials

Classifying Defects
Point Defects
Dislocations & Strength of Materials
Cracks and Materials Failure (Fracture)

V. Materials Processing

Phases & Phase Transformation
Phase Diagrams
TTT Diagrams

Grade Policy:

10% – Class Participation
15% – Homework
25% – Exam 1
25% – Exam 2
25% – Final Exam
2% – Extra Credit (Mini Projects)

Attendance Policy:

Attendance is mandatory for this course. Any unexcused absence will result in a grade of zero for both the in-class quiz during that session. In-class quizzes will be administered during the first 10 minutes of the period, and students arriving late will receive a zero for that quiz. Please note that no in-class quizzes will be given during scheduled lab hours to ensure sufficient time for the completion of lab work.

Make-Up Policy:
Students who miss an exam due to an Institute-sanctioned activity will be allowed to take a make-up exam. Make-up exams will only be granted for legitimate reasons, and it is essential that you contact me in writing (email is acceptable) prior to the scheduled exam to arrange a make-up. Failure to notify me in advance may result in the inability to schedule a make-up exam. When possible, make-up exams will be administered during the week following the original exam date. Please note that make-up exams may differ from the ones given during the regular exam period.

Academic Integrity:
All students enrolled in this course are expected to adhere to the Georgia Tech Honor Code and uphold the highest standards of academic integrity. Any violations or suspicions of academic misconduct will be reported to the Office of Academic Integrity and the Dean of Students for further investigation.

Collaboration:
While students are encouraged to discuss assignments in general terms, all work must be completed individually unless specified otherwise. You may seek help from the course instructors, but it is crucial that each student independently produces their own work. Copying any part of an assignment from another student, or allowing others to copy your work, is considered plagiarism and is strictly prohibited.