University of CINCINNATI

Syllabus

MTEN3012, Introduction to Metallurgy

Instructor Name: Donglu Shi
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Office Location: 493 Rhodes Hall
Office Hours and Location:
Zoom: https://ucincinnati.zoom.us/s/9377684662#success

Course Overview, Description, Purpose

Overview: Introduction to Metallurgy is one of the core courses for the Materials Minor that provides engineering students with fundamental knowledge in metallurgy, property and structure relationships, and advanced manufacturing technologies. Introduction to Metallurgy is developed to prepare students for addressing some of the critical issues in metal and alloys, for instance, materials in extreme conditions, and to give students first-hand experience in problem definition and solution synthesis within the context of materials science and engineering.

Course description: This course introduces various basic concepts of metallurgy, such as crystal structures, line defects, phase diagrams, mechanical properties, and hardening mechanisms. Also introduced are strengthening methods and failure processes in engineering materials. Metallurgical fundamentals include dispersion strengthening by phase transformations and heat treatment, nucleation and growth in solid-state reactions, precipitation hardening, and phase transformation kinetics. The binary Fe-Fe3C phase diagram is introduced via isothermal transformation, time-temperature-transformation (TTT), and continuous cooling transformation (CCT) phase diagrams. These basic concepts will be applied for design, process, and manufacture of metals and alloys in major industrial applications.

Purpose: The purpose of this course is to intellectually challenge students to explore the materials properties and structures in industrial applications such as high temperature alloys, materials in extreme conditions, and environment sustainability. This course is designed not only to inspire innovative and creative ideas in metallurgy but also to cultivate increased awareness of ethics and global issues.

Course Learning Outcomes

Upon successful completion, students will have the knowledge and skills to:

1. Think critically and creatively about the design of new materials and structures that offer unique properties required for industrial applications.
2. Understand the major challenges in metal and alloy applications under extreme conditions such as high temperature and corrosion.
3. Understand the key issues in global energy and environmental sustainability, and the current strategies to address them via advanced metallurgy.
4. Demonstrate an ability to work effectively in highly interdisciplinary research and working environment.

5. Articulate the basic principles of new technologies currently used in metallurgy.

6. Aware of societal and environmental impacts of materials processing and recycling.

Pre-requisites

Any 2000-3000 level physics and chemistry courses

Academic Program Prerequisites

This undergraduate course is available to students from all engineering programs

Academic Level Prerequisites

Undergraduate level

Course Format

Single activity format.

Course Materials

Required readings/equipment/technology

Textbooks:

The Science and Engineering of Materials (6th edition)

Donald R. Askeland

Assessments/Activities and Grading Policy

Grading standard for a class average of 75% or above

90% to 100% - A, 80% to 89% - B, 70% to 79% - C, 60% to 69% - D, 59% or below – F

Grading policy

1.	One midterm	30%
2.	5-6 homework assignments	30%
3.	Final	40%
	Total:	100%

Classroom Procedures/Policies

Communication

Students can reach the instructor via email (donglu.shi@uc.edu) or work telephone (513 556 3100) for any class related issues. Help sessions on homework and exams can be arranged in person in 493 Rhodes Hall or online via Zoom (https://ucincinnati.zoom.us/s/9377684662#success) at pre-scheduled times and office hours.

Technology use during/for class

The course materials including lecture notes, videos, homework, and solution keys are all uploaded on Canvas. The lectures will be given in person in the designated classroom with all electronic technologies, unless otherwise notified. To learn more about accessibility at the University of Cincinnati, visit https://www.uc.edu/about/accessibility-network.html

Attendance Policy

The instructor must be notified of any absence in advance.

Faculty attendance

In case the instructor does not arrive within the first 15 minutes of class, students may assume that the class is no longer offered in person that day and they may leave without any consequences. The recorded lecture is available on Canvas.

Class Cancellation Policy

In case a class is cancelled for unexpected reasons, the recorded lecture for that class will be made available on Canvas with detailed instructions and assignments.

Diversity, Equity, and Inclusion Statement

We highly value the participation and contributions of those from diverse backgrounds and perspectives.

Notice of Non-Discrimination

This class will be built and conducted in a welcoming and inclusive environment where discrimination, harassment, and retaliation are not tolerated.

Accessibility Policy

We highly value accessibility and work to create an inclusive and equitable environment to provide universal access. Information regarding the Accessibility Policy can be found at https://uc.instructure.com/courses/1456074

Trigger Warning

Our classroom provides an open space for the critical and civil exchange of ideas. The instructor will aim to forewarn students about potentially disturbing content and ask all students to help to create an atmosphere of mutual respect and sensitivity.

Academic Integrity

Academic integrity is critically important as a core university value not only for academic success of the students but also for the academic reputation of the University. Therefore, we expect that students will conduct themselves in an honest and ethical manner and respect the intellectual work of others.

Specific instructions for academic integrity will be provided before each assignment such as homework and exams.

Student Resources

The following websites provide the university resources to address students' academic success as well as their health and wellness. https://online.uc.edu/student-resources/ https://uc.instructure.com/courses/1456074

Course Calendar

Week	*Lecture Topics*	*In-Class Activities*	*After class Reading*
Part I	**Atomic Structure, Arrangement, and Movement**		
Chapter 1	Introduction to Materials Science and Engineering	Lecture in class	Reading reference papers assigned
Chapter 2	Atomic Structure	Lecture in class	Reading reference papers assigned
Chapter 3	Atomic Arrangement	Lecture in class	Reading reference papers assigned
Chapter 4	Imperfection in the Atomic Arrangement	Lecture in class	Reading reference papers assigned
Chapter 5	Atomic Movement in Materials	Lecture in class	Reading reference papers assigned
Part II	**Controlling the Microstructure and Mechanical Properties of Materials**		
Chapter 6	Mechanical Testing and Properties	Lecture in class	Reading reference papers assigned
Chapter 7	Strain Hardening and Annealing	Lecture in class	Reading reference papers assigned
Chapter 8	Principles of Solidification Strengthening and Processing	Lecture in class	Reading reference papers assigned
Chapter 9	Solid Solution Strengthening and Phase Equilibrium	Lecture in class	Reading reference papers assigned
Chapter 10	Dispersion Strengthening	Lecture in class	Reading reference papers assigned
Chapter 11	Dispersion Strengthening by Phase Transformations and Heat Treatment	Lecture in class	Reading reference papers assigned
Part III	**Engineering Materials**		
Chapter 12	Ferrous Alloys	Lecture in class	Reading reference papers assigned

I reserve the right to update this syllabus as class needs arise. Be assured that I will communicate to you any changes to our schedule, syllabus, or policies quickly and efficiently through Canvas.