MTSE 3060 Phase Transformations in Materials
Spring 2026

Course Information

Instructor Information:

Instructor: Yufeng Zheng
Office: NTDP E120
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Email: Yufeng.Zheng@unt.edu
Website: Advanced Metals, Manufacturing and Microscopy Group
Office Hours: Thursday 11:00- 12:00PM (or by appointment, email preferred)

TA: Shanmukha Guraja
Office: NTDP E135
Email: ShanmukhaGuraja@my.unt.edu
Office Hours: Wednesday, 4-5PM, E135

Course Description:

This course will provide the student with an understanding of the basic principles and mechanisms underlying both solid-solid and liquid-solid phase transformations with an emphasis on metallic materials. The objective is to apply the concepts of thermodynamics, diffusion and kinetics, and crystallography (crystal structure and symmetry in materials) to develop a clear understanding of the free energy changes and kinetics associated with various types of phase transformations.

Course Pre/Co-requisites:

Prerequisites:

- MTSE 3010 Bonding and Structure
- MTSE 3030 Thermodynamics and Phase Diagram
- MTSE 3040 Transport Phenomena in Materials

Required textbooks, course materials:

- Textbooks required: Phase Transformations in Metals and Alloys, David A. Porter, Kenneth E. Easterling and Mohamed Y. Sherif, 3rd Edition or 4th Edition, CRC Press, Boca Raton, 2008 or 2021
- Lecture notes will be posted after class on CANVAS

Unique class procedures /structures:

- Class Components: Classroom lecture
- Instruction Mode: In person

Student Learning Objectives:

ABET Student Learning Outcomes:

- SLO 1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

- SLO 3: An ability to communicate effectively with a range of audiences.

Specifically, by the end of the course, you should be able to

- Understand thermodynamics principles and kinetics governing phase transformations
- Analyze phase diagrams and TTT/CCT diagrams to predict microstructure evolution during heat treatments
- Describe nucleation, growth, and coarsening mechanisms in phase transformations, including homogeneous and heterogeneous nucleation, growth kinetics, and Ostwald ripening
- Understand displacive phase transformations, focusing on martensitic transformations
- Understand characteristic phase transformations in steels, including ferrite, pearlite, bainite, and martensite.

Course Requirements:

Undergraduate students:

- Class Attendance: 5%
- Group Project and Presentation: 15%
- Homework: 30%
- Midterm Exam: 25%
- Final Exam: 25%
- Extra Credit: 5% (5 pts for 5 in-class surveys)

Grading Criteria, Scale, and Standards

Grading Scale: A: 90-100; B: 80-89; C: 70-79; D: 60-69; F: <60

- Class attendance is mandatory. Class attendance will be formally tracked in every class.
- Five homework are required.
- One group project/presentation is required. The group presentation is scheduled in week 16 (Tu, 04/29).
- One midterm exam and one final exam are required. It is student's responsibility to contact instructor to re-schedule the exam time, if needed.

Late Work or Make-up Exams Policies

- No late homework will be accepted unless instructor is contacted in advance with reasons.
- Make-up exams can be arranged only if the instructor is contacted in advance with reasons.

Course Calendar or Topics Outline:

Tu/Thu 2:30pm- 3:50pm, Lecture, Classroom: NTDP B158

- Week 1: Syllabus and Intro
  - Lecture 1: Syllabus and Intro
  - Lecture 2: Thermodynamics
- Week 2: Chapter 1 Thermodynamics
  - Lecture 3: Thermodynamics
  - Lecture 4: Phase diagram
- Week 3: Chapter 2 Diffusion

  - Lecture 5: Diffusion
  - Lecture 6: Diffusion
- Week 4: Chapter 3 Interface
  - Lecture 7: Interface
  - Lecture 8: Interface
- Week 5: Chapter 4 Solidification
  - Lecture 9: Solidification
  - Lecture 10: Solidification
- Week 6: Chapter 4 Solidification
  - Lecture 11: Solidification
  - Lecture 12: Solidification
- Week 7: Chapter 4 Solidification
  - Lecture 13: Solidification
  - Lecture 14: Solidification
- Week 8: Midterm Exam
  - Lecture 15: Diffusional Transformation
  - **Lecture 16: Mid-term Exam**
- **Week 9: Spring Break**
  - Lecture: N/A
  - Lab: N/A
- Week 10: Chapter 5 Diffusional Transformation
  - Lecture 17: Diffusional Transformation
  - Lecture 18: Diffusional Transformation
- Week 11: Chapter 5 Diffusional Transformation
  - Lecture 19: Diffusional Transformation
  - Lecture 20: Diffusional Transformation
- Week 12: Chapter 6 Diffusionless Transformation
  - Lecture 21: Diffusionless Transformation
  - Lecture 22: Diffusionless Transformation
- Week 13: Chapter 6 Diffusionless Transformation
  - Lecture 23: Diffusionless Transformation
  - Lecture 24: Diffusionless Transformation
- Week 14: Chapter 7 Phase Transformations in Steel
  - Lecture 25: Phase Transformations in Steel
  - Lecture 26: Phase Transformations in Steel
- Week 15: Chapter 7 Phase Transformations in Steel
  - Lecture 27: Phase Transformations in Steel
  - Lecture 28: Phase Transformations in Steel
- Week 16 Group Presentation and Review
  - Lecture 29: Group Project Presentation
  - Lecture 30: Review
- **Final Exam: 05/05 (Tue) 12:30-2:30PM**

Homework, Survey, and Exam Calendar:

- Week 1
  - Survey 1
- Week 3
  - Homework 1
- Week 4
  - Survey 2
- Week 5
  - Homework 2
- Week 6
  - Homework 3
- Week 7
  - Survey 3
- Week 8
  - Homework 4 and Midterm exam
- Week 10
  - Survey 4
- Week 12
  - Homework 5
- Week 16
  - Group presentation; and Survey 5
- Week 17
  - Final exam

University Policies

Statement regarding Artificial Intelligence:

UNT acknowledges the evolving capabilities of Artificial Intelligence (AI) technologies and their various effects on student writing and content creation. Students are only permitted to use AI technology in the creation of any course content if permitted by the course instructor. If the use of AI technology is detected, without specific instructor permission, the student will be deemed in violation of the plagiarism policy.

The use of AI technologies is strictly prohibited for all coursework in this class, including homework, group projects, and group presentations. Any use of AI tools for content generation, data analysis, or writing assistance without explicit instructor approval will be considered a violation of the plagiarism policy and subject to academic misconduct consequences as outlined by UNT. Students are expected to complete all assignments independently or collaboratively with their peers using their own understanding and effort.

Statement on Lab Safety

While working in laboratory sessions, students enrolled in TEM Lab are required to follow proper safety procedures and guidelines in all activities requiring lifting, climbing, walking on slippery surfaces, using equipment and tools, handling chemical solutions and hot and cold products. Students should be aware that UNT is not liable for injuries incurred while students are participating in class activities. All students are encouraged to secure adequate insurance coverage in the event of accidental injury. Students who do not have insurance coverage should consider obtaining Student Health Insurance. Brochures for student

insurance are available in the UNT Student Health and Wellness Center. Students who are injured during class activities may seek medical attention at the Student Health and Wellness Center at rates that are reduced compared to other medical facilities. If students have an insurance plan other than Student Health Insurance at UNT, they should be sure that the plan covers treatment at this facility. If students choose not to go to the UNT Student Health and Wellness Center, they may be transported to an emergency room at a local hospital. Students are responsible for expenses incurred there.

Statement on Creating an Inclusive Learning Environment:

I value the many perspectives students bring to our campus. Please work with me to create a classroom culture of open communication, mutual respect, and belonging. All discussions should be respectful and civil. Although disagreements and debates are encouraged, personal attacks are unacceptable. Together, we can ensure a safe and welcoming classroom for all. If you ever feel like this is not the case, please stop by my office and let me know. We are all learning together.

Every student in this class should have the right to learn and engage within an environment of respect and courtesy from others. We will discuss our classroom's habits of engagement and I also encourage you to review UNT's student code of conduct so that we can all start with the same baseline civility understanding (Code of Student Conduct) (https://policy.unt.edu/policy/07-012).

Statement of Disability Services:

The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time; however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information, refer to the Office of Disability Access website (https://studentaffairs.unt.edu/office-disability-access). You may also contact ODA by phone at (940) 565-4323.

Statement for Academic Success Services:

UNT strives to offer you a high-quality education and a supportive environment, so you learn and grow. As a faculty member, I am committed to helping you be successful as a student. To learn more about campus resources and information on how you can be successful at UNT, go to unt.edu/success and explore unt.edu/wellness. To get all your enrollment and student financial-related questions answered, go to scrappysays.unt.edu.