

MTSE 3000.006
“Fundamentals of Materials Science and Engineering”
Fall 2025 – 3 Credit Hours

Instructor: Prof. Anupama Kaul **Office:** C136G, Discovery Park
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Office Hours: Mondays and Wednesdays 1:00 pm – 2 pm and by appointment

Lecture Time and Location:

Mondays and Wednesdays, 11:30 am – 12:50 pm, Discovery Park, B157

Textbook: *Fundamentals of Materials Science and Engineering, An Integrated Approach* by William D. Callister & David G. Rethwisch, 4th Edition, John Wiley, 2011/2012 (ISBN: 9781118061602).

Other Suggested Textbooks:

Introduction to Materials Science for Engineers, by Shackelford, Prentice Hall; *Understanding Solids* by Tilley, Wiley & Sons, any Edition; *The Science and Engineering of Materials*, D. R. Askeland, P.P. Fulay, W.J. Wright, Cengage Learning, any Edition.

Materials Engineering, Science, Processing and Design, by Ashby, Shercliff and Cebon, 4th Edition, Elsevier (Butterworth-Heinemann), Cambridge, UK (2019).

Course Description

Principles of bonding, structure, and structure/property relationships for metals and their alloys, ceramics, polymers and composites. Emphasis on properties and how processes change structure and, consequently, properties.

Prerequisites: PHYS 1710. CHEM 1410/CHEM 1430 or CHEM 1415/CHEM 1435.

Teaching Assistant: Utsab Kafley; **Email:** utsabkafely@my.unt.edu; **Office Hours:** Tu: 11 am – 1 pm and by appointment, D144.

Chapters from Callister that will be covered

Chapter 1 – Introduction
Chapter 2 – Atomic Structure and Interatomic Bonding
Chapter 3 – Structures of Metals and Ceramics
Chapter 4 – Polymer Structures
Chapter 5 – Imperfections in Solids
Chapter 6 – Diffusion
Chapter 7 – Mechanical Properties
Chapter 8 – Deformation and Strengthening Mechanisms
Chapter 10 – Phase Diagrams
Chapter 11 – Phase Transformations

Course (Learning) Objectives:

1. Demonstrate ability to relate bond energy to properties of engineering materials.

2. Interpret various crystal structures using Miller Indices for planes and directions.
3. Determine contributions of various strengthening mechanisms, including solid solution strengthening, precipitation strengthening, strain hardening, and grain size strengthening (the Hall-Petch relationship).
4. Demonstrate ability to read a phase diagram, including determining phase diagram type, predict phase compositions (given c_0 and T), and predict microstructures for given compositions.
5. Interpret mechanical properties, including yield strength, ultimate tensile strength, and elastic modulus from engineering plots of σ - ϵ .
6. Exhibit awareness of societal implications associated with various materials, including specifically occupational safety and health and global availabilities of commodity material.
7. Conduct and present a material selection survey as part of a team for current materials applications.

ABET / Student (Learning) Outcomes (SOs):

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (Course Objectives 1,2,3,4,5,7)
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Specific goals for the course

- a. *Specific outcomes of instruction*
- b. *Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.*

	Student/ABET Outcome	1	2	3	4	5	6	7
Specific Course Learning Objectives		x		x	x	x		x
1. Demonstrate ability to relate bond energy to properties of engineering materials		x						
2. Interpret various crystal structures using Miller Indices for planes and directions		x						
3. Determine contributions of various strengthening mechanisms, including solid solution strengthening, precipitation strengthening, strain		x						

hardening, and grain size strengthening (the Hall-Petch relationship)								
4. Demonstrate ability to read a phase diagram, including determining phase diagram type, predict phase compositions (given C_0 and T), and predict microstructures for given compositions.		x						
5. Interpret mechanical properties, including yield strength, ultimate tensile strength, and elastic modulus from engineering plots of σ - ϵ		x						
6. Exhibit awareness of societal implications associated with a material, including globally, economically, and environmentally, as well as occupational safety					x			x
7. Conduct and present a material selection survey as part of a team for current materials applications.		x		x		x		x

Tentative Grading Scheme (subject to change):

(5) Quizzes, Average:	25 %
(3) Exams, Average:	55 %
(1) Team Project:	20 %

Team Project

The team project will be composed of a final paper (10%) and a presentation (10%). At the end of Exam 3, you will have the opportunity to evaluate the rest of your team members through a peer-review process for their contribution toward the team project. This will include both the *participation* and the *technical content* of their contributions for the project, which will be taken into consideration toward assigning the individual grades for the projects.

Homework

There will be 10 HW assignments which will be distributed throughout the semester. While the homework will not be graded, it will nonetheless form the core upon which the quizzes and exams are based. Therefore, students should give important consideration to the content of the homework assignments to become familiar with the material in order to have a high likelihood of success on the quizzes and exams.

Notes related to Lectures and Grading

1. Canvas will be used as the primary communication tool, as the syllabus, lecture notes, homework assignments and solutions will be posted on Canvas which can be accessed at <https://unt.instructure.com/>
2. Homework assignments are intended to serve as a way to exercise your understanding of the concepts. Solutions to homework assignments will be posted on Canvas.

3. There will be 5 in-class quizzes and each will be for a duration of approximately 15-20 minutes. The content of the quizzes will be based on recent homework assignments and material covered during lectures.
4. There will be 3 in-class exams. Each exam will include a combination of (A) multiple choice questions, (B) short answer questions, and (C) quantitative problems. The 3 exams will be weighted equally and an average for the exams will be computed which will count toward 55% of the overall grade. Each exam builds upon concepts from previous chapters and, hence, the second and third exams are progressively more comprehensive.
5. For all exams and quizzes, the only thing you may use during the exam is a calculator (plus a pencil, pen, and/or an eraser). Earphones, cell phones, laptops, etc. will not be allowed.

Attendance

Attendance will be taken at the *beginning* of every class and will also be tied toward the mini-quizzes discussed below. Attendance will allow students to earn up to 3 **bonus points** if they have attended 100 % of the in-person lectures over the duration of the semester.

Mini-quizzes (MQs)

Mini-quizzes will be pop-up quizzes to initiate discussion on content covered in the prior lecture. The mini-quizzes will serve as a means to earn 3 bonus points toward your overall grade and will be given sharply at 11:30am for about 3-4 minutes. In addition to the regular MQs, there will be times that MQs will be collected randomly throughout the semester. On such days, the students will have a chance to earn an additional equivalent to 3 bonus points over the course of the semester. Therefore, if you are late to class, and if the mini quizzes are collected, you will not have a chance to earn these bonus points.

COVID-19 Impact on Attendance

While attendance is expected as outlined above, it is important for all of us to be mindful of the health and safety of everyone in our community, especially given concerns about COVID-19. Please contact me if you are unable to attend class because you are ill, or unable to attend class due to a related issue regarding COVID-19. It is important that you communicate with me prior to being absent so I may make a decision about accommodating your request to be excused from class.

If you are experiencing any symptoms of COVID-19 (<https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Hotline at 844-366-5892 or COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure. While attendance is an important part of succeeding in this class, your own health, and those of others in the community, is more important.

Statement on Face Covering

For everyone's safety face coverings are highly recommended indoors in all UNT facilities. If you are unable to wear a face covering due to a disability, please contact the Office of Disability Access to request an accommodation. UNT face covering requirements are subject to change due to community health guidelines. Any changes will be communicated.

Makeup Exam Policy

If a student cannot take an exam on the scheduled date due to some unavoidable circumstances, such as out of town business trip, sickness, etc., then he/she must notify the instructor *in writing* BEFORE the

scheduled exam time to schedule a makeup exam. A 10% penalty may be effective, if this is deemed necessary.

Calculators

Programmable calculators are not allowed. Sharing of calculators is not allowed. Bring them to quizzes and exams. You must have an inexpensive scientific calculator that can solve:

- Trig functions (SIN, COS, TAN)

- Exponentials (e^x)

- Square Root

- x^y

- Natural Logs (LN)

- Logs (LOG)

- Inverse

Cell Phones

Please remember to turn off phones prior to class. Cell phones are not to be on the desks during quizzes or examinations.

ADA Policy

The University of North Texas complies with Section 504 of the 1973 Rehabilitation Act and with the Americans with Disabilities Act of 1990. UNT makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide a student with an accommodation letter to be delivered to faculty to begin a private discussion regarding one's specific course needs. Students may request accommodations at any time, however, ODA notices of 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 accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the [ODA website \(https://disability.unt.edu/\)](https://disability.unt.edu/).

Additional Policies

Authorized Absences and Extenuating Circumstances

Absences due to extenuating circumstances or participation in sponsored events must be verified by the Dean of Students. Consideration of such absences will be made for quizzes and examinations. For participation in sponsored activities, you must seek approval prior to the absence. For extenuating circumstances, you have 1 week to contact the instructor and/or the Dean of Students to initiate the process.

Absence for Religious Holidays

In accordance with state law, a student absent due to the observance of a religious holiday may take examinations or complete assignments scheduled for the day(s) missed, including those missed for travel, within a reasonable time after the absence. The student is responsible to notify the instructor of each class of the date of the anticipated absence as early in the semester as possible. Only holidays or holy days observed by a religion whose place of worship is exempt from property taxation under Section 11.20 of the Tax Code may be included. A student who is excused under this provision may not be penalized for the absence.

Academic Integrity Policy

Academic Integrity Standards and Consequences. According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University. Therefore, students are expected to be honest and ethical in their academic work. Academic dishonesty is defined as an intentional act of deception in one of the following areas:

- * cheating – use or attempted use of unauthorized materials, information or study aids
- * fabrication – falsification or invention of any information
- * assisting – helping another commit an act of academic dishonesty
- * tampering – altering or interfering with evaluation instruments and documents
- * plagiarism – representing the words or ideas of another person as one's own.

For more information about academic integrity and the University's policies and procedures in this area, please see the UNT academic manual. Any student in violation of these policies will be given an overall **F grade (Fail)**. In addition, your case will be forwarded to university administrators, and you may be subject to additional punishments/sanctions according to university policies. When in doubt, please ask me.

Acceptable Student Behavior

You will be expected to conduct yourself in a professional manner. Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The University's expectations for student conduct apply to all instructional forums, including University and electronic classroom, labs, discussion groups, field trips, etc. Visit UNT's [Code of Student Conduct](https://deanofstudents.unt.edu/conduct) (<https://deanofstudents.unt.edu/conduct>) to learn more.

Prohibition of Discrimination, Harassment, and Retaliation (Policy 16.004)

The University of North Texas (UNT) prohibits discrimination and harassment because of race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, veteran status, or any other characteristic protected under applicable federal or state law in its application and admission processes; educational programs and activities; employment policies, procedures, and processes; and university facilities. The University takes active measures to prevent such conduct and investigates and takes remedial action when appropriate.