MTSE 3000: Fundamentals of Materials Science and Engineering-I

2026 Spring: Lecture in NTDP B192, Tu/Th 11:30 AM – 12:50 PM

Office Hours: Monday 3PM–4PM; Friday 10 AM; Or by appointment

Instructor: Dr. Srinivasan G. Srivilliputhur, DP C136C
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The course will be in-person, but the Office-Hours are over Zoom.

Course Outline

This course combines case studies to teach materials science and materials selection in design. It will introduce engineering students to a rigorous process of selecting materials for engineering designs, and connect this to *bonding, structure, processing, and properties of* materials. Prof. Mike Ashby's book and Ansys Granta EduPack software will be extensively used in lectures, assignments, and exams.

The course will ensure that students have a broad-based knowledge of the science of all types of materials at an introductory level. The students will specifically learn the science of mechanical properties of materials and develop an ability to select the "suitable" materials, considering the limiting design variables in a qualitative and quantitative fashion. The influence of materials costs and its incorporation into design will also considered.

Specific Course Information

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

Textbook: "Introduction to Materials Science & Engineering: A Design Led Approach" M Ashby, Hugh Shercliff and David Cebon, 1st Ed. Elsevier (Butterworth-Heinemann) (2024).

Supplementary Book: "Materials Engineering, Science, Processing and Design:" M Ashby, Hugh Shercliff and David Cebon, 4th Ed. Elsevier (Butterworth-Heinemann) (2019).

Lecture Notes*:* on CANVAS. Copies of the textbook are reserved in the Engineering Library.

Class Policies

1. **Office hours:** Attending office hour sessions is entirely voluntary. It will be used for homework help and answer/clarify doubts. I will also help with any conceptual questions related to the course.

   Historically, students who ask questions during office hours (or listen to others with questions) tend to understand concepts better. This correlates well with their much better performance in the class.

2. CANVAS will be used primary for posting announcements, lecture slides, assignments and solutions.

3. Homework, quiz, and exams due dates will be posted on CANVAS. Students will upload their Homework and quiz solutions on CANVAS on or before their due dates. *Emailed answers will NOT be accepted.*

4. **Mr. Alejandro Padilla Gonzalez is the TA** for this class. He will grade homework assignments. Grading exams is solely my responsibility.

5. **Lectures:** Attendance is mandatory and will cover concepts and example problems. Often, I will present a problem that illustrates the theory during a lecture and encourage students to solve it on their

own. I will present a discussion and solution during my office hours on Wednesdays. The lectures will be held mostly in-class. The students will be notified if they move to Online mode in rare cases.

6. **Four Homework Assignments:** Will involve conceptual and numerical questions.

   Homework problems are often challenging. I will help you during my office hours if you need it. But you must attempt them first.

   Homework due dates are posted on CANVAS. Late homework will get partial credits only until I post their solutions on CANVAS. I will not accept late homework after I post their solutions.

7. **About Ten Quizzes: Ten videos (each ~7 minutes long) are available on CANVAS. Watch each video and answer a quiz with 5-6 multiple choice questions on the topics covered there.** Quizzes w*ill be administered on CANVAS.*

8. **Three Exams:** *Will be* **administered in class** *after due announcement.* They will contain multiple choice, short answer, and quantitative questions/problems. There will be a review prior to each exam.

   a. **Exam-01**: In the week of February 22, 2026.

   b. **Exam-02**: In the week of April 12, 2026.

   c. **Exam-03**: May 05, 2026 (Tuesday) from 10:00 AM – 12:00 PM in the lecture hall.

   d. I will make a good effort to return your graded exams within two weeks after they are given. In rare cases, this may not happen due to other faculty related commitments.

   e. You may use only a non-programmable calculator, pencils, pens, and eraser in quizzes and exams.

   f. **Earphones, cell phones, laptops, smart watches, and other devices are banned in exams.**

Tentative Grading Rubric

Homework 20%; Quiz (10 quizzes) 20%; Exam (3 exams) 60%

Final Grade Basis

A 90%+; B 80 to < 90%; C 70 to < 80%; D 60 to < 70%; F < 60%

Exam Makeup Policy: *Makeup exams will be allowed only for mitigating circumstances such as business travel, serious illness of student or a close family member.* A student missing her/his exam due such unavoidable situations must notify the instructor *in writing* and provide necessary documentation such as doctor's note, supervisor's note, conference talk abstract, etc. UNT student athletes must talk to the professor to discuss accommodation.

I will not permit a makeup exam if you plan to travel before your final exams.

Authorized Absences and Extenuating Circumstances: Absences to participate in *UNT-sponsored activities* must be verified by the Dean of Students. Consideration of such absences will be made for quizzes and exams, but not homework. Students must seek approval prior to such absences. For absences due to *extenuating circumstances*, contact the instructor within 1 week of your absence.

AI Usage Policy: You must NOT blindly use AI to do your homework assignments. Reasonable use of AI such as ChatGPT in homework assignments is allowed but you must explain what/how/where you used it. AI CANNOT be used in quizzes and exams.

Class Attendance Policy: *Class attendance is Mandatory.* Please notify the instructor if you must miss a class or will be late. *Excused absences* include illness, conference travel, family emergency, religious holiday, and any other unplanned difficulty as determined by the instructor. *Unexcused absences*

will invite penalty. One point per absence will be deducted from the final course grade (up to 9 absences) of students with *five or more unexcused absences. Ten or more unexcused absences* will lead to a student being dropped from the class.

Entering the class during a lecture is disruptive. Habitual latecomers will be asked to leave.

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 the date of the anticipated absence early in the semester. 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.

Cell Phone Usage Policy: **Cell phones and other such devices cannot be used in class. Texting, online activity, electronic messaging, playing games etc. are prohibited. Violators of this policy must leave the class.**

Specific Goals for the Course: *Specific course outcomes of and student outcomes.*

Specific Goals for the Course

a) Specific Course Learning Outcome
1. Relate bond energy and crystal structures to properties of engineering materials.
2. Understand properties, specifically yield strength, ultimate tensile strength, and elastic modulus from engineering plots of σ-ε . Understand mechanisms of solid solution strengthening, precipitation strengthening, strain hardening, and grain size strengthening.
3. Demonstrate ability to understand fundamentals of common phase transformations, read a phase composition-temperature diagram, including determining phase diagram type, predict phase compositions, and predict microstructures for given compositions.
4. Conduct and present a material selection survey for materials applications as a team. Exhibit awareness of societal implications associated with various materials, including specifically occupational safety and health and global availabilities of materials.

b) This course addresses *ABET Student Outcome 7* (an ability to acquire and apply new knowledge as needed, using appropriate learning strategies).

Disabilities Accommodation: UNT provides reasonable accommodation to individuals with disabilities, as defined by law – Section 504 of the 1973 Rehabilitation Act and the Americans with Disabilities Act of 1990. Contact the Office of Disability Accommodation at 940-565-4323 *during the first week of semester to learn more on this*.

Expectations for Student Conduct and Academic Integrity

The students must conduct themselves in a professional manner and be honest and ethical in their work. *Academic dishonesty such as plagiarism and cheating will NOT be tolerated.* Such dishonesty is defined as an intentional act of deception in one or more of the following, disallowed, actions:

- **Assisting** – helping another commit an act of academic dishonesty.
- **Cheating** – use or attempted use of unauthorized materials, information or study aids.

- **Fabrication** – falsification or invention of any information.
- **Plagiarism** – presenting the work or words or ideas of another person as one's own.
- **Tampering** – altering or interfering with evaluation instruments and documents.
- **AI Usage** – Using artificial intelligence (AI) tools such as ChatGPT and others.

Any student violating these *Academic dishonesty* policies will receive a **Failing course grade**. Furthermore, they will be referred to UNT honors committee for additional sanctions. Consult UNT's academic manual for relevant policies and processes. When in doubt, please ask me.

Course Evaluation: Student Perceptions of Teaching (SPOT) is the student evaluation system for UNT and allows students the ability to confidentially provide constructive feedback to improve the quality of learning in the course. Please fill out the evaluations at the end of the semester.

Syllabus Change Policy: Any changes to the syllabus (in an extraordinary situation) will be clearly communicated to the students.

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.

Emergency Notification & Procedures: UNT uses a system called Eagle Alert to quickly notify students with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). In the event of a university closure, please refer to UNT contingency plans for.

Email me on or before 01/21/2026 that you have read this document to get partial credit for homework-1.

MTSE 3000: Tentative Topics to be Covered

Topics Covered	Chapter
History & Overview: Materials and Mechanical Properties • Overview of materials, its processes, history, type, and character. • Description of Mechanical properties – elastic modulus, yield/tensile strength, ductility, toughness, fracture toughness, fatigue and creep, etc.	1.1–1.6 + parts of chapters 4–9, 13
Classifying Materials and Processes • Organizing materials and processes, process-property interactions. • Material property charts, computer-aided information management.	3.1–3.7
Concepts and Process of Materials Selection in Design • The process of engineering design – concept and strategic thinking. • The importance of various properties in design • Translation, screening, ranking, documentation, and choice of material. • *Materials Indices, cases studies & property charts in design.*	3.1–3.7
Stiffness and Weight, Stiffness-Limited Design • Science of density and elastic modulus. • Bonding in materials and basics of atomic arrangement, structure and crystallography of metals, polymers, ceramics, and hybrid materials. • *Stiffness-limited design* – cases studies & property charts.	4.1–4.11 5.1-5.10 GL 1-1
Plasticity, Yielding and Ductility; Strength-Limited Design • Definition of strength, plastic work, and ductility. • Origins of strength and ductility – theoretical strength and defects. • Dislocations and relation to strength – strengthening mechanisms. • *Yield-limited design* – case studies & property charts.	6.1–6.10 7.1-7.8
High-Temperature Materials Behavior • Temperature dependence of material properties. • The diffusion phenomenon and the mechanisms of creep. • *Creep-safe design* – case studies & property charts.	13.1–13.12
Processing and Properties of Materials • Phase diagrams and phase transformations. • Processing for Properties; Microstructure of materials. • Microstructure evolution in processing. • Metals and non-metals processing.	19.1–19.11 GL 2.1