MTSE 3000.006
Fundamentals of Materials Science and Engineering
Spring 2021, 3 Credit hours

Instructor: Prof. El Bouanani, Office: E111, Discovery Park
E-mail: bouanani@unt.edu Phone: 940-369-8109
Office Hours: Wednesdays 9:00am - 11:00am and by appointment

Lecture: Tuesday and Thursdays, 11:30 a.m. – 12:50 p.m.
Location: Remote via Zoom

Electronic copies of lectures on Canvas.

Other Suggested Textbooks:
Introduction to Materials Science for Engineers, by Shackleford, Prentice Hall
Understanding Solids by Tilley, Wiley & Sons, any Edition;

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.

EXAM I (Ch#: 2,3): 02/16/2021 LOCATION: Remote 2:30-4:30 PM
EXAM II (Ch#: 5,6): 03/30/2021 LOCATION: Remote 2:30-4:30 PM
EXAM III (Ch#: 7,8,10): 04/27/2021 LOCATION: Remote 10:30-12:30 PM

Tentative Grading Scheme (subject to change):

(7) Homeworks, Average: 10 %
(5) Quizzes, Average: 10 %
(3) Exams, Average: 60 %
(1) Team Project: 20 %

1. Quizzes and Exams are closed-book. Pop-up quizzes will not be announced.
2. Attendance of the class is required.
3. Make-up Policy: Make-up tests for quizzes will not be allowed under any circumstance.
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 C₀ 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 Course Learning Outcome

<table>
<thead>
<tr>
<th>Student/ABET Outcome</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Demonstrate ability to relate bond energy to properties of engineering materials</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Interpret various crystal structures using Miller Indices for planes and directions</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Determine contributions of various strengthening mechanisms, including solid solution strengthening, precipitation strengthening, strain hardening, and grain size strengthening (the Hall-Petch relationship)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>4. Demonstrate ability to read a phase diagram, including determining phase diagram type, predict phase compositions (given C₀ and T), and predict microstructures for given compositions.</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Interpret mechanical properties, including yield strength, ultimate tensile strength, and elastic modulus from engineering plots of σ-ε</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Exhibit awareness of societal implications associated with various materials, including specifically occupational safety and health and global availabilities of commodity material</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Conduct and present a material selection survey as part of a team for current materials applications.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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. These scores will be taken into consideration.

### Notes related to Lectures and Grading

1. Canvas will be used as the primary communication tool. The syllabus, lecture notes, homework assignments and solutions will be posted on Canvas which can be accessed at [https://unt.instructure.com/](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 prior to the homework due date.
3. There will be in-class popup quizzes and each will be for a duration of approximately 15 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 60% 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.
**Makeup Exam 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, conference talk abstract, etc.

**Class Attendance is Mandatory.** Optimal learning demands regular class attendance and active listening/participation in classroom discussion. Please notify the instructor if you have to miss a class or will be late. 10 or more unexcused absences will lead to a student being dropped from the class. Excused absences include illness, conference travel, family emergency, religious holiday, and any other unplanned difficulty as determined by the instructor.

**Calculators** You may use a scientific calculator in your exams and quizzes. **Programmable** calculators and sharing of calculators are not allowed.

Your calculator must be able to find the value of trigonometric (\( \sin, \cos, \tan \)), exponential (\( e^x \)), power (\( x^y \)), square root, natural log (\( \ln \)), base 10 log (\( \log \)), and inverse functions

**Cell Phone Usage Policy** Cell phones and other electronic communication devices cannot be used, and must remain “out-of-sight”, during class time. **Texting, online activity, electronic messaging, playing games etc. during class time are also prohibited. Students violating this policy will be asked to leave the class.**

**Disabilities Accommodation**

UNT complies with Section 504 of the 1973 Rehabilitation Act and with the Americans with Disabilities Act of 1990. It provides reasonable accommodation and auxiliary aids to individuals with disabilities, as defined under the law. If you believe you have a disability requiring accommodation, please contact the Office of Disability Accommodation at 940-565-4323 during the first week of class.
Authorized Absences and Extenuating Circumstances

Absences for participating in university-sponsored activities must be verified by the Dean of Students. Consideration of such absences will be made for quizzes and examinations, but not homework. For participation in sponsored activities, a student must seek approval prior to their absence. For absences due to extenuating circumstances, you have 1 week to contact the instructor to begin 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.

Statement of Expectations for Student Conduct and Academic Integrity

Consult UNT’s academic manual for the relevant policies and procedures. The students must conduct themselves in a professional manner, and be honest and ethical in their academic work. Academic dishonesty such as plagiarism and cheating will NOT be tolerated. Academic dishonesty is defined as an intentional act of deception in one or more of the following areas:

- **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** – representing the words or ideas of another person as one's own.
- **Tampering** – altering or interfering with evaluation instruments and documents

Any student in violation of these policies will be given an overall **F grade (Fail)**. In addition, each violation will be forwarded to university administrators for additional punishments/sanctions in accordance with university policies. When in doubt, please ask me.
COVID-19: UNT

Face Coverings:

Face coverings are required in all UNT facilities. Students are expected to wear face coverings during this class. 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 via the instructor.

______________________________________________________________

Attendance Policy: Attendance is mandatory.

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 COVID-19 including symptoms, potential exposure, pending or positive test results, or if you have been given specific instructions to isolate or quarantine from a health care provider or a local authority. 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 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.

The UNT fall schedule requires this course to have fully remote instruction beginning November 28th. Additional remote instruction may be necessary if community health conditions change or you need to self-isolate or quarantine due to COVID-19. Students will need access to a webcam and microphone to participate in fully remote portions of the class.

Synchronous (live) sessions in this course will be recorded for students enrolled in this class section to refer to throughout the semester. Class recordings are the intellectual property of the university or instructor and are reserved for use only by students in this class and only for educational purposes. Students may not post or otherwise share the recordings outside the class, or outside the Canvas Learning Management System, in any form. Failing to follow this restriction is a violation of the UNT Code of Student Conduct and could lead to disciplinary action.