ENGINEERING MATERIALS

INSTRUCTOR
Dr. Reza Mirshams, P.E.
Professor of Engineering Technology
Office: F-128, Discovery Park
Telephone: 940-565-2594
E-mail Address: Reza.Mirshams@unt.edu
Office hours: Wednesdays 11:00 and 3:00 PM. Fridays by appointment.

COURSE LEARNING OBJECTIVES (CLOs)
Engineers and engineering technologists design products and the processing systems for their production. As materials are required to produce the designed components, engineers and engineering technologists should be knowledgeable about the properties and performance of materials in service. With the completion of this course, you will learn the fundamental scientific knowledge about materials for engineering applications and effects of processing on their internal microstructure and properties, so you can select the most suitable ones for various application and evaluate basic causes of materials failure in service.

The students who complete the course will know:

1. Interrelationships of Processing-Structure-Properties-Performance in Solid Materials
2. Fundamentals of Materials Selection for Engineering Applications
3. Fundamental Knowledge for Evaluation and Analysis of Materials Failure
4. The principles of materials microstructure characterization and mechanical testing.

Information about Student Learning Outcomes (SLOs) and teaching strategies are in the attached APPENDIX I.

CATALOG COURSE DESCRIPTION
4 Credit hours (3 credit hours lecture and 1 credit hours laboratory)
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 1410/1430 or CHEM 1415/1435.

COURSE MATERIALS AND RESOURCES

REQUIRED TEXTBOOK (print or online version)
➢ Materials Science and Engineering, An Introduction,
  Course ID: 740886.
  WileyPlus.com will be used for class exercises, online quizzes, and homework from the textbook.
➢ UNT Canvas will be used for posting the course materials and instructions.
➢ Homework assignments will be assigned on the course textbook website each Wednesday with due date on the following Wednesday before the class hour.

LECTURES SLIDES
➢ I will post on UNT Canvas the topics of discussion, reading topics, and a draft of handout prior to the lecture day
for you to print and take notes on them. However, you need to take notes of discussion and lectures.

➢ Some of the class days will be as “flipped classes”. For these classes, your “homework” will be to watch pre-recorded lectures or/and the in-class period will be a chance to ask questions and work problems.

ASSESSMENT METHODOLOGY
1. Class attendance and engagement.
2. Online Homework (every week on the textbook website).
3. Class quizzes (in class on paper or online).
4. Midterm and final exams.

CLASS ATTENDANCE AND ENGAGEMENT
Engagement, participation and interaction are important elements of the learning process. To that end, we will be using iClicker, so each student must register to the site and have a device (computer, smartphone or tablet) for polling responses for this course. iClicker at UNT are provided for students use at no cost. Please read instruction on the Canvas for registration and downloading the app on your device (android, iphone, laptop).

Class attendance is required, however, there will not be penalty for not participation and attendance.

HOMEWORK (online):
1. Homework assignments will be online through the course textbook website (WileyPlus.com).
2. Number of questions in each homework will be varied.
3. There will be deductions for late homework submissions.
4. No make-up on homework assignments.

Class Exercises and Problem Solving
1. Bring your own laptop or borrow from the Discovery Park library front desk.

EXAMS (in-class on paper):
1. Total score of each exam will be on percentile, with different value points for each question.
2. Exam questions will be on topics have been discussed in the class lectures and reading assignments in the textbook.
3. There may be bonus question(s) in some exams, however, there will not be drop of the exam scores.
4. Exam review materials will be offered on the class before the exam.
5. There will NOT be drop of lowest exam score for the final course grading.
6. Methods for improving your exam scores will be discussed in the class.
EVALUATION AND GRADING SCALE

The grading breakdown is as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Attendance</td>
<td>5%</td>
</tr>
<tr>
<td>Homework Assignments (online)</td>
<td>15%</td>
</tr>
<tr>
<td>Class problem solving exercises and quizzes</td>
<td>15%</td>
</tr>
<tr>
<td>Laboratory</td>
<td>25%</td>
</tr>
<tr>
<td>Midterm Exam (Thursday October 17)</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam (10:30 AM–12:30 PM on Tuesday December 10, 2019)</td>
<td>20%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**GRADING SCALE**

- A: 90% - 100%
- B: 75% - 89%
- C: 60% - 74%
- D: 50% - 59%
- F: Below 55%

Grades will not be curved.

**GENERAL RULES FOR EXAMS AND QUIZZES:**

1. Grades for the course will be assigned as it has been shown above based on the Evaluation Values. There will NOT be curving of the exam scores or total scores for assigning a grade.

2. Exams and class quizzes are written and closed textbook and notebooks. A copy of the fundamental equations will be provided. Access to Internet and use of iPhone, smartphone, smart watch, and laptop NOT allowed during exams and quizzes. In some occasions, use of laptop or desktop computers would be allowed if approved monitoring software have been installed.

3. To protect the integrity of exams and quizzes, you may bring a limited type of calculators to exams and quizzes in this course. The only calculator models acceptable for use during the exams and quizzes are as follows.
   - Casio: All fx-115 and fx-991 models (Any Casio calculator must have “fx-115” or “fx-991” in its model name.)
   - Hewlett Packard: The HP 33s and HP 35s models, but no others
   - Texas Instruments: All TI-30X and TI-36X models (Any Texas Instruments calculator must have “TI-30X” or “TI-36X” in its model name.)

4. For in-class quizzes and exams, the backpack with the cell phone will be left at the front of the classroom.

5. Graded paper quizzes and midterm exams will available for review by the students in my office after I post the grade on the Canvas gradebook. Request for reviewing your graded papers will not be accepted after one week of the posting date.

6. No make-up will be given for the scheduled exams, unless the student has a legitimate excuse documented properly (e.g., letter from court clerk that he/she must appear in a court, letter from physician that he/she is sick).

7. Grades are based in part on the student’s ability to communicate in writing solutions to question. You must present your entire solution in an orderly way for problems that need calculations. For some certain questions, you must show the complete process of your solutions. Partial credit may be assigned for correct steps that have been taken in a solution. Points will not be assigned only on the final answers for those types of questions.

8. Requests for a review of a graded exam problem must be submitted during the following class hour after which the grade is posted. In this matter, the review is not limited to a single problem requested by the student. Upon
8. During exams and quizzes, students may leave one at a time for the restroom. If a student has stepped out of the class to go to the restroom, upon his or her return, another student can leave to go to the restroom. One student can be out of the classroom at a time.

ADDITIONAL COURSE POLICIES
1. Cell phones, iPhones, iPods, iPads, laptops, and smartwatches must be in silent mode before the start of the class.
2. This syllabus is subject to change at any time during the semester with changes to be announced during the class hours and posted in the Canvas.
3. Email Communications: All email communications must be through your UNT assigned email address. You should write ENGR 3450 -Fall 2019 in the subject line. I will not reply emails from yahoo, gmail, outlook, Hotmail, etc.
4. Dishonesty: The UNT Catalog procedures on cheating and plagiarism will be vigorously enforced. It is the duty of each student to protect their work so it is not available to others for copying or submission as their efforts. Any violation of the established rules and procedures for exams and quizzes could be considered as dishonesty. This is especially true of files and programs that are generated or copied on the computer and handhold programmable calculators for using during class quizzes and exams. Students that knowingly allow others to use their work are partners in this unethical behavior. All rules relating to academic dishonesty will be enforced in accordance with University policies.
5. Distribution of Course materials: State common law and federal copyright laws protect this course lectures and materials. They have my own original expression and revisions to the textbook author(s) and I record them while I deliver them in order. Whereas you are authorized to take notes in class, thereby creating a derivative work from my lecture, and/or make a print of my lecture notes/slides. The authorization extends only to making one set of notes for your own personal use and no other use. You are not authorized to record my lectures, to provide your notes to anyone else or to make any commercial use of them without express prior permission from me.

DISABILITIES ACCOMODATION
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 Accommodation (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 see the Office of Disability Accommodation website at http://www.unt.edu/oda. You may also contact them by phone at 940.565.4323.
## APPENDIX I

**Student Learning Outcomes, Teaching Strategy, and ABET Students Learning Outcomes (SLOs)**

**ENGR 3450 – Engineering Materials**

<table>
<thead>
<tr>
<th>OUTCOMES</th>
<th>ASSESSMENT Methodology</th>
<th>INSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Interrelationships of processing-structure-properties-performance in solid materials. <strong>(ABET ETAC SLO # 1)</strong></td>
<td>1. Class attendance and engagement.</td>
<td>- Lectures</td>
</tr>
<tr>
<td>1.1. Demonstrate the ability to relate materials properties and microstructure by</td>
<td>2. Homework assignments</td>
<td>- Class Exercises</td>
</tr>
<tr>
<td>1.1.1. Relate bond energy to properties of engineering materials</td>
<td></td>
<td>- Some Video Clips</td>
</tr>
<tr>
<td>1.1.2. Analyze crystalline structures</td>
<td></td>
<td>- Reading Assignments</td>
</tr>
<tr>
<td>1.1.3. Calculate Miller Indices, Packing Factor, and Density of Selected Unit Cells.</td>
<td></td>
<td>- Some “flipped class” sessions</td>
</tr>
<tr>
<td>1.1.4. Describing crystals imperfections</td>
<td></td>
<td>- Extended questions quizzes.</td>
</tr>
<tr>
<td>1.1.5. Explain the process of work hardening and Schmidt’s Law</td>
<td></td>
<td>(problem solving)</td>
</tr>
<tr>
<td>1.1.6. Illustrate understanding of atomic scale diffusion of atoms</td>
<td></td>
<td>- See laboratory syllabus</td>
</tr>
<tr>
<td>1.1.7. Interpret mechanical properties, including yield strength, ultimate tensile strength, and elastic modulus from engineering plots of $\sigma-\varepsilon$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2. Demonstrate understanding the relationships of processing and microstructure by</td>
<td>3. Formative Tests: Multiple choice pop quizzes.</td>
<td></td>
</tr>
<tr>
<td>1.2.1. Illustrate contributions of various strengthening mechanisms, including solid solution strengthening, precipitation strengthening, strain hardening, and grain size strengthening relationship.</td>
<td>- Extended questions quizzes.</td>
<td></td>
</tr>
<tr>
<td>1.2.2. Explain a phase diagram, including determining phase diagram type, predict phase compositions (given various temperatures and compositions), and predict microstructures for given compositions.</td>
<td>4. Summative Tests: Midterm Exams - Final Comprehensive Exam</td>
<td></td>
</tr>
<tr>
<td>1.2.3. Demonstrate understanding of heat-treatment of steels and cast irons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Fundamentals of materials selection for engineering applications.</td>
<td>5. See laboratory syllabus</td>
<td></td>
</tr>
<tr>
<td><strong>(ABET ETAC SLO # 1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1. Demonstrate knowledge of engineering materials by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1.1. Classify various engineering materials: Ceramics; Polymers; Composites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1.2. Conduct and present a materials selection survey as part of a team for current materials applications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Evaluate and analyze of materials failure. <strong>(ABET ETAC SLO # 1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1. Demonstrate understanding of various materials failure mechanisms by</td>
<td>1. See laboratory syllabus</td>
<td></td>
</tr>
<tr>
<td>3.1.1. Describe the type of failure as Mechanical or Degradation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.2. Characterize the type of failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.3. Analyze the possible process for materials failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. The principles of materials microstructure characterization and mechanical testing.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX II
Course Topics

Microscale Building Structure of Solid Materials
- Atomic and ionic bond characteristics
- Crystalline structures, Miller Indices, Packing Factor, and Theoretical Density, etc.
- Understanding crystals imperfections
- Dislocations and Strengthening
- Polymers and Ceramics

Materials Processing and Microstructure
- Various strengthening mechanisms, including solid solution strengthening, precipitation strengthening, strain hardening, and grain size strengthening relationship.
- Phase diagrams, including, predict phase compositions (given various temperatures and compositions), and predict microstructures for given compositions.
- Heat-treatment of steels and cast irons
- Surface hardening and diffusion of atoms

Materials Selection and Failure in Engineering Practice
- Engineering Materials Classification
- Mechanical Properties
- Materials Failure
- Materials Selection in Design
- Materials Degradation and Corrosion
- Materials Failure Analysis (Case Studies)