ENGINEERING MATERIALS

INSTRUCTOR
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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

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

CATALOG COURSE DESCRIPTION
3 Credit hours
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,

➢ You should register by the provided course ID for this course. Course ID is 558632 at www.wileyplus.com.

➢ Homework and exercise problems will be accessible through WileyPlus website.

LECTURES SLIDES

➢ I will post on UNT Blackboard 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 Participation and Engagement.
2. Online Homework (every chapter on WileyPlus).
3. Class Quizzes (every 2 weeks on Thursdays, except in the exam weeks).
4. Three (3) Exams.

CLASS PARTICIPATION AND ENGAGEMENT (REEF at UNT-Denton are provided for students use at no cost)

REEF Polling: Engagement, participation, and interaction are important elements of the learning process. To that end, we will be using REEF polling, so each student must be registered to REEF and have a device (computer, smartphone, or tablet) for polling responses during the class hours for this course.

Please read instruction on the Blackboard for registration and downloading the app on your device.

Academic Integrity: *Please note that the misuse of REEF will be considered a violation of proper student conduct and will be treated as cheating. For this class, REEF is to be used as a learning tool by you in the classroom. Misuse would include submitting answers for a friend who is not in attendance in class, submitting answers when you are absent, having someone else submit answers for you when you are absent, or any other use of REEF by which you are not submitting your own work in class.

HOMEWORK (online on WileyPlus.com):
1. Homework assignments will be online through the course textbook website (WileyPlus.com).
2. Number of questions in each homework will be varied.
3. Average scores of your top 80% of homework assignments will be used in counting the course final grade.
4. There will not be deadline extension for homework submissions.
5. No make-up on homework assignments.

QUIZZES (on paper or online)
1. Number of questions in each quiz will be varied.
2. Questions will be like the questions in the homework, practice assignments, or examples in the textbook.
3. One lowest score will be dropped in averaging of quizzes scores.

EXAMS (on paper):
1. Total score of each exam will be on percentile, with different value points for each question.
2. Exams 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 sessions will be offered on the class before the exam.
5. There will NOT be drop of any exam scores.

EVALUATION AND GRADING SCALE

EVALUATION VALUES

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Participation and Engagement</td>
<td>10%</td>
</tr>
<tr>
<td>Homework</td>
<td>15%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>15%</td>
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<tr>
<td>Exam 1 (February 16, 2017)</td>
<td>20%</td>
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<tr>
<td>Exam 2 (March 30, 2017)</td>
<td>20%</td>
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<tr>
<td>Final Exam (8:00 AM – 10:00 AM on May 11, 2017)</td>
<td>20%</td>
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</tbody>
</table>
GRADING SCALE
A: 90 % - 100%
B: 75% - 89 %
C: 65% - 74%
D: 55% - 64%
F: Below 55%

GENERAL RULES FOR EXAMS AND QUIZZES:
1. Grades for the course will be assigned as it has been shown above on the basis of the Evaluation Schedule. 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 of dynamics will be provided. Use of iPhone, smart phone, smart watch, and laptop NOT allowed during exams and quizzes.

3. To protect the integrity of exams and quizzes, there is a limit the types of calculators you may bring 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. Graded quizzes will be returned to students in the class. You must pick up your graded papers. Unclaimed papers will be recycled one week after I post the grade on the Blackboard gradebook.

5. No make-up will be given for the scheduled exams and quizzes, 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).

6. 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 will 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.

6. Requests for a review of a graded exam problem must be submitted during the following class hour after which the exam is returned. In this matter, the review is not limited to a single problem requested by the student. Upon review, the exam score may increase, remain the same, or decrease.

7. 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. Class Attendance: Attendance is required for the class hours.

2. Cell phones, iPhones, iPods, iPads, laptops must be in silent mode before the start of the class.

3. 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 Blackboard.

4. Email Communications: All email communications must be through your UNT assigned email address. You should write ENGR 3450 -Spring 2017 in the subject line. I will not reply emails from yahoo, gmail, outlook, Hotmail, etc.

5. 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 handheld 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.

6. **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 complies with Section 504 of the 1973 Rehabilitation Act and with the Americans with Disabilities Act of 1990. The University of North Texas provides academic adjustments and auxiliary aids to individuals with disabilities, as defined under the law. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring accommodation, please see the instructor and/or contact the Office of Disability Accommodation at 940-565-4323 during the first week of class.
## APPENDIX I

**Student Learning Outcomes and Teaching Strategy**

ENGR 3450 – Engineering Materials

<table>
<thead>
<tr>
<th>OUTCOMES</th>
<th>ASSESSMENT</th>
<th>INSTRUCTION</th>
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<tbody>
<tr>
<td>1. Interrelationships of processing-structure-properties-performance in solid materials</td>
<td>Formative Tests: - Multiple choice, - Extended questions (problem solving, mini projects, presentation)</td>
<td>- Lectures</td>
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<tr>
<td>1.1. Demonstrate the ability to relate materials properties and microstructure by</td>
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<td>- Homework (in and out of class, some group work)</td>
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<tr>
<td>1.1.1. Relate bond energy to properties of engineering materials</td>
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<td>- Quizzes (in class)</td>
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<td>1.1.2. Analyze crystalline structures</td>
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<td>- Some video clips</td>
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<td>1.1.3. Calculate Miller Indices, Packing Factor, and Density of Selected Unit Cells.</td>
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<td>- Reading textbook</td>
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<td>1.1.4. Describing crystals imperfections</td>
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<td>- Reading other course Materials</td>
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<td>1.1.5. Explain the process of work hardening and Schmidt’s Law</td>
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<td>- Some “flipped class” sessions</td>
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<td>1.1.6. Illustrate understanding of atomic scale diffusion of atoms</td>
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<td>1.1.7. Interpret mechanical properties, including yield strength, ultimate tensile strength, and elastic modulus from engineering plots of σ−ε</td>
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<td>1.2. Demonstrate understanding the relationships of processing and microstructure by</td>
<td>Summative Tests: - Midterm Exam - Final Comprehensive Exam</td>
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<td>1.2.1. Illustrate contributions of various strengthening mechanisms, including solid solution strengthening, precipitation strengthening, strain hardening, and grain size strengthening relationship.</td>
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<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>
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<td>1.2.3. Demonstrate understanding of heat-treatment of steels and cast irons</td>
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<tr>
<td>2. Fundamentals of materials selection for engineering applications</td>
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<td>2.1. Demonstrate knowledge of engineering materials by</td>
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<td>2.1.1. Classify various engineering materials: Ceramics; Polymers; Composites</td>
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<td>2.1.2. Conduct and present a materials selection survey as part of a team for current materials applications</td>
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<td>3. Evaluate and analyze of materials failure</td>
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<td>3.1. Demonstrate understanding of various materials failure mechanisms by</td>
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<td>3.1.1. Describe the type of failure as Mechanical or Degradation</td>
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<td>3.1.2. Characterize the type of failure</td>
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<td>3.1.3. Analyze the possible process for materials failure</td>
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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)