ENGINEERING MATERIALS

INSTRUCTOR
Dr. Reza Mirshams
Office: F-128, Discovery Park
Telephone: 940-565-2594
E-mail Address: Reza.Mirshams@unt.edu
Email Subject Line: ENGR 3450 – Summer 2016
Office hours: Mondays and Wednesdays 11 AM - 12 PM and 3:00 – 4:00 PM.

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.
ENGR 3451-Engineering Materials Laboratory is required for MET and MEE Majors

COURSE MATERIALS AND RESOURCES

REQUIRED TEXTBOOK (print or online version)

- You need to register by the provided code for this course. Course ID is 517596 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 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.

DISCUSSION BOAD

- Discussion Board on the Blackboard have been built for asking questions and participation in discussion of individual topics in the course.
- I will post answers to frequently asked questions.
- If you have a private message, please email me using the email system on the Blackboard and not the UNT email system.
- Also, get in the habit to check the Blackboard everyday as I will post important messages there about the class.
- I generally will answer to students’ questions within 1 business day. I also typically check messages on the weekends, but I don't guarantee it as I may have family commitments, too.

ASSESSMENT METODOLOGY

1. Online Homework (every chapter).
2. Class Quizzes (every week).
3. Three (3) Exams.

HOMEWORK:

1. Homework assignments will be online through the course textbook website.
2. Number of questions in each homework will be varied. However, each question will have 10 points value.
3. Suggested solutions will be provided and feedback will be provided on submitted questions.
4. Average scores of your top 80% of homework assignments will be used in counting the course final grade.
5. No late homework will be accepted.
6. No make-up on homework assignments.

CLASS QUIZZES:

1. Number of questions in each quiz will be varied. However, each question will have 20 points value.
2. Questions will be similar to the questions in the homework and practice assignments or examples in the textbook.
3. Average scores of top 80% quizzes will be counted toward your final grade.

EXAMS:
1. Total score of each exam will be on 100 points, with different value points for each question.
2. Exams questions will be on topics have been discussed in the class lectures and reading assignments.
3. There would 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.

EVALUATION AND GRADING SCALE

EVALUATION VALUES
- Class Attendance: 5%
- Homework: 15%
- Class Quizzes: 20%
- Exam 1 (June 22): 20%
- Exam 2 (July 20): 20%
- Exam 3 (TBA): 20%

GRADING SCALE
- A: 90% - 100%
- B: 75% - 89%
- C: 65% - 74%
- D: 55% - 64%
- F: Below 55%

GENERAL RULES FOR EXAMS AND QUIZZES:
1. All class quizzes are closed book and only basic trigonometric calculators may be used. Please see the following website for the calculators will be allowed during the exams and quizzes: [http://ncees.org/exams/calculator-policy/](http://ncees.org/exams/calculator-policy/)
2. Graded quizzes will be returned to the 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.
3. 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).
4. Grades are based in part on the student's ability to communicate in writing solutions to question. You must present your entire solutions in an orderly way for problems need calculation. For some certain questions, you must show complete process of your
solutions. Partial credits will be assigned for correct steps have been taken in a solution. Grade points will not be assigned only on the final answers for those types of questions.

5. Requests for the review of a graded exam problem must be submitted during the class hour of following the return of a graded exam. 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.

ADDITIONAL COURSE POLICIES

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

2. Students who are not completing and doing well on the homework or quizzes may be dropped from the class even if you are doing well on the exams.

3. Cell phones, iPhones, iPods, iPads, laptops must be turned off or in silent mode before the start of the class and left in your pocket, purse, or book bag.

4. 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.

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 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.

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 at the same time that 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 ACCOMMODATION

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>
</tr>
</thead>
<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 - Homework (in and out of class, some group work)</td>
</tr>
<tr>
<td>1.1. Demonstrate the ability to relate materials properties and microstructure by</td>
<td>Summative Tests: - Midterm Exam - Final Comprehensive Exam</td>
<td>- Quizzes (in class) - Some video clips - Reading textbook - Reading other course Materials</td>
</tr>
<tr>
<td>1.1.1. Relate bond energy to properties of engineering materials</td>
<td></td>
<td>- Some “flipped class” sessions</td>
</tr>
<tr>
<td>1.1.2. Analyze crystalline structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.3. Calculate Miller Indices, Packing Factor, and Density of Selected Unit Cells.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.4. Describing crystals imperfections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.5. Explain the process of work hardening and Schmidt’s Law</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.6. Illustrate understanding of atomic scale diffusion of atoms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.7. Interpret mechanical properties, including yield strength, ultimate tensile strength, and elastic modulus from engineering plots of σ–ε</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2. Demonstrate understanding the relationships of processing and microstructure by</td>
<td>Formative Tests: - Multiple choice, - Extended questions (problem solving, mini projects, presentation)</td>
<td>- Lectures - Homework (in and out of class, some group work)</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>Summative Tests: - Midterm Exam - Final Comprehensive Exam</td>
<td>- Quizzes (in class) - Some video clips - Reading textbook - Reading other course Materials</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></td>
<td>- Some “flipped class” sessions</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></td>
<td></td>
</tr>
<tr>
<td>2.1. Demonstrate knowledge of engineering materials by</td>
<td>Formative Tests: - Multiple choice, - Extended questions (problem solving, mini projects, presentation)</td>
<td>- Lectures - Homework (in and out of class, some group work)</td>
</tr>
<tr>
<td>2.1.1. Classify various engineering materials: Ceramics; Polymers; Composites</td>
<td>Summative Tests: - Midterm Exam - Final Comprehensive Exam</td>
<td>- Quizzes (in class) - Some video clips - Reading textbook - Reading other course Materials</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>- Some “flipped class” sessions</td>
</tr>
<tr>
<td>3. Evaluate and analyze of materials failure</td>
<td></td>
<td>- Some “flipped class” sessions</td>
</tr>
<tr>
<td>3.1. Demonstrate understanding of various materials failure mechanisms by</td>
<td>Formative Tests: - Multiple choice, - Extended questions (problem solving, mini projects, presentation)</td>
<td>- Lectures - Homework (in and out of class, some group work)</td>
</tr>
<tr>
<td>3.1.1. Describe the type of failure as Mechanical or Degradation</td>
<td>Summative Tests: - Midterm Exam - Final Comprehensive Exam</td>
<td>- Quizzes (in class) - Some video clips - Reading textbook - Reading other course Materials</td>
</tr>
<tr>
<td>3.1.2. Characterize the type of failure</td>
<td></td>
<td>- Some “flipped class” sessions</td>
</tr>
<tr>
<td>3.1.3. Analyze the possible process for materials failure</td>
<td></td>
<td>- Some “flipped class” sessions</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

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