

MSE 2001B – Fall 2016
Principles and Applications of Engineering Materials
Mondays, Wednesdays, and Fridays 11:05-11:55 AM
Location: Instructional Center 219

Course Description: Materials science and engineering is based on the unifying principle that the performance of materials is controlled by their structure, properties, and processing. In this course we will first learn how to describe and quantify the structure of materials. The structure will then be related to specific materials properties and how temperature, deformation, and other processing parameters can be used to change the structure and properties of materials.

Instructor: Prof. Christopher Muhlstein,
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Office Hours: My office hours are on Mondays from 1:00-2:00 pm and the TAs office hours will be posted on T-square.

Textbook: James P. Schaffer, Ashok Saxena, Stephen D. Antolovich, Thomas H. Sanders, Jr. and Steven B. Warner, *The Science and Design of Engineering Materials*, Irwin, Chicago, IL. Please note that any edition of the textbook can be used and that it is considered a required resource for the course.

Course Website: T-square site will be used to post the course syllabus, lecture notes, homework, and homework-solutions. Important announcements will also be sent to your T-square account so please check it regularly.

Quizzes and Exams: All quizzes and exams will be closed book. No formula sheets other than the ones provided with the exam paper will be allowed. The exams will emphasize topics that are detailed in the textbook as outlined below.

1. Exam I- tentatively Ch. 1-4
2. Exam II- tentatively Ch. 5-7
3. Exam III- tentatively Ch. 8-9
4. Final Exam- comprehensive (Ch. 1-10)

Grades: Your grade in the course will be determined based on your performance on one online pretest, four written examinations, and a series of written pop quizzes. All exams and quizzes will be closed notes, closed book tests (i.e., no supplementary materials of any kind are to be used). The pretest is administered via T-Square, and your score is based on if you take the exam (full credit) or if you do not (no credit). The purpose of the pretest is to document your knowledge when you enter the class, so there is no expectation that you will answer the questions correctly. The pop quizzes (10 minutes long) will be given at the start of the class period following the completion of the lectures associated with a given chapter. The first three examinations (50 minutes long) will be held during the regular meeting time of the class on the dates indicated on the syllabus. The last examination will be administered during the final exam period (2 hours 50 minutes). Final grades will be curved at the instructor's discretion based on a strategy that will be discussed during the first class meeting.

| <u>Exam (Tentative Chapters and Date)</u> | <u>Percentage of Final Grade</u> |
|--|---|
| Pretest (8/24-8/26) | 2% |
| Exam I (Ch. 1-4, 9/23) | 15% |
| Exam II (Ch. 5-7, 10/24) | 15% |
| Exam III (Ch. 8-9, 11/30) | 15% |
| Pop Quizzes (start of some lectures) | 20% |
| Final Exam (Ch. 1-10, 12/14 8AM-10:50AM) | 33% |

Midterm grades: Midterm grades will be reported as “S” or “U”. A “U” will indicate unsatisfactory performance, i.e., a “D” or “F.” The midterm grade will be determined by the grade on the first examination.

Homework: Homework problems will be given after each chapter is completed. Homework is not to be turned-in, and you are responsible for using the provided solutions to gauge your understanding of the material. Students are strongly encouraged to work on the homework and extra problems from the book. Neglecting the homework will likely jeopardize your performance in the class. Students are allowed/encouraged to study together (including working together on the homework assignments). You can ask question regarding your homework, although you should try to think about the problems before asking me or the TA(s).

Quizzes: A 10-minute pop quiz may be given at the start of the lecture that follows one where a chapter was finished. Please note that there will not be a quiz after chapter 1 or 10 (the first and last chapters for the semester, respectively) or on chapters that are completed immediately before an exam. Quizzes will be at the start of the following lecture period and no supplemental reference materials will be allowed (i.e., they are closed to notes, the textbook, and other references).

Make up policy: Pop quizzes will be conducted in the normal class period. Your lowest pop quiz score will be dropped when your grade for the course is calculated. Those with Institute sanctioned activity excuses will be allowed to take missed quizzes, per Institute policy. Make-up exams will only be permitted when absences are due to legitimate reasons such as illness, religious observance, or other events recognized by the Institute as a valid excuse. In any case, you must contact the instructor in advance of the test in writing (email is fine) to schedule a make-up exam. If you do not contact the instructor in advance, it may not be possible to schedule a make-up test. Whenever possible, make-ups will be administered during the week following the scheduled date of the quiz or exam. Make-up exams and quizzes may be different from those administered during the regular examination period.

Extenuating Circumstances: Please be sure to meet with the Dean of Students if you encounter extenuating circumstances that interfere with your ability to attend class and/or prepare for exams. The Dean’s office is your best resource when you would prefer to not discuss the details of your personal situation.

Grade Accuracy: Errors in grading and/or recording of scores for quizzes and exams must be addressed within 7 days of posting on T-Square by contacting the instructor in writing via email. Disputes after this one-week period will not be

considered.

Final Exam Conflicts: The Institute has established the policies for final exam scheduling conflicts that are summarized in the list below. If you request an accommodation, please contact the instructor via email and include a list of all of your courses (course numbers and sections) and their exam periods on the day in question. If you have additional questions about the Institute's policies, please refer to the Office of the Registrar's website which is located at <http://registrar.gatech.edu/students/examguide.php>. Please note the following Institute policies:

- "All students should check the Final Exam Schedule against their own class schedule and report any conflicts to the instructor(s) as soon as possible. It is the responsibility of each student to see that all possible conflicts are resolved by the instructor and the proper authorization received no later than 2 weeks before the Monday of exam week. A special period is provided as a conflict period in which to reschedule conflicting examinations. Refer to the Final Exam Schedule for the conflict date. Other periods within the exam week may also be used for conflicting examinations provided no student is forced to take more than two examinations in one day."
- "Any course that is offered outside the normal scheduling format must make arrangements to give way to courses offered in the normal time slot. If a conflict arises between two courses that offer finals outside the normal scheduling format, the conflict will be resolved by the instructor rescheduling the examination for the course with the lower number. The common final for any course may not take up more than one exam period."
- "In the event a student has two examinations scheduled for the same period, the conflict will be resolved by the course having the lower course level number being considered in conflict. The final examination in that course shall be given during the conflict examination period or, by agreement of the instructor and the student, at a mutually satisfactory time."
- "In the event a student is scheduled for three examinations in one day, the examination scheduled for the middle period will be considered in conflict. The conflict will be resolved by giving the examination during the conflict period at another time mutually agreed upon by the instructor and the student."

Academic Integrity: All students in this class are expected to respect the *Georgia Tech honor code* and behave in a professional manner when it comes to academic integrity. Please also note the policy for electronic devices below. Any students violating the honor code or suspected of academic misconduct will be turned over to the office of Academic Integrity, Dean of Students to investigate the incident(s). Cheating off of another person's test or quiz is unethical and unacceptable. Cheating off of anyone else's work is a direct violation of the GT Academic Honor Code, and will be dealt with accordingly. *For any questions involving any Academic Honor Code issues, consult me, my teaching assistants, or www.honor.gatech.edu.*

Electronic Devices: The only electronic device that you may use during a quiz or exams is a commercially available calculator that cannot communicate with other devices without a direct physical connection (i.e., no wireless, IR or other communication

capabilities). Programmable and graphing calculators are allowed, but their memories should be appropriately cleared. Your use of a calculator should be consistent with the class policy that reference materials of any kind are *not permitted* on quizzes or exams. The use of any mobile/wireless communication device (smart watch, cell phone, smart phone, etc.) in any way, shape, or form during a quiz or exam is strictly forbidden. Please be sure to put away your cell phones and watches before the quiz or exam begins. If you have *any* electronic device available/in your possession during a quiz or exam, you will be considered in violation of the academic integrity policy and referred to the office of Academic Integrity. All electronic devices must be placed inside of and remain in a closed bag, purse, or backpack during quizzes and exams. Sharing or passing of calculators is also strictly forbidden: all persons involved in the sharing or passing will be in violation of the academic integrity policy and referred to the office of Academic Integrity.

Word: Use of any previous semester course materials is allowed for this course; however, I remind you that while they may serve as examples for you, they are not guidelines for any tests, quizzes, homework, or any other coursework that may be assigned during the semester. Examples of quizzes and exams from previous semesters are posted on T-Square.

Special Needs: The Georgia Institute of Technology encourages qualified persons with disabilities to participate in its programs and activities. If you anticipate needing any type of accommodation in this course or have questions about physical access, please tell the instructor as soon as possible.

Course Objectives: Students will learn the fundamentals of structure-property-processing-performance relationships of engineering materials; learn the fundamentals of mechanical, chemical, electrical, and thermal properties of materials; be prepared to undertake more in-depth courses in specialized areas within materials science and engineering.

Course Outcomes: Students should be able to demonstrate their understanding by qualitatively and quantitatively describing: 1. the five microstructural elements- atomic/molecular structure, defects, solute, precipitates, and grain boundaries and how they manifest themselves in each class of material. 2. how the key microstructural elements are controlled by composition, temperature, time, and deformation. 3. how material structure relates to mechanical and electrical performance. 4. the structure, chemistry, and phase fractions in solids. 5. how materials properties are calculated from empirical data.

Teaching Assistants: You are encouraged to contact your TA(s) for questions/problems. Below you will find a list of the TA(s) and e-mail address(es). TA contact and office hour information will also be posted on T-square

Head TA: Saad Javaid
e-mail: saad@gatech.edu
Office: Bunger Henry 124
Office Hours: By Appointment

MSE 2001G – Fall 2016
Principles and Applications of Engineering Materials

Tentative Schedule

| <u>Week</u> | <u>Dates</u> | <u>Topics</u> | <u>Chapter</u> |
|-------------|------------------|--|----------------|
| 1 | 8/24-8/26 | PRETEST (ONLINE) | |
| | 8/22 | Introduction to Materials | Ch. 1 |
| | 8/24 | Atomic Bonding | Ch. 2 |
| | 8/26 | Atomic Bonding | Ch. 2 |
| 2 | 8/29 | Atomic Bonding | Ch. 2 |
| | 8/31 | Crystal Structures | Ch. 3* |
| | 9/2 | Crystal Structures | Ch. 3 |
| 3 | 9/5 | Labor Day Holiday | |
| | 9/7 | Crystal Structures | Ch. 3 |
| | 9/9 | Crystal Structures | Ch. 3 |
| 4 | 9/12 | Imperfections in solids- Point Defects | Ch. 4* |
| | 9/14 | Imperfections in Solids- Point Defects | Ch. 4 |
| | 9/16 | Imperfections in Solids- Point Defects | Ch. 4 |
| 5 | 9/19 | Imperfections in Solids- Point Defects | Ch. 4 |
| | 9/21 | Imperfections in Solids- Diffusion | Ch. 4 |
| | 9/23 | EXAM I (Chapters 1-4) | |
| 6 | 9/26 | Imperfections in Solids- Linear Planer and Point Defects | Ch. 5 |
| | 9/28 | Imperfections in Solids- Linear Planer and Point Defects | Ch. 5 |
| | 9/30 | Imperfections in Solids- Linear Planer and Point Defects | Ch. 5 |
| 7 | 10/3 | Non Crystalline and Semi-crystalline Solids | Ch. 6* |
| | 10/5 | Non Crystalline and Semi-crystalline Solids | Ch. 6 |
| | 10/7 | Non Crystalline and Semi-crystalline Solids | Ch. 6 |
| 8 | 10/10 | FALL BREAK | |
| | 10/12 | Phase Equilibria and Phase Diagrams | Ch. 7* |
| | 10/14 | Phase Equilibria and Phase Diagrams | Ch. 7 |
| 9 | 10/17 | Phase Equilibria and Phase Diagrams | Ch. 7 |
| | 10/19 | Phase Diagrams | Ch. 7 |
| | 10/21 | Phase Diagrams | Ch. 7 |
| 10 | 10/24 | EXAM II (Chapters 5-7) | |
| | 10/26 | Kinetics Microstructure and Phase Transformation | Ch. 8 |

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|----|-------|--|--------|
| | 10/28 | Kinetics Microstructure and Phase Transformation | Ch. 8 |
| 11 | 10/31 | Phase Transformations | Ch. 8 |
| | 11/2 | Phase Transformations | Ch. 8 |
| | 11/4 | Phase Transformations | Ch. 8 |
| 12 | 11/7 | Martensitic Transformations | Ch. 8 |
| | 11/9 | Stress Strain Behavior | Ch. 9* |
| | 11/11 | Ductile and Brittle Fracture | Ch. 9 |
| 13 | 11/14 | Brittle Fracture | Ch. 9 |
| | 11/16 | Fracture Mechanics | Ch. 9 |
| | 11/18 | Fracture Mechanics | Ch. 9 |
| 14 | 11/21 | Fatigue Fracture, Time Dependent Behavior – Creep | Ch. 9 |
| | 11/23 | Official School Holiday (Thanksgiving) | |
| | 11/25 | Official School Holiday (Thanksgiving) | |
| 15 | 11/28 | Electrical Conductivity and energy band diagrams | Ch. 10 |
| | 11/30 | EXAM III (Chapters 8-9) | |
| | 12/2 | Semiconductors: elemental, compound, n-type, p-type | Ch. 10 |
| 16 | 12/5 | Semiconductors: Temperature dependence | Ch. 10 |
| 17 | 12/14 | Final Exam (Period 10, 12/14 (Wed) 8:00-10:50 AM) | |
| 18 | 12/19 | Grades Due | |

* indicates a likely quiz date. We will have quizzes after completing the chapter 2, 3, 5, 6, and 8