MSE 2001– Fall 2026
Principles and Applications of Engineering Materials

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Textbook: Recommended Textbook (*as a reference*): James P. Schaffer et al., The Science and Design of Engineering Materials, 2ND Ed., McGraw-Hill. However, we will not follow the order of chapters in the recommended text (and I shall provide an explanation for this below) *but we will start with optics as the starting point* – The reasons will be outlined below. I have also listed several texts that are useful references and I will make every effort to help with material for you to read, should the following not suffice.

Another Reference that will be quite useful:

Shackelford, J. *Introduction to Materials Science for Engineers*. 6th edition. Upper Saddle River, NJ: Pearson, 2004. ISBN: 9780131424869.

Chapter 3, "Crystalline Structure"
Chapter 4, "Crystal Defects."
Chapter 5, "Diffusion."
Chapter 9, "Phase Diagrams."
Chapter 12, "Ceramics and Glasses."
Chapter 13, "Polymers."
Chapter 14, "Optical and Magnetic Materials"

This is an interesting book and takes a broad view of materials science and engineering.

Resources: The following resources will be useful for your study but I will try to update things as and when necessary/possible.

The static links to the electronic resources (available free via the GT library) are:

- David Cebon, Hugh Shercliff, Michael F. Ashby, *Materials*, 2nd Edition, Butterworth-Heinemann 2009, ISBN: 9780080961552.

  https://learning.oreilly.com/library/view/materials-2nd-edition/9781856177436/

- Alan Crosky, Mark Hoffman, Paul Munroe and Belinda Allen, *Materials Engineering Online Tutorials*

  https://textbooks.elsevier.com///manualsprotectedtextbooks/9780081023761/Tutorials/index.htm

- [Saylor] = *General Chemistry: Principles, Patterns, and Applications*. Saylor Foundation, 2011. [A free online textbook]

  This is a very interesting text and you should consult this book for a number of aspects – Although it says it is a General Chemistry textbook, there are some universities that use this as a text for Solid State Chemistry – Many of the chapters dealing with "Science" aspect of the course is dealt with quite nicely, and you would benefit immensely by looking through the relevant chapters.

Course Website: Canvas will be used to post the course syllabus, lecture notes, homework, and homework-solutions.

Quizzes and Exams: All quizzes and exams will be closed book, but will be limited in time to the allocated time, unless otherwise specified or modified due to extraneous factors. The exams will emphasize topics as outlined below.

- *Exam I- tentatively*: Introduction, Optics, Structure of the Atom, Crystal Structure
- *Exam II- tentatively*: 12th Nov,Defects and Non-Crystalline Solids and Polymers
- *Final Exam*- (Written, in Class) Comprehensive.

Reason for Starting with Optics:

We live in a world that is beautiful, and this beauty is brought to *light with science as a tool*, and in the words of Marie Curie, who notes, "I am among those who think that science has great beauty. A scientist in his laboratory is not only a technician, he is also a child place before natural phenomenon, which impress him like a fairy tale". All one has to do is look around to "see" the beauty that surrounds us. The word "*see*" is the key and forms the basis of what we know about our existence in this world of ours. One can provide a large number of examples that are beautiful to us, humans, like the pink/reddish color of the clouds in the evening as the sun sets, the incredible northern lights, the clear blue of the sky, the breathtaking blue of some oceans, the brilliant blue color of the wing-scales of a Morpho butterfly, the metallic green of the beetle, Chrysina Glorosia, that fascinated Albert Michelson, a Nobel Prize winner, a gentle fog over water on a cold morning are among the many phenomena that are fascinating. Figure 1, below, provides an array of these that we humans call beautiful. All of these are manifestations of light interacting with matter and that interaction detected by the visual system we possess. Hence, I have decided that we need to start with optics as a motivator for the study of materials.

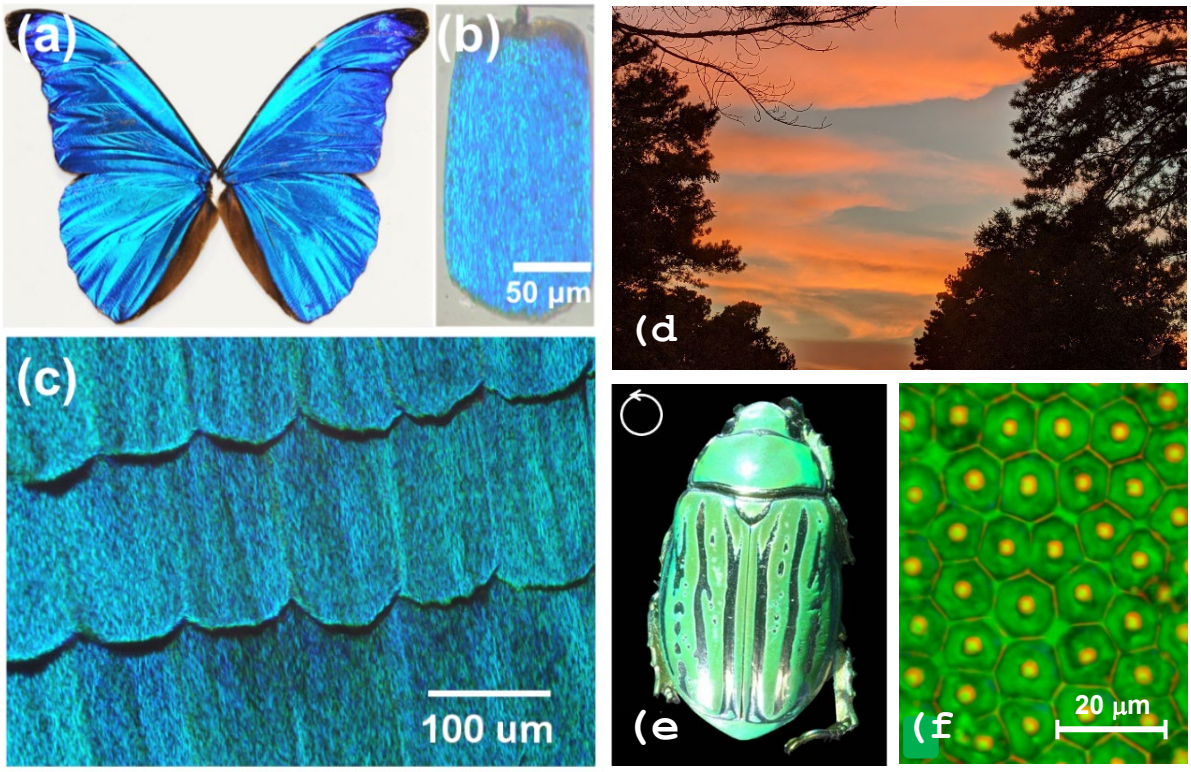

Figure 1. Shown are images of what we humans, the visual animals would call beautiful images. (a) Shows Blue *Morpho* butterfly with its beautiful, metallic blue color. (b) A single scale of the Blue *Morpho*. (c) Shows the tile like arrangement of the individual wing scales of the butterfly Blue *Morpho*. (d) The beautiful clouds, in the late evening near the author's home in Atlanta, USA. (e) Image of a Jewel beetle that reflects circularly polarized light that fascinated Albert Michelson and (f) shows what the beetle looks like under a polarized light microscope in reflection.

All of these images are here to illustrate that the colors are due to the interaction of light with matter as we, humans, are visual creatures.

Office Hours: TBD

TA: *No TA for the course*

Lectures: Attendance in lecture correlates strongly with performance for any course, and reading assigned chapters prior to lecture is encouraged and beneficial for lecture.

Attendance: Attendance is necessary to earn "in class" activity points (20% of final grade). Please note this class will proceed through material at a faster-than-normal pace, hence attending class is essential for performing well.

Grades: Your grade in the course will be assessed based on your performance on two written exams and the final exam, which is comprehensive. The first two examinations 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 (3 hours). Final grades will be based on the following :

Course Grades: **Score** 89.5% - 100% (A); 74.5% - 89.4% (B); 59.5% - 74.4% (C); 49.5% - 59.4%(D); < 49.5% (F)

Exam	**Percentage of Final Grade**
Exam I	20%
Exam II	20%
Final Exam (as scheduled-2025)	30%
Writing Assignments, Attendance+paper/presentation	*30%*

(Note: I have not given you many writing assignments so far)

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.

Written Assignments: This is important for appreciating the material that will be covered in the semester.

I *will assign writing assignments* for you every so often – When you write, you will have to organize your thoughts, and present the arguments in a logical fashion, which enables you to "learn" the material. I have been doing this for the past two years, and it has helped students understand the material better. I am asking you to write, because I believe that writing requires serious thinking. In addition, serious thinking is what I am really after – in other words, I want to make you curious.

These are not to be graded, but they carry 10% of the grades of the course. If you make an earnest attempt, you will get the 10% assigned. These assignments maybe completed during class, say at the end of the class; or a longer assignment asking you to describe an experiment discusses in class or some other combination, all with the idea of helping you understand the material that is presented.

Homework: Homework problems *may* 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. You 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. You are allowed/encouraged to study together (including working together on the homework assignments). *You can ask questions regarding your homework, although you should try to think about the problems before asking me, or googling for the answer*.

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://www.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. 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.

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.

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* relationships

of engineering materials; the relationship of these fundamentals to the performance of these materials; the major properties, mechanical, chemical, optical, and thermal properties of materials; prepare students to undertake more in-depth courses in specialized areas within materials science and engineering.

Course Outcomes: At the end of the course, you should have a good understanding of the following:

- Fundamentals of structure-property-processing relationships in engineering materials.
- Cognizant of the interactions of light with matter (as this is how we know everything about us)
- Relate fundamentals to the performance of the materials.
- Understand phase diagrams for the different classes of materials
- Discuss the major differences in the characteristics of ceramics, metals, and polymers
- Be able to discuss mechanical properties of classes of materials.

Finally something about *Netiquette*

- Netiquette refers to etiquette that is used when communicating on the Internet. Review the Core Rules of Netiquette. When you are communicating via email, discussion forums or synchronously (real-time), please use correct spelling, punctuation and grammar consistent with the academic environment and scholarship.

Rules of Academic Etiquette (From: Molly Worthen, UNC – Chapel Hill)

General rules of thumb:

- When in doubt about how you should speak, write, or act, *always err on the side of formality.* You will never offend or annoy someone by being overly formal and polite.
- While you are in college, your coursework is your job. You should behave as you would in a professional work environment.

When addressing your professor(s) in person:

- Always address them as "Professor Smith" or "Dr. Smith."
- Do not call them by their first names or anything else unless they explicitly ask you to do so.

When writing an email to your professor:

- Begin the email with "Dear Professor Smith," Dear Prof. Smith," or "Dear Dr. Smith." Do not begin the email "Hi" without addressing your professor by their title and surname.
- Emails should not be in a confrontational tone. For example, if you want to discuss your exam and how it is graded, do not write saying "I want to *contest* my exam" – This is confrontational and sets the tone for the meeting. Be mindful of the fact emails can be misread.
- *Be alert to the tone of your message*. Any email to a professor or teaching assistant should sound like a formal letter, not a text message or a demand to a customer service representative. For example, you should write:

Dear Professor Smith,
I am unable to come to your office hours this week. Are you available at any time on Monday instead?

Sincerely, Jane

Do NOT write

Hi,
I need to talk to you about the test. Can I come by Mon? Thx Jane

Do NOT write

Hello,
I'm a senior and I need your class to graduate. Connect Carolina says I need permission. I need you to enroll me immediately.
Jane

- Write in complete sentences with correct spelling, grammar, and punctuation.
- Proofread your email before sending it.

More importantly, please do not send me emails at odd hours of the day, and responses to your messages will be accommodated within 48hrs, unless a response is deemed necessary in a shorter time frame.

Finally, something about attendance:

Absences:
Class attendance is expected. Students who miss class might also miss important aspects of the course, and that can impact your grades. Institute policy on absences for illness or personal emergencies may be found at:
http://www.catalog.gatech.edu/policies/student-absence-regulations/ (Links to an external site.)

Required Items (from Georgia Tech Rules)

Students with special needs or accommodation, please contact the Office of Disability Services
https://disabilityservices.gatech.edu

Student-Faculty expectations are given here: https://catalog.gatech.edu/rules/22/

Students are expected to fully comply with the Georgia Tech Honor Code given here:
https://policylibrary.gatech.edu/student-life/academic-honor-code