Instructor: Preet Singh (preet.singh@mse.gatech.edu)
Course Prefix and Number: MSE 4105
Term: Fall 2026

Course Description

Deformation and fracture of metals, ceramics, polymers and composites, with the focus on correlating their monotonic- and time-dependent mechanical properties and behaviors with atomic bonding, microstructure, and micromechanics, for applications relevant to material selection and design, mechanical forming processes, and analysis of engineering failures.

Course Learning Outcomes

1. Students will describe the deformation behavior of major classes of materials, including metals, ceramics, polymers, and composites, in terms of the relationships between their various mechanisms, properties, and applied forces and displacements.
2. Students will demonstrate an understanding of the fundamental principles of linear elastic fracture mechanics, test methods, and microstructure effects.
3. Students will demonstrate an understanding of material degradation mechanisms.
4. Students will demonstrate the ability to perform basic stress analyses and evaluate performance of design based on stiffness, strength, fatigue resistance, etcRequired

Course Materials

No textbooks or materials are required, but access to the recommended textbook will help with homework and practice problems

Recommended Textbook: Marc Meyers and Krishan Chawla, *Mechanical Behavior of Materials,2nd Edition*, Cambridge University Press., New York.

Other Resources Used: D. Hull and D.J. Bacon, Introduction to Dislocations, 4th Edition, Elsevier, 2001(ISBN:978-0-7506-4681-9). Electronically available free of charge through the Georgia Tech Library or on campus networked computers at http://www.sciencedirect.com/science/book/9780750646819

Dissemination of IT for the Promotion of Materials Science (DoITPoMS)
https://www.doitpoms.ac.uk/tlplib/index.php

Grading Policy:

Your grade in the course will be determined based on your performance on three written examinations, quizzes, and a group project. All exams will be closed notes, closed book tests (i.e., no supplementary materials of any kind are to be used). The three examinations will be held during the regular meeting time of the class on the dates indicated on the syllabus.

Exam *(Tentative Chapters)*	**Percentage of Final Grade**
Exam #1	20%
Exam #2	20%
Exam #3	20%
Class Quizzes	20%
Group Project + Presentation	20%

Description of Graded Components

Final Grade: The minimum weighted score grade ranges for the semester are as follows:

A	≥85%
B	75-84%
C	65-74%
D	50-64%
F	<50%

USG Required Course Policies

Attendance and/or Participation

Accommodations for Individuals with Disabilities: If you have learning needs that require special accommodation, please contact ODS office at http://disabilityservices.gatech.edu/, or (404)894-2563 as soon as possible, to discuss your needs and obtain an accommodations letter. Please also let me know about your special needs.

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 are not comfortable discussing 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 Canvas 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://www.registrar.gatech.edu/students/examguide.php

Student Use of Mobile Devices: Please silence all mobile devices at the beginning of class. Laptops and IPADS may be used during but only for the purpose of taking notes.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Additional Georgia Tech Required Policies

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Make-up exams or quizzes 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 or a makeup quiz. If you do not contact the instructor in advance, it may not be possible to schedule a make-up test. When possible, make-ups will be administered during the week following the originally scheduled date. Make-up exams may be different from those administered during the regular examination period.

Midterm grade: Midterm grade will be reported as "S" (satisfactory), or "U" (unsatisfactory) performance, i.e., a "D" or "F," and will be determined based on examination and home-works. However, the final grades may be curved at the instructors' discretion based on the overall students' performance.

On-line Quizzes: A 10 to 15 minute quizzes will be given after finishing a major topic/chapter *(unless otherwise specified)*. Students will take this quiz on Canvas before beginning of the following lecture (after finishing a topic). *Announcement of the upcoming quiz date will be made **in the classroom** upon completion of each major topic/chapter.*

Homework: Homework problems will be given for each chapter or lecture topic. The homework problems are listed in the lecture slide for each new chapter. 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 the TA(s) or the instructor.

Student Use of Mobile Devices in the Classroom

Please silence all mobile devices at the beginning of class. Laptops and IPADS may be used during but only for the purpose of taking notes.

Campus Resources for Students

Academic Support: Academic Success and Advising (a unit in the Office of Undergraduate Education & Student Success) provides free support for your courses. Students can attend scheduled supplemental review (PLUS) sessions, stop by Drop-In Tutoring, or schedule a one-on-one appointment through Knack. To explore what options work best for you, please visit us online at success.gatech.edu/tutoring, email us at tutoring@gatech.edu, or come see us at Clough Undergraduate Learning Commons, Suite 283.

A list of resources for graduate students is given on the Office of Graduate and Postdoctoral Education website. Specific information for current graduate students includes

- Academic Resources such as the Communications Center, Language Institute, Library, Catalog, Registrar, resources for conducting research, Advocacy and Conflict Resolution resources, and how to manage unexpected situations that may impact your academic performance;
- Student Resources such as Campus Services, Child Care/Family programs, Health & Wellness, Career Services, and the Student Resource Guide; and
- Professional Development such as the programming from the Career Center and other professional development resources and events"]

Student Well-Being:

"At Georgia Tech, we are concerned about your overall physical, social, and mental well-being. A comprehensive list of wellness related resources has been compiled and maintained by the Office of the Vice President for Student Engagement and Well-being (student-resource-guide (gatech.edu)

More resources on supporting student well-being on the syllabus and beyond are available through the Learning Well Initiative.

Teaching Assistants:

TAs will hold Microsoft Teams Office hours. You are encouraged to contact your TAs for questions/problems.

Name: **TBD** **Email:** **TBD**

Office: **Online office hours;**

Office Hours: To Be Announced

Topics Covered:

(a) Mechanical response and Stress States

(b) Elasticity and viscoelasticity theories, properties, and anisotropy

(c) Yielding and plastic flow in crystalline solids

(d) Deformation of polymers and glasses

(e) Strengthening mechanisms and composites

(f) Time-dependent deformation (Creep) and Superplasticity

(g) Fracture mechanics theories, toughness, and embrittlement

(h) Ductile/brittle transition phenomenon and microstructure effects

(i) Cyclic stress/strain-controlled fatigue failure and life prediction

(j) Analysis of engineering failures