

ME 6204 – Micromechanics of Materials

Fall 2021

Tue: 9:30 - 10:45 AM / Thu: 9:30 - 10:45 AM

- Credit: 3-0-3 (3 credits, 3 hours per week)
- Prerequisites: Graduate standing: Principles of Continuum Mechanics (ME6201) or equivalent, Mechanics of Deformable Bodies (COE3001) or equivalent
- Instructor: Dr. Stephane Berbenni
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- Office Hours: Tue 10:45 -11:45 AM / Thu 10:45 -11:45 AM or by appointment
(residential or via BlueJeans)
- Textbook (recommended): • Jianmin Qu and Mohammed Cherkaoui, Fundamentals of Micromechanics of Solids, John Wiley, 2006
- Other reference textbooks:
- Toshio Mura, Micromechanics of defects in solids. Kluwer Academic Publishers, Dordrecht, The Netherlands, 1987
 - Sia Nemat-Nasser and M. Hori, Micromechanics: Overall Properties of Heterogeneous Materials, North- Holland, 1993.
 - George J. Dvorak, Micromechanics of Composite Materials (Solid Mechanics and Its Applications), Springer, 2013.
- Objectives: This class will introduce the unified theories of micromechanics of solids: - To study the microstructure of materials in the context of continuum theories of mechanics, - To develop methods for predicting the mechanical behavior of composite materials
- Topics:
- Introduction of micromechanics of solids, motivation, important definitions and examples (2 weeks)
 - Review of the continuum mechanics field equations for micromechanics, General theory of eigenstrains (2 weeks)
 - General solutions, Green's function method, Fourier Transform representation, Lippmann-Schwinger equation for micro-heterogenous elasticity with eigenstrains (2 weeks)
 - Eshelby's inclusion problem, inhomogeneity problem, Equivalent Inclusion Method (2 weeks)

- Effective properties of heterogeneous materials, average theorems, Hill's lemma (2 weeks)
- Voigt, Reuss approximations (1 week)
- Different homogenization schemes for heterogeneous elastic materials: Eshelby scheme, Mori-Tanaka scheme, Self-Consistent scheme, Hashin-Shtrikmann estimates, Generalized self-consistent scheme (3 weeks).

Course Assignments: All course assignments will be submitted electronically via Canvas. Homework assignments will be graded and the solutions will be handed out and posted on Canvas. No late assignments will be accepted (except acceptable reason). All class handouts will be given in class and via Canvas.

Evaluation: 30% Homework
30% Mid-term Exam
40% Final Exam

Grading Scale: Your final grade will be assigned as a letter grade according to the following scale:
A 90-100%
B 80-89%
C 70-79%
D 60-69%
F 0-59%

Important dates: First class day: Aug. 24
Mid-term exam (1 hour and 20 minutes): to be defined (at least two weeks in advance)
Drop day: Oct. 30
Recess week: Nov. 1-5
Final instructional class day: Dec. 6-7
Final examination (2 hours and 50 minutes). Period: Dec. 8-17. The schedule of the final exam will be defined later in the semester (at least one month in advance) and will be non negotiable.

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. For information on Georgia Tech's Academic Honor Code, please visit <http://www.catalog.gatech.edu/policies/honor-code/> or <http://www.catalog.gatech.edu/rules/18/>. Any student suspected of cheating or plagiarizing on an exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

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. See <http://www.catalog.gatech.edu/rules/22/> for an articulation of some basic expectation 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.

Requirements and Guidelines due to Covid'19 pandemic:

Delivery mode: Residential (traditional, in-person delivery of courses using social distancing measures in the classroom). Due to COVID-19 pandemic, students are asked to keep the seat they will be assigned in classroom all over the entire semester.

Expectations and Guidelines:

Attendance policy attendance will be taken at the beginning of each class. Each of us has a responsibility to ourselves. We are all required to wear a face covering while inside any campus facilities/buildings, including during in-person classes, and to adhere to social distancing of at least 6 feet. If an individual forgets to bring a face covering to class or into any indoor space, there will be a clearly marked supply of these in each building. If a student fails to follow Georgia Tech's policies on social distancing and face coverings, they will initially be reminded of the policy and if necessary, asked to leave the class, meeting, or space. If they still fail to follow the policy, they may be referred to the Office of the Dean of Students.