

ME 6204 – Micromechanics of Materials

Fall 2019

Tue: 11:00 AM-12:30 PM / Thu: 11:00 AM-12:30 PM

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

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Office Hours: Tue: 9:00-11:00 AM / Thu: 9:00-11:00 AM (or by appointment)

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 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).

Assignments: Homework assignments will be graded and the solutions will be handed out. No late assignments will be accepted (except acceptable reason). All class handouts will be given in class, and, will be available in Dr Berbenni's office.

Evaluation: 30% Homework
30% Mid-term
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: Sept. 22 (introductory lecture)
Mid-term examination (1.5 hours): Oct. 24 (drop day: Oct. 26)
Recess week: Oct. 28-Nov. 1
Final instructional class day: Dec. 3
Final examination (2 hours 50 minutes): to be defined in the period Dec. 5-12. The final date will be sent by end of September. The schedule of the final exam is non negotiable.

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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.