Georgia Institute of Technology

ME 6204 – Micromechanics of Materials

Fall 2017
Tue: 3:30-5:00 PM / Thu: 3:30-5:00 PM

Credit: 3-0-3 (3 credits, 3 hours per week)

Prerequisites: Graduate standing: Principles of Continuum Mechanics (ME6201) or equivalent (recommended)

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Office Hours: Tue 2:00 PM-3:30 PM / Thu 5:00 PM-6:00 PM (or by appointment)

Textbooks (recommended):
- Jianmin Qu and Mohammed Cherkaoui, Fundamentals of Micromechanics of Solids, John Wiley, 2006
- Toshio Mura, Micromechanics of defects in solids. Kluwer Academic Publishers, Dordrecht, The Netherlands, 1987

Other reference textbooks:
- 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, eigenstrain theory (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, Mori-Tanaka, Self-Consistent schemes, 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: Aug 24 (introductive lecture)
Mid-term examination (1.5 hours): Oct 24 (before drop day: Oct 28)
Recess week: Oct 30-Nov 3
Final instructional class day: Dec 5
Final examination (3 hours): The final examination week is scheduled for the period Dec 7- Dec 14. The final date will be announced during the semester at least 2 weeks in advance.

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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.