MAE 6140: State Variable Modeling

Room/Time: Upson 146 T, R 11:25-12:40
Credit Hours**:** 4
Prerequisites: MAE 6110 or approval of instructor
Instructors: M.N. Silberstein (ms2682), 281 Kimball Hall

TEXTBOOK

Morton E. Gurtin, Eliot Fried, Lallit Anand, *The Mechanics and Thermodynamics of Continua (2010)* (free online version available for Cornell students)

OTHER RESOURCES

1. Applied Mechanics of Solids, Bower, http://solidmechanics.org/
2. Continuum Mechanics and Thermodynamics, Tadmor, Miller and Elliot, 2012 - from a Cornell IP: http://lib.myilibrary.com/Open.aspx?id=357955&src=2
3. Modeling Materials, Tadmor, Miller, 2012 – http://lib.myilibrary.com/Open.aspx?id=334091&src=2
4. Imechanica Advanced Elasticity lecture notes from Zhigang Suo - http://imechanica.org/node/725

COURSE WEBPAGE

http://canvas.cornell.edu/

OVERVIEW

This course will present an introduction to constitutive modeling, specifically focusing on the state variable modeling framework. This approach can be used to represent a broad range of material behaviors and material systems, including: metals, polymers, biomaterials, and composites; anisotropy and rate and temperature dependent plasticity. Implicit in the state variable method is the representation of processes at small size scales within the constitutive response at the macroscale. Experimental model validation and quantification of state variables will also be explored.

TOPICS

- Survey of materials
- Constitutive models – overview
- Model validation – overview
- Continuum mechanics background/review
- Linear elasticity, isotropic and anisotropic
- Hyperelasticity
- Viscoelasticity
- Plasticity
- Coupling with non-mechanical fields
- Other topics upon request

GRADING

The assignments for this course will be 5 mini projects distributed throughout the semester, and each worth 20% of the total grade. The projects can cover any material system. The focus of the project options will follow the course topics, selecting 5 from (1) classifying materials, (2) linear thermo elasticity, (3) hyperelasticity, (4) viscoelasticity, (5) plasticity, (6) multiphysics coupling. At least one of these must be a presentation of a detailed review of a constitutive modeling paper and at least one must be a computational implementation of a constitutive model.