53:243 (58:251) Computational Inelasticity

2002/04 Catalog
(Revised)

53:243 (58:251) Computational Inelasticity  3 s.h.

Description:  Applied continuum mechanics; mathematics and numerics of constitutive modeling of solids; elastoplasticity; viscoplasticity.


Coordinator:  C.C. Swan, Assoc. Professor of Civil & Environmental Engineering

Goals:  Develop competency in implementing and testing sound inelastic constitutive models for solids in a computational mechanics framework.

Suggested pre- or co-requisites: 53:141 (58:179) Continuum Mechanics & Elasticity

Topics (Approximate Class Hours):

1.  Vectors, tensors, and linear operators in continuum mechanics (4)
2.  Continuum deformation (3)
3.  Stress and balance of momenta (3)
4.  Invariants of the stress tensor (1)
5.  Thermodynamic restrictions on constitutive models (5)
6.  Classical rate-independent elastoplasticity (4)
7.  Principle of maximum plastic dissipation (2)
8.  Classical yield criteria in elastoplasticity (1)
9.  Classical viscoplasticity (3)
10.  Integration and return-mapping algorithms for plasticity and viscoplasticity (6)
11.  Implementation aspects in computational mechanics framework (2)
12.  Non-smooth, multi-surface plasticity (3)
13.  Finite deformation continuum mechanics (4)
14.  Objective rate integration algorithms (4)
15.  Plasticity models based on multiplicative decompositions (4)

Computer Usage:  Yes
Laboratory Project:  None

Prepared by:   C.C. Swan   Date:  July 2003
Average Class Hours Per Week: Lecture 3.0, Discussion 0, Laboratory 0, Other 0, Total 3.0

Teaching Aids, Facilities, and Instrumentation Used: None

Objectives, Approach, and Perspective of Course:

Students develop working knowledge of constitutive model development and implementation in a computational mechanics framework. The approach is to first establish a sound mathematical framework for modeling material behaviors based on continuum thermodynamic considerations. Rate-independent elastoplasticity models are first presented followed by introduction of rate-dependent viscoplasticity models. Incremental loading and unloading conditions are discussed. Mathematics of assorted numerical integration algorithms which typically involve return mapping is covered. To gain a practical grasp of the numerical and mathematical issues, students are assigned the numerical implementation of increasingly more involved constitutive models in a finite element framework throughout the semester and then required to test their implementations on a number of problems. The mathematical level of sophistication required is consistent with the needs of the advanced engineering graduate student.

Programs Served:

Civil & Environmental Engineering, Mechanical & Industrial Engineering, and Biomedical Engineering

Students Served:

Advanced graduate students

Frequency of Offering:

Every other academic year.