THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Computational Analysis of Manufacturing Processes

ISE 7510

Credit Hours:
3.00 - 3.00

Course Levels:
Graduate

Course Components:
Lecture

Course Description:
This course is designed to teach graduate students about constitutive models used for numerical simulation of the inelastic behavior of bulk and sheet materials.

Prerequisites and Co-requisites:
Prereq: Grad standing in ISE, or MechEng, or MatScEn; and knowledge using commercial math software (Matlab, etc.), or ability to write simple codes with Fortran, C++, etc., and knowledge using commercial FEA code (e.g. ABAQUS, LS-Dyna, PAM STAMP, ANSYS, DEFORM, etc.); or permission of instructor.

Course Goals / Objectives:
- To teach students about the modeling of the behavior of anisotropic metals with nonlinear, rate-independent, elastic-plastic phenomenological yield functions.
- Briefly, teach about the modeling of polycrystalline metals with microstructure-based constitutive models (e.g., crystal plasticity).
- Numerically analyze the large plastic deformation of materials under uniaxial tension and biaxial deformations. Analyze complex material deformation in sheet metal stamping. Analyze the effect of material anisotropy on plastic deformation.
- Analyze manufacturing defects such as tensile instability that leads to fracture, springback, and wrinkling within the context of material properties.
- Derive analytical solutions for simple manufacturing processes.

Course Topics:

- Uniaxial tensile test and basic material behavior
- Tensile instability in sheet metals (uniaxial, plane strain, biaxial)
- Numerical methods to solve uniaxial tension test
- Tensors and notations
- Stress (3 hr) Strain (3 hr)
- Student presentations on paper review (2 hr) Rigid plasticity and the concept of yield function – isotropic and anisotropic (4 hr)
- Incremental theory of plasticity (3 hr) Numerical method for stress integration (3 hr)
- Forming Limit Diagram (FLD) and application to sheet metal forming (2 hr) Crystal plasticity for polycrystalline materials (2 hr) Student presentations on Final Project (2 hr)

Designation:
Elective