COURSE NOTES

Instructor in Charge:
Ronaldo I. Borja
Y2E2 Room 277C; Tel. 723-3664
E-Mail: borja@stanford.edu
Office Hours: M & W 1:30 – 2:30 P.M.

Course Assistant:
Qing (Will) Yin
E-Mail: qingyin@stanford.edu
Office Hours: To be announced

Textbook:

- R.I. Borja, Plasticity Modeling and Computation, Springer-Verlag, 2013.

Notes:

- The course outline on page 2 is tentative and subject to change.
- The course deals with the basic aspects of inelastic material behavior from a modeling standpoint.
- Homework problem sets will be assigned on a regular basis. Most of the homework questions are found in the textbook. You will simply receive email instructions from me on what problems from the book to solve, along with some attachments (such as code templates for computing assignments). Computing assignments will require knowledge of Matlab or other computer language.
- There will be a one-hour midterm examination (Monday, May 13) and a take-home final examination. Weighting for the final grade is: Final Examination: 40%, Mid-Term Examination: 30%, Homework: 30%.
- Website: `http://web.stanford.edu/~borja` and then click on "Classes".

COURSE OUTLINE

1. **Introduction (Chapter 1)**

   The big picture; structure of a nonlinear FE program.

2. **Plasticity in one dimension (Chapter 2)**

   One-dimensional nonlinear problems; basic numerical solution procedures; notion of isotropic and kinematic hardening in one dimension.

3. **J2 plasticity (Chapter 3)**

   Deviatoric plasticity; flow rule; isotropic, kinematic, and combined hardening; plastic dissipation.

4. **Integration algorithm for J2 plasticity (Chapter 3)**

   Radial return algorithm; consistent tangent operator; introduction to general return mapping algorithm.

   Midterm Examination – May 13

5. **Isotropic functions (Chapter 4)**

   Spectral representation; Mohr-Coulomb and Drucker-Prager models; return-mapping in principal directions.

6. **Cap models (Chapter 6)**

   Hyperelasticity; nonlinear elasticity; hyperelasto-plasticity; critical state plasticity; volumetric, deviatoric, and mixed hardening.

8. **Discontinuities (Chapter 7)**

   Contact problem; Lagrange multipliers, penalty, and augmented Lagrangian methods.

7. **Viscoplasticity (Class Notes)**

   Rate-dependent problems; Duvaut-Lions and Perzyna viscoplasticity; time integration; creep and stress relaxation; viscoplastic regularization.

   Take-Home Final Examination