Nonlinear Computational Mechanics

ENME E6364

*Prof. Jacob Fish Fall 2016*

*Office Location: Mudd 606 Office Hours: Wen 5PM -6PM*

 *e-mail:* *fishj@columbia.edu*

*Course comments*

1. The material in this course will be taken from several books and journal papers.

2. Introductory courses in Finite Element method or equivalent are required.

3. Grading: 20% for class assignments and 80% for the project.

4. The project topic should be relevant to the course material and should include at least some portion of programming. A progress reports and a final report are required. The progress report is due at the midterm. The final report should be submitted by last day of classes.

5. All homeworks and project have to be submitted in electronic format (preferably WORD) and uploaded to CourseWorks.

Course Contents

1. Introduction

2. Selected Topics in Continuum Mechanics

3. From Strong and Weak Form to Solution of Nonlinear System of Algebraic Equations

4. Constitutive Laws and Stress Update Procedures

5. Consistent Linearization and Tangent Stiffness Matrix

6. Finite Element Formulation of Solids and Shells

7. Equality Constraints and Contact

8. Multiphysics

9. Object oriented finite element code structure

10. FOOF tutorial

References

1. J. Fish, Z. Yuan, Y. Jiao. Nonlinear Finite Elements: From Theory to Object Oriented Fortran Code (in preparation)
2. Belytschko, T., Liu, W.K. and Moran, B., Nonlinear Finite Elements for Continua and Structures, 2nd edition J. Wiley & Sons, New York, 2014.
3. J.C. Simo and T.J.R. Hughes, Computational Inelasticity. Springer 1998.
4. P. Wriggers. Nonlinear Finite Element Methods. Springer, 2008.
5. J.E. Dennis, Jr. and R.B. Schnabel, Numerical Methods for Unconstrained Optimization and Nonlinear Equations, Prentice-Hall, Englewood Cliffs, 1983.
6. R. D. Borst, M. A. Crisfield, J. J. C. Remmers, C. V. Verhoosel. Nonlinear Finite Element Analysis of Solids and Structures, 2nd Edition. Wiley 2012.
7. E. de S. Neto, D Peric, D.R.J. Owen. Computational Methods For Plasticity. Wiley, 2008.
8. S. Nemat-Nasser. Plasticity: A Treatise on Finite Deformation ofHeterogeneous Inelastic Materials. Cambridge University Press, 2004.