Duke University
Pratt School of Engineering

CE 630 / ME 525
Nonlinear Finite Element Analysis

Spring 2017

Instructor: Professor Guglielmo Scovazzi
381 Gross Hall
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Sakai Course Page: https://sakai.duke.edu

Lecture: Tue-Thurs 3:05-4:20
318 Gross Hall

Office Hours: by appointment
381 Gross Hall

Textbook: None required. Instructional material will consist of lecture notes and occasional prepared handouts and research articles. You may find the references below useful.

References: T.J.R. Hughes,
The Finite Element Method
(Prentice Hall, 2000)

Zienkiewicz, O.C. & R.L. Taylor,
The Finite Element Method for Solid and Structural Mechanics
(6th Edition, Elsevier, 2005)

Bonet, J. & R.D. Wood,
Nonlinear Continuum Mechanics for Finite Element Analysis
(Cambridge University Press, 1997)

Strang, G. and G.J. Fix,
An Analysis of the Finite Element Method
(Prentice Hall, 1973)

Grading: 50% Homework and Programming Assignments
50% Final Project

Notes

1. Homework will be assigned periodically during the semester, and will be graded. Diligence in doing the homework assignments is essential for understanding of the material. I do not discourage working together on homework; however, plagiarism will not be tolerated.

2. The final project for the course will be on a topic proposed by the student, but must be approved by me before work is begun. It is expected that most projects will consist of the programming, testing and demonstration of an element to handle some nonlinear phenomenon. Examples are nonlinear heat conduction, large displacement beam theory, elastoplasticity, large strain elasticity, contact/impact phenomena, and etc. Try to discuss your idea for the project with me early in the semester. The grade on the final project will be based on two items: 1) A written report (due on the last working day of the reading period, Friday, April 26); and 2) An oral presentation to be given to the class during the last week of classes (April 20 or 22). As with the midterm, independent work on the final project is mandatory.

Tentative Lecture Schedule

Week(s)	Topics
0*	Introduction
1	Review of general FEM concepts
2-3	Types of nonlinearity; simple examples of material nonlinearity
4-6	Nonlinear equation solving; Newton-Raphson, quasi-Newton, conjugate gradient, arc-length strategies
7	Geometric nonlinearity. Finite strain elasticity
8	Finite strain elasticity (cont'd)
	SPRING BREAK
9	Computational plasticity
10	Computational plasticity (cont'd)
11-12	Transient problems
13	Student presentations

* denotes short week