CONTINUUM MECHANICS

Instructors: **Prof. Antonios Giannakopoulos**
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Class: Fridays 15:00-18:00
Office Hours:

Textbook:
P. Chadwick, 1999. Continuum Mechanics. Concise Theory and Problems. 2nd edition, Dover Publications. Mineola, New York
Recommended Reading:
Nonlinear Solid Mechanics, Gerhard Holzapfel, Wiley, 2000.
Non-linear Elastic Deformations, R.W. Ogden, pub. Dover, 1984.
Introduction to the Mechanics of a Continuous Medium, Lawrence Malvern, pub. Prentice-Hall, 1969.
A First Course in Continuum Mechanics, 3rd edition, Yuan-Cheng Fung, pub. PrenticeHall, 1994.
Nonlinear Finite Elements for Continua and Structures, Ted Belytschko et al., pub. Wiley, 2000.
Tensor Analysis and Continuum Mechanics, Wilhelm Flügge, pub. Springer-Verlag, 1972.
Continuum Mechanics, Walter Jaunzemis, pub. MacMillan, 1967.
ii The Non-linear Field Theories of Mechanics, Clifford Truesdell and Walter Noll, 3rd ed, pub. Springer 2004.
Vector Analysis, Schaum's Outline Series, Murray Spiegel, pub. McGraw-Hill, 1959.

CONTENTS

1. Tensor analysis.
2. The Rayleigh transport theorem.
3. The deformation gradient.
4. The polar decomposition theorem.
4. Rotations and stretches. Lagrangian and Eulerian description of deformation metrics.
6. Mass conservation.
7. Conservation of linear momentum.
8. Conservation of angular momentum.
9. The stress tensors: Cauchy, 1st and 2nd Piola-Kirchhoff.
10. Objective deformation measures. The velocity gradient tensor.
11. Decomposition to strain rate and spin.
12. Principal stretches and principal directions. Invariants of symmetric tensors.
13. Orthogonal tensors.
14. Equilibrium equations and the Virtual Work theorem.
15. Constitutive equations in elasticity and fluid mechanics.
16. Anisotropy.
17. Hyperelasticity.
18. Internal constrains: incompressibility, inextensibility.
19. The first thermodynamic theorem.
20. The second thermodynamic theorem.
21. Objective stress rates.
22. Objective deformation rates.
23. Mechanical power and work conjugate stresses and deformation tensors.

24. Jump conditions and discontinuities.
25. Problems of large deformation elasticity.
26. Problems of fluid mechanics.