MECH 6306-001

Continuum Mechanics

Fall 2013

Instructor: Prof. Xin-Lin Gao
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Classroom: ECSS 2.306
Time: TR 4:00-5:15 p.m.

Prerequisites: MECH3301 (Advanced Mechanics of Materials), ENGR3300 (Advanced Engineering Mathematics), MATH2418 (Linear Algebra)

Textbook (optional):

- W. M. Lai, D. Rubin and E. Krempl, *Introduction to Continuum Mechanics*, 4th edition, Butterworth–Heinemann, Woburn, MA, 2009

Reference Books:

- P. Chadwick, *Continuum Mechanics: Concise Theory and Problems*, Halsted, 1976
- L. E. Malvern, *Introduction to the Mechanics of a Continuous Medium*, Prentice-Hall, Upper Saddle River, NJ, 1969
- Y. C. Fung, *A First Course in Continuum Mechanics*, 3rd edition, Prentice Hall, 1994
- M. E. Gurtin, *An Introduction to Continuum Mechanics*, Academic Press, 1981
- A. J. M. Spencer, *Continuum Mechanics*, Longman, 1980
- R. W. Ogden, *Non-Linear Elastic Deformations*, Dover, 1997
- J. N. Reddy, *An Introduction to Continuum Mechanics*, Cambridge Univ. Press, 2008
- M. E. Gurtin, E. Fried, L. Anand, *The Mechanics and Thermodynamics of Continua*, Cambridge Univ. Press, 2010
- G. A. Holzapfel, *Nonlinear Solid Mechanics*, Wiley, 2000.

Grading:

Homework	20%
Mid-term Exam	40%
Final	40%

TA: Yong He   Office: ECSS 3.619   E-mail: yxh120330@utdallas.edu

Office Hours:

Tuesday, Thursday	1:00 – 2:00pm
Monday, Wednesday (TA's Office)	1:00 – 2:00pm

Course Objectives

- Develop a thorough understanding of fundamental principles governing deformations, constitutive behavior and stress responses of a continuum
- Learn to formulate mechanics problems rigorously and concisely by using tensorial, index or engineering notations
- Apply general theories to solve representative problems in solid and fluid mechanics

Course Outline/Topics*

1. **Tensor Analysis:** index notation, tensor algebra, tensor calculus (~ **3 weeks**)

2. **Kinematics and Kinetics:** motion, material and spatial descriptions, rigid-body motion, displacement and strain, principle strains, rate of deformation tensor, additive decomposition, mass conservation, compatibility, deformation gradient, polar decomposition theorem, strain tensors, area and volume changes, stress vector, principle stresses, stress tensors (~ **4 weeks**)

3. **Conservation Laws:** equation of motion, stress power, energy equation, Clausius-Duhem inequality, divergence theorem, Reynolds's transport theorem, integral (weak) forms of conservation laws (~ **3 weeks**)

4. **Constitutive Equations:** frame of reference, principle of material frame indifference, isotropic hyperelastic solids, nonlinear elasticity, sample large deformation elasticity problems (~ **2 week**)

5. **Linearized Elasticity:** generalized Hooke's law, anisotropic/orthotropic/transversely isotropic/isotropic materials, stress and displacement formulations, Navier equations, wave propagation in isotropic elastic solids, torsion of cylindrical bars (~ **1 week**)

6. **Fluid Mechanics:** inviscid fluids, incompressibility, hydrostatics, viscous fluids, Newtonian fluids, Navier-Stoke's equations, sample solutions of potential and incompressible flow problems (~ **1 week**)

* *These topics are tentative and subject to change.*

Other Relevant Information

- Solving problem is essential in learning the course materials. Several sets of homework problems will be assigned and graded.
- The instructor is available for additional help with appointments.
- The class notes are intended to be self-consistent, but more examples can be found in the textbook and references suggested.