"Never regard your study as a duty, but as the enviable opportunity to learn to know the liberating influence of beauty in the realm of the spirit for your own personal joy and to the profit of the community to which your later work belongs."

Albert Einstein

Fall 2017

BMD----, MEG---| Continuum mechanics, 12 Units

This course provides an introduction to continuum mechanics. The main objective of the course is to understand mathematical modeling of solid-like or fluid-like materials. Class participation and discussion in a seminar-type fashion are encouraged. The course begins with a historical review of the subject followed by a review of vector and tensor analysis, before discussing various measures of deformation and stress formulations. The development and understanding of appropriate constitutive models are at the core of this course. Both analytical and to some extent experimental results are presented through readings from reports in recent journals and the relevance of these results to the solution of unsolved problems is highlighted. The intent is to provide the basic ideas of continuum mechanics for engineering and science students with little background in mechanics or mathematical modeling, with emphasis on the application of quantitative and system perspectives to fluid and solid mechanics problems. In addition to looking at various examples, the last few weeks of the course are dedicated to discussing individually-crafted research projects for the students.

Pre-requisites: 21-260 Differential Equations or permission of instructor.
Knowledge in mechanics of deformable solids (24-202) and fluid mechanics desirable.

Instructor: Dr. Mehrdad Massoudi
MEHRDADM@ANDREW.CMU.EDU
Office: Visiting Room 7219 Wean Hall
Office Hours: After class, and by appointment
Time and Place: Wednesdays 4:30-7:30 pm
Wean Hall 7218: August 30 and September 6th
Wean Hall 7201: September 13 to December 13th

No food, cell phones (texting) or laptops in the class without prior permission.

Textbook: Fundamentals of Continuum Mechanics: With Applications to Mechanical, Thermomechanical, and Smart Materials by Stephen Bechtel and Robert Lowe, $120.00
Publisher: Academic Press; 1 edition (November 19, 2014)
ISBN-10: 012394600X
ISBN-13: 978-0123946003

A. References on Continuum Mechanics:

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7. S.C. Cowin. *Continuum Mechanics of Anisotropic Materials*. Springer, 2013.
8. A. C. Eringen. *Nonlocal Continuum Field Theories*. Springer, 2002.
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22. C. Truesdell and W. Noll. *The Non-Linear Field Theories of Mechanics*, Springer-Verlag, 2nd ed., 1992.

B. References on Solid Mechanics and Elasticity:

1. R. J. Atkin and N. Fox. *An Introduction to the Theory of Elasticity*. Dover Publications.
2. B. Audoly and Y. Pomeau. *Elasticity and Geometry*. Oxford University Press, 2010.
3. Y. Basar, and D. Weichert. *Nonlinear Continuum Mechanics of Solids*. Springer, 2000.
4. A. F. Bower. *Applied Mechanics of Solids*. CRC Press, 2010.
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C. References on Fluid Mechanics and Rheology:

1. H. A. Barnes, J. F. Hutton, and K. Walters. *An Introduction to Rheology*. Elsevier, 1989.

2. R. B. Bird, R. C. Armstrong, and O. Hassager**.** *Dynamics of Polymeric Liquids, Vol. 1.* Wiley-Interscience; 2nd edition (May 1987).
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20. H. Schlichting. *Boundary Layer Theory*.

Week 1: August 30, 2017
Introduction, History, Background, Overview [My Notes]

Week 2: September 6, 2017
Overview
Mathematical Preliminaries (Vectors, Tensors) [Lecture Notes]

Week 3: September 13, 2017

Mathematical Preliminaries (Vectors, Tensors) [Lecture Notes]
Kinematics [Lecture Notes]

Week 4: September 20, 2017
Kinematics [Lecture Notes]
Measures of Deformation [Lecture Notes]

Week 5: September 27, 2017
Measures of Deformation [Lecture Notes]

Week 6: October 4, 2017
Balance Laws [Lecture Notes]
Stress Tensors [Supplementary Notes]

Week 7: October 11, 2017
Constitutive Relations [Supplementary Notes]

Week 8: October 18, 2017
Midterm Exam/Project
Constitutive Relations [Supplementary Notes]

Week 9: October 25, 2017
Topics in Fluid Mechanics [Lecture Notes])

Week 10: November 1, 2017
Topics in Fluid Mechanics [Lecture Notes]

Week 11: November 8, 2017
Topics in Fluid Mechanics [Lecture Notes]

Week 12: November 15, 2017
Topics in Solid Mechanics [Lecture Notes, Supplementary Notes]

Week 13: November 22, 2017
No class/Thanksgiving Holiday

Week 14: November 29, 2017
Topics in Solid Mechanics [Lecture Notes, Supplementary Notes]

Week 15: December 6, 2017
Term Projects/Presentation

Week 16: December 13, 2017
Term Projects/Presentation

Grading:

Class participation and weekly Homework assignments, including scanned or xeroxed copies of your hand-written notes based on the lectures in class: 30%
Midterm Project: 20%
Final Project- PPT Presentation and Report: 50%
