
CE 8930 - 004 (Spring 2016)
Computational Poromechanics

INSTRUCTOR

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Research website: <http://www.clemson.edu/ces/geomechanics>

Office hours: any time

CLASS TIME AND PLACE

6:30 - 9:30pm Mondays Lowry Hall 301

RECOMMENDED TEXTBOOKS

Lecture notes and handout will be posted on blackboard. The following books are highly recommended references:

[1]. O. Coussy, Poromechanics, John Wiley & Sons, 2004.

[2]. J. Bear, Dynamics of Fluids in Porous Media, Dover Publications, 1972.

[3]. R.I. Borja, Plasticity - Modeling and Computation, Springer, 2013.

[4]. J. Rudnicki, Fundamentals of Continuum Mechanics, Wiley, 2014.

[5]. T. Belytschko, W.K. Liu and B. Moran, Nonlinear Finite Elements for Continua and Structures, Wiley, 2000.

COURSE DESCRIPTION

Computational poromechanics deals with the numerical solution of coupled multi-physics problems in porous media such as biological tissue, geomaterials, foams, etc. In particular, the balance of mass and linear momentum equations in multi-phased media (e.g., solid and fluids) will be derived from continuum mechanics principles and solved using finite element procedures. The course culminates with the analysis of coupled flow-deformation problems of fluid-saturated porous materials

COURSE OBJECTIVES

By the end of this course, students will be able to develop an understanding for the basic balance laws governing the physics of fluid-saturated porous media and to be able to cast such balance laws within the framework of finite element procedures to analyze coupled flow-deformation boundary-value problems.

GRADING

Homework 40%

Final project 60%

CLASS ATTENDANCE AND POLICY

- Students are required to attend every lecture. If you miss more than three lectures without valid excuses, you will be dropped or receive incomplete grade for this course.
- In the event that the instructor is late for the lecture, you are free to leave after you have waited for 10 minutes.

TENTATIVE CLASS TOPICS

- 1. Introduction**
The big picture; basic definitions; historic aspect
- 2. Brief Review of Continuum Mechanics and Finite Element Method**
Basic tensor and vector calculus; structure of a typical FE program
- 3. Flow Through Porous Media**
General conservation laws; constitutive assumptions; Darcy's law.
- 4. Finite Element Formulation of Fluid Diffusion**
Strong and weak forms; Galerkin approximation; matrix problem; solution of elliptic and parabolic systems; generalized trapezoidal family of methods.
- 5. Finite Element Formulation of Coupled Solid Deformation-Fluid Flow**
Mixture theory; the effective stress concept; variational principles; mixed formulation; elastic deformation of porous media; incompressibility constraint.
- 6. Selected Advanced Topics on Modeling of Porous Media**

HOMEWORK & FINAL PROJECT

Homework and/or computational assignments will be given after every major topic.

For final project, students can pick a topic relevant to this course and to their own research interests. Students will submit a final written report and give an in-class presentation at the end of this course.

ACADEMIC INTEGRITY

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a "high seminary of learning." Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. When in the opinion of a faculty member, there is evidence that a student has committed an act of academic dishonesty, the faculty member shall make a formal written charge of academic dishonesty including a description of the misconduct, to the Dean of the Graduate School. At the same time, the faculty member may, but is not required to, inform each involved student privately of the nature of the alleged charge.

STUDENTS WITH DISABILITIES

Students with disabilities who need accommodations should make an appointment with Dr. Arlene Stewart, Director of Disability Services, to discuss specific needs within the first month of classes. Students should present a Faculty Accommodation Letter from Student Disability Services when they meet with instructors. Student Disability Services is located in Suite 239 Academic Success Building (656-6848; sds-1@clemson.edu). Please be aware that accommodations are not retroactive and new Faculty Accommodation Letters must be presented each semester.

CLEMSON UNIVERSITY'S TITLE IX POLICY

Clemson University's Title IX (Sexual Harassment) policy is located at

<http://www.clemson.edu/campus-life/campus-services/access/harassment.html>

Jerry Knighton serves as Clemson's Title IX coordinator.