

Continuum Mechanics-ME720
ME Department, North Dakota State University-Spring 2023

Instructor: Dr. Ghodrat Karami
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Contact: Email: G.Karami@ndsu.edu ; phone: 231-5859
Office Hrs: TUTH 10:00am-12:00 pm
Course website: <https://bb.ndsu.nodak.edu/webapps/portal/frameset.jsp>
Course Scheduling: TuTh 12:30pm-1:45 pm Dolve 204
Join Zoom Meeting
<https://ndsu.zoom.us/j/94888315246?pwd=L3lYVFF0V3FMUWNmQjBCWXY2NGlrZz09>

Meeting ID: 948 8831 5246

Passcode: ME720

Text: G. Karami, Principles of Linear and Nonlinear Continuum Mechanics.

The following reference textbooks can be benefited.

1. Mase, G.E. and Mase, G.T., Continuum Mechanics for Engineers, CRC Press, Boca Raton, Florida, 1992.
2. Ogden, R.E. Non - linear Elastic Deformations, John - Wiley, New-York, 1984.
3. Eringen, A.C., Nonlinear Theory of Continuous Media, Mc- Graw-Hill, New York, 1962.
4. Eringen, A.C., Mechanics of Continua, 2nd ed., Robert E. Krieger Publishing Company, New York, 1980.
5. Chung, T.J., Continuum Mechanic, Prentice-Hall Int. Edition, New York, 1988.
6. J. Bonet and R. D. Wood, Nonlinear Continuum Mechanics for Finite Element Analysis, 2nd ed., Cambridge University Press, New York (2008).
7. A. C. Eringen and G. W. Hanson, Nonlocal Continuum Field Theories Springer-Verlag, New York (2002).
8. W. Flügge, Viscoelasticity, 2nd ed., Springer-Verlag, New York (1975).
9. M. E. Gurtin, An Introduction to Continuum Mechanics, Elsevier Science & Technology, San Diego, CA (1981).
10. M. E. Gurtin, E. Fried, and L. Anand, the Mechanics and Thermodynamics of Continua, Cambridge University Press, New York (2010).
11. W. Jaunzemis, Continuum Mechanics, Macmillan, New York (1967).
12. L. E. Malvern, Introduction to the Mechanics of a Continuous Medium, Prentice Hall, Englewood Cliffs, NJ (1997).
13. N. I. Mushkelishvili, Some Basic Problems of the Mathematical Theory of Elasticity, Noordhoff, Groningen, the Netherlands (1963).
14. Naghdi, P. M., P. M. Naghdi's Notes on Continuum Mechanics, Department of Mechanical Engineering, University of California, Berkeley, 2001.
15. R. W. Ogden, Non-Linear Elastic Deformations, Halsted (John Wiley & Sons), New York (1984).
16. J. T. Oden and J. N. Reddy, Variational Principles in Theoretical Mechanics, 2nd ed., Springer-Verlag, Berlin (1983).
17. W. S. Slaughter, the Linearized Theory of Elasticity, Birkhauser, Boston (2002).
18. S. P. Timoshenko and J. N. Goodier, Theory of Elasticity, 3rd ed., McGraw Hill, New York (1970).

19. C. A. Truesdell, Elements of Continuum Mechanics, 2nd printing, Springer Verlag, New York (1984).

Prerequisites

BS in Mechanical, Civil, Structural or related engineering fields. Completion of courses in mechanics of materials and fluid dynamics is helpful.

Overview

Continuum mechanics is a mathematical framework for studying the natural phenomena which are based on fundamental scientific laws of physics, extracted from centuries of research on the behavior of physical systems under the action of external forces. No real material is actually continuous. From the physics and chemistry one knows that all materials are formed of discrete atoms and molecules. Even at microscales, materials may be composed of distinct grains of different constituents. Nevertheless, treating material as continuous allows us to use the mathematical tools of continuous functions to express the phenomena and solve the problems based on average behavior.

The vocabulary of continuum mechanics involves mathematical objects in tensor forms. Studying the vectors and tensors are therefore essential. Mathematical models of continuum bodies are referred to simply as mechanics – a phrase that encompasses broad fields of science concerned with the behavior of solids, fluids and complex materials. Mechanics is important to almost all areas of science and technology and remains an intellectually rich subject for all major engineering subjects. Therefore, the subject of continuum mechanics to senior undergraduate and beginning graduate students is essential for a strong background for all major engineering fields. A course on continuum mechanics provides the basic principles of mechanics and prepares engineers and scientists for advanced courses in traditional as well as the emerging fields such as biomechanics and nanomechanics.

Lecture Topics

Tensor Theory in Cartesian Coordinates
Tensor Theory in Curvilinear Coordinates
Kinematics of Deformation- Strain
Kinematics of Motion
Stress Principles
Constitutive Equations....
Linear Elasticity
Newtonian Fluid Dynamics

Grading

1. Mid-Term Exams- 50%
 2. Final Exam- 30%
 3. Homework Assignments- 20%
- The homework problems are based on lecture materials.

NDSU Academic Honesty Statement and CEA Honor System

All work in this course must be completed in a manner consistent with NDSU University Senate Policy, Section 335. Code of Academic Responsibility and Conduct (available on the Web at <http://www.ndsu.edu/fileadmin/policy/335.pdf>). Violation of this code will result in a penalty or penalties to be determined by the instructor to fit the gravity of the offense and the circumstances of the particular case. The instructor may: (1) fail the student for the particular assignment or test, (2) give the student a failing grade in the course, or (3) recommend that the student drop the course.

Students taking CEA courses are required to sign the Honor Pledge at the beginning of each semester as outlined below. “On my honor I will not give nor receive unauthorized assistance in completing assignments and work submitted for review or assessment. Furthermore, I understand the requirements in the College of Engineering and Architecture Honor System and accept the responsibility I have to complete all my work with complete integrity.”

The Engineering & Architecture Honor System can be found on the CEA homepage at http://www.ndsu.edu/coe/undergraduate_students/honor_code/

Attendance

Students should realize that there are materials covered in class which are not discussed in the textbook. The student is responsible for ALL material presented in class whether or not he or she was present in class. If they miss a class, it is the student’s responsibility to obtain notes from a classmate. Full credit can be received for work turned in late due to an excused absence. It is the student's responsibility to contact the instructor in such a case. If the student is going to miss a test for a good reason, he/she should telephone or e-mail the instructor BEFORE the test to arrange for a make-up exam.

Disabilities

Any student with disability who needs accommodations is encouraged to speak with the instructor as soon as possible to make appropriate arrangements for those accommodations.