

# MCEN 5023/ASEN 5012

## Solid Mechanics I

Fall 2017

*Updated on October 10: Final exam and location*

<b>Lectures:</b>	MWF	12:00-12:50pm	RAMY N1B23
<b>Instructor:</b>	Dr. Rong Long		
<b>Office:</b>	ECME 273, Tel: 303-492-3295 Email: <a href="mailto:rong.long@colorado.edu">rong.long@colorado.edu</a>		
<b>Office hours:</b>	4-5pm Mondays, 3-5pm Wednesdays		
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<b>Office hours:</b>	10-11:30am Tuesdays and Thursdays, Idea Forge Commons		

**Course Description:** Introduces tensor analysis, deformation and strain measurements, stress and its relation to force and moment, the basic principles of equilibrium, geometric compatibility, and material behaviors. Discusses energy methods, finite deformation theory, and constitutive equations and applies these concepts to the analysis of some engineering problems.

**Prerequisites:** MCEN 2063 for ME; APPM 2360 and ASEN 2001, 2003, and 3112, or equivalent.

**Textbook:** No textbook is required. Lecture notes will be based on the following book:  
*Elasticity in Engineering Mechanics*, 2nd edition, by Arthur R. Boresi, Ken P. Chong and James D. Lee. Wiley, 2011.

The following are recommended reference books:

*Applied Mechanics of Solids*, Allan F. Bower, <http://solidmechanics.org/>

*Classical and Computational Solid Mechanics*, Fung, Y.C., Tong, P., World Scientific Publishing, Singapore, 2001.

### Grading:

- Homework (Best 6 of 7) 20%
- Midterm Exam1 (Sep. 29, in class) 20%
- Midterm Exam2 (Nov. 3, in class) 20%
- Final Exam (1:30-4pm, December 17, RAMY N1B23) 40%

All assignments and exams will be recorded as a percentage grade. The total will be converted to a letter grade and will follow a distribution.

If you miss any of the midterm exams for a valid reason, you can add the weight of the missed midterm to the final exam. No make-up exams will be provided.

**Online resources:** Lecture notes, homework, homework solutions and exam solutions will be posted on D2L.

## Course Outline

1. *Introduction*
2. *Concepts and Fundamentals of Scalar, Vectors, and Tensors*
  - Concepts of scalar, vectors, and tensors
  - Basic operations of scalar, vectors, and tensors
3. *Stress Tensor*
  - Stress Tensor
    - i. Traction and stress tensor
    - ii. Stress transformation and Mohr's circle
    - iii. Stress invariants
  - Equation of static equilibrium
4. *Deformation and strain tensor*
  - Strain Tensor
    - i. Deformation and strain
    - ii. Strain tensor and transformation of strain tensor
    - iii. Strain invariants
  - Compatibility of strain fields
5. *Linear Elasticity-Boundary Value Problem*
  - Mechanical properties of materials
  - Generalized Hooke's law
  - Governing equations
  - Boundary value problems for elasticity
6. *Plane problems*
  - Plane stress and plane strain
  - Airy stress function
7. *Torsion*
8. *Energy Theorems and Variation Method*
  - Energy principles
  - Variational method
  - Applications
9. *Introduction of Inelasticity*
  - Plasticity
  - Viscoelasticity
10. *Advanced Topics*
  - 3D elasticity and Hertz contact theory
  - Finite deformation
  - Fracture mechanics

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**Academic Integrity** “All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at <http://www.colorado.edu/policies/honor.html> and at <http://www.colorado.edu/academics/honorcode/>.”

**Disability Services** “If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Center for Community, N200, and <http://www.colorado.edu/disabilityservices/>.”

**Policy regarding religious observances** “Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. See full details at [http://www.colorado.edu/policies/fac\\_relig.html](http://www.colorado.edu/policies/fac_relig.html).”

**Classroom Behavior** “Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran’s status, sexual orientation, gender, gender identity, and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student’s legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at <http://www.colorado.edu/policies/classbehavior.html> and at [http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student\\_code](http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code).”

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