

# MEC 536 – Mechanics of Solids

The State University of New York, Korea

Spring 2020

**Instructor:** Prof. Y. Eugene Pak, Academic Building B623, (032) 626-1815

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**Lectures:** Mon 9:00-11:50 AM

**Office Hours:** Mon/Wed 2:00-3:30 PM (or by appointment)

## Reference books :

- G. T. Mase et al., "Continuum Mechanics for Engineers," 3rd ed., CRC Press, 2009 (ISBN: 978-1-4200-8538-9)
- R. J. Asaro & V. A. Lubarda, "Mechanics of Solids and Materials," Cambridge, 2006 (ISBN: 978-0-521-16611-9)
- L. E. Malvern, "Introduction to the Mechanics of a Continuous Medium," Prentice-Hall, 1969 (ISBN: 978-0-134-87603-0)

## Prerequisites :

- MEC363: Mechanics of Solids, MEC 455/530: Applies Stress Analysis, or equivalent

## Grading:

- |                              |     |
|------------------------------|-----|
| - Homework                   | 30% |
| - 2 Midterm exams @ 20% each | 40% |
| - Final exam                 | 30% |

**Exams:** 2 Midterms (in class, 1.5 hrs.)

1 Final (9:00~11:30 AM, Monday, June 15)

No makeup exam unless arranged prior to the exam and for extenuating circumstances.

**Homework:** Late homework will receive half credit before the solutions are posted and will not be accepted after that.

## Course Objective:

The course is designed for graduate students to learn the fundamental formulations and solution procedures in solving solid and structural mechanics problems through analytical methods.

Through understanding of tensor algebra, solution formulations and various materials behaviors (including large and inelastic deformations), students will effectively utilize these solution techniques to determine stress and deformation fields of engineering structures and components. The course also prepares students to become professional engineers through effective communications in formulating and solving engineering problems.

### **Course outline**

- I. Review of mathematical preliminaries
  1. Vector and tensor notations
  2. Indicial and dyadic notations
  3. Matrices and vector operations
  4. Differential operators in Cartesian and polar coordinates
  
- III. Analysis of Stress
  1. Basic concept of a continuum
  2. Physical interpretation of divergence and curl operations
  3. Principle of linear and angular momentum
  4. Principal stresses and principal directions
  5. Transformation of stress from Cartesian to other coordinate systems
  
- IV. Analysis of Strain
  1. Concept of material and spatial coordinates
  2. Nonlinear deformation
  3. Lagrangian and Eulerian strain tensors
  4. Linearization to infinitesimal strains
  
- V. Constitutive relations
  1. Generalized Hooke's law
  2. Strain energy concepts
  3. Stress-strain relations for linear isotropic material
  
- VI. Formulations for Linear Elastic Materials
  1. Clapeyron's Theorem
  2. Uniqueness of solution
  3. Well-posedness of boundary value problems
  4. Principle of superposition
  
- V. Formulations for Inelastic Material Behavior
  1. Plasticity

2. Viscoelasticity

IV. Mechanics of Defects in Solid

1. Basic concepts of fracture mechanics
2. Defects (dislocations and cracks) and inhomogeneities
3. Configurational forces on material defects

**ABET Student Outcomes:**

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

**Disability Support Services (DSS):**

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact One-Stop Service Center, Academic Building A201, (82) 32-626-1117. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

**Policies:**

- Students are required to use Blackboard, where important announcements, slides, homework, assignments, and supplementary materials of the course are posted. The Blackboard can be accessed at <https://blackboard.stonybrook.edu/>.
- The time and details about exams will be announced in the class (and also posted on the Blackboard).
- It is the responsibility of students to make sure that they can access the Blackboard and they have a working email registered with it. The Blackboard should be checked frequently for new materials.
- Exams will be closed book and note. Each person should have a calculator for the required computations.

**Academic Integrity Statement:**

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website:

[http://www.stonybrook.edu/commcms/academic\\_integrity/index.html](http://www.stonybrook.edu/commcms/academic_integrity/index.html)

**Critical Incident Management Statement:**

The State University of New York, Korea expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn.

**Attendance Policy of SUNY Korea:**

1. All students of SUNY Korea are required to attend every class.
2. Unexcused absences will affect seriously the student's final grade in the course.
3. If a student has over 20% unexcused absence, the student's final course grade will be an 'F'.
4. Students should report the reason of absence to the instructor in advance, or immediately after the absence.
5. When a student excuses his/her absence, the student must provide documentation of the reason for the absence to the instructor.
6. The instructor of the course reserves the right to excuse absences.
7. The course instructor may excuse the absence if the submitted documentation fulfills the conditions below.
  - Extreme emergencies (e.g. death in the family)
  - Severe medical reasons with doctor's note (Not a slight illness)
  - Very important events (e.g. national conference, official school event)
8. At the end of semester, the course instructor should submit a copy of the attendance sheet to the Academic Affairs Office.