MEC 455/530 – Applied Stress Analysis

Department of Mechanical Engineering

The State University of New York, Korea

Fall 2021

Instructor: Prof. Y. Eugene Pak,
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Lecture: Mon/Wed 3:30~4:50 PM

- Class will meet online until further notification
- Prof. Y. Eugene Pak's Personal Meeting Room
  https://stonybrook.zoom.us/j/8054297300?pwd=Uit6Sk9Tck83ZHRwelFoL0krb0g4UT09
  Meeting ID: 805 429 7300
  Passcode: 655705
- All students should have webcam turned on during class

Office Hours: Tue/Thu 3:30~5:00 PM (or by appointment)

TA: TBA

Reference books:

- *Advanced Strength and Applied Stress Analysis*, R. G. Budynas, McGraw-Hill
- *Advanced Mechanics of Materials and Applied Elasticity*, 5th Edit. A. C. Ugural ad S. K. Fenster, Prentice Hall
- *Applied Mechanics of Solids*, A. F. Bower, CRC Press
- *Continuum Mechanics*, G. E. Mase, *Schaum's Outline Series*, McGraw-Hill
- *Basic Equations of Engineering Science*, Hughes and Gaylord, *Schaum's Outline Series*, McGraw-Hill

Prerequisites: MEC 363 or equivalent

Grading:

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

Exams: 2 Midterms (online, 1.5 hrs each)

1 Final (online, Dec. 13, Mon, 3:15~4:45 PM)

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 senior and 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, 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. Mathematical preliminaries

1. Vector and tensor notations
2. Indicial notations
3. Matrices and vector operations
4. System of linear algebraic equations

II. Basic formulations of elasticity in 1-D

1. Governing equations
2. Boundary conditions
3. Constitutive relations
4. Solutions to boundary value problems

III. Analysis of Stress

1. Traction vector: Cauchy's formula
2. Equilibrium equations for 2-D body
3. Vector and tensor transformations
4. Principal stresses and principal directions
5. Transformation of stress from Cartesian to polar coordinates

IV. Analysis of Strain

1. Linear infinitesimal strains
2. Principal strains and directions

V. 2-D problems of elasticity

1. Plane stress and plane strain formulations
2. 2-D elasticity equations in polar coordinates
3. 2-D axisymmetric problems: Thick-walled cylinder, rotating disk
4. Polynomial solutions to Airy stress function
5. Plane stress problems in polar coordinates
6. Stress concentrations around a circular hole under uniaxial and biaxial tension

VI. Strain energy concepts

1. Bar under tension
2. Circular rod under torsion
3. Beam in bending

VII. Thermal stresses

1. Thermoelastic stress-strain relations
2. Thermoelastic response of partially constrained bodies
3. Thermally-induced misfits in cylindrical inclusion

VIII. Analysis of composite beams

1. Thermoelastic response of bimetallic strip

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

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.