



School of Engineering  
*Sonny Astani Department  
of Civil and Environmental  
Engineering*

## **CE 507: Mechanics of Solids**

**Units: 4**

**Fall 2022 Monday 3:30-6:50 PM (200 minutes)**

**Location:** RTH105 and online DEN@viterbi  
29732R 29733D

**Instructor: Prof Vincent Lee**

**Office:** KAP 230B

**Office Hours:** 2 hours per week, time and day TBD  
9-5pm daily on Piazza

**Contact Info:** Email: [vlee@usc.edu](mailto:vlee@usc.edu)

Phone number: 213-740-0568

**Teaching Assistant:** TBD

**Office:**

**Office Hours:**

**Contact Info:**

**IT Help:** TBD

**Hours of Service:**

**Contact Info:**

**This is a DEN class, , Distnace Educational Network**

**<https://courses.uscdcn.net/d2l/home>**

**To log in**

**<https://courses.uscdcn.net/d2l/login>**

## Course Description

The materials presented will serve as a basis for the studies of the fundamental theory of linear elasticity applicable to multiple branches of solid mechanics, including the theories of finite elements, geotechnical (soil) mechanics, structural mechanics, elastic wave propagation applicable to earthquake engineering, plates and shells and composite materials. The course is valuable and fundamental for students prepared to be practicing engineers and/or research scientists.

## Learning Objectives and Outcomes

By the end of the course, the student will be able to:

1. Understand, learn and use the theory of tensors in the theory of stresses, deformation and strains.
2. Study the theory of deformation, strains and stresses and treated separately and independently.
3. study their dependence through the three-dimensional generalized stress-strain theory, the so-called constitutive relations of linear, isotropic materials.
4. Learn the two-dimensional theory of plane elasticity in both rectangular and polar coordinates using Airy Stress functions
5. Learn the three-dimensional theory of elastic bars subjected to end loads.
6. Learn the theory of bars of arbitrary cross-section subjected to torsion using Prandtl torsion functions
7. Study the Bending of Bars, displacement of cantilever Beams subjected to Transverse End forces in three-dimension.
8. Study energy theorems, complementary energy theorems, virtual displacement methods and related Rayleigh-Ritz methods.
9. Study plasticity and viscoelasticity

**Prerequisite or Recommended Preparation:** *undergraduate Civil or Mechanical engineering course in Mechanics of Deformable Bodies or a course in Solid Mechanics*

**Co-Requisite(s):** *None*

**Concurrent Enrollment:** *None*

## Course Notes

**This is an internet course presented by DEN, Distance Educational Network**

<https://courses.uscden.net/d2l/login>

The class will have letter grade. The class will use the DEN blackboard website as the primary medium for distribution of course material, including assignments, typed and written lecture notes and for syllabus, announcements and examination dates.

## Technological Proficiency and Hardware/Software Required

N/A

## Textbook and Supplementary Materials

**P.L. Gould: Introduction to Linear Elasticity, Springer-Verlag, 3<sup>rd</sup> Ed. ISBN 9781461448327 or 2<sup>nd</sup> Ed., ISBN 0387941002, OR**

**Ref: A. P. Boresi ad K.P. Chong Elasticity in Engineering Mechanics, Elsevier, ISBN 0-444-01177-3**

The above textbooks are available for purchase from the USC bookstore. Supplemental reading material will be provided as needed.

### **Description and Assessment of Assignments**

The points per homework assignment and their % grade in the table below are only approximate.

**All homework assigned are due on the first class of next week**

<b>Assignment</b>	<b>Points</b>	<b>% of Grade</b>
1	60 to 70	1.66
2	60 to 70	1.67
3	60 to 70	1.67
4	60 to 70	1.66
5	60 to 70	1.67
6	60 to 70	1.67
7	60 to 70	1.66
8	60 to 70	1.67
9	60 to 70	1.67
10	60 to 70	1.66
11	60 to 70	1.67
12	60 to 70	1.67
<b>TOTAL</b>		<b>20</b>

### **Grading Scale**

Students will be graded based on their total scores (possibly relative to the overall class performance) The following is merely a rough guideline, and is subject to revision depending on the overall class performance.

<b>Assignment</b>	<b>Points</b>	<b>% of Grade</b>
Homework	60/70 each	20%
Midterm I	100	24%
Midterm II	100	24%
Final	100	32%
<b>TOTAL</b>		<b>100%</b>

### **Assignment Submission Policy**

Unless otherwise stated, homework assignments are due at the beginning of the class and/or submitted in DEN dropbox. Solutions will be posted on DEN blackboard shortly after the assignments are turned in.

### **Grading Timeline**

The homeworks and midterms will be graded and handed back roughly one week after their due date.

### **Additional Policies**

Late homework will not be accepted. No exceptions except institution-established emergency reasons; credit for such late homework is with the discretion of the instructor.

Reasonable collaboration in solving homework problems is allowed. This includes reviewing and discussing the problems with current CE 471 students, TA or the instructor. Everybody has to write his/her own solution independently and make sure to fully understand it. Exchanging solutions, consulting with people other than class members, finding solutions on the web or elsewhere, etc. are not allowed. Violations result in losing the credit for the entire homework set in addition to a significant percentage of the overall course grade, all with the discretion of the instructor.

All answers should be clearly and fully justified. If the steps are not clear, points will be deducted even if the final answer is correct.

Attendance will be taken in every lecture. The students are expected to be attentive, and in particular refrain from using computers or hand held devices, except for the sole purpose of the class. Non-compliance will result in point deduction from class participation part of the grading, and possibly a percentage of the overall course grade, all with the discretion of the instructor.

### Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Posted Lecture Notes	Deliverable/ Due Wed
<b>Week 1</b> <b>Aug22</b>	Tensor Notation, Coordinate Transformation, Eigenvalues	L01, L02	Homework 1 assigned
<b>Week 2</b> <b>Aug29</b>	Eigenvalues (cont.) Cubic Polynomials, State of stress, Equilibrium Equations	L03, L04, L05	Homework 2 assigned
<b>Week 3</b>	<b>Sep 5 Labor Day</b> USC holiday		
<b>Week 4</b> <b>Sep12</b>	Principal Stresses, Strain and deformation, Strain Compatibility	L06, L07, L08	Homework 3 assigned;
<b>Week 5</b> <b>Sep19</b>	Stress versus Strain, Linear Elasticity, Stress Compatibility – Beltrami-Mitchell Eqns	L09, L10, L11	Homework 4 assigned
<b>Week 6</b> <b>Sep26</b>	3D Examples, Plane Stress, Plane Strain, 2D Cartesian Problems, <b>Mid-Term #1</b>	L11, L12	
<b>Week 7</b> <b>Oct 3</b>	Plane stress, Plane strain, 2-D Cartesian Airy Stress functions	L13, L14, L15	Homework 5 assigned
<b>Week 8</b> <b>Oct 10</b>	Plane stress/Strain Polar Coordinates I - Airy Stress functions	L16, L17	Homework 6 assigned
<b>Week 9</b> <b>Oct 17</b>	Polar Coordinates II Axis/Non-axisymmetric Problems Complex Function Theory	L18, L19	Homework 7 assigned
<b>Week 10</b> <b>Oct 24</b>	Complex Variable Method, Review Mid-Term#2 Problems 1MT#2 Problem: Complex Method	L20	Homework 8 assigned
<b>Week 11</b> <b>Oct 31</b>	Torsion I, II, Prandtl Torsion function, Examples <b>Mid-Term #2</b>	L20, L21	Homework 9 assigned
<b>Week 12</b> <b>Nov 7</b>	Torsion III Elliptic, Triangular, Rectangular Sections	L22	Homework 10 assigned;
<b>Week 13</b> Nov 14	Energy Methods I, II: energy Theorems, Virtual displacement & related Rayleigh-Ritz methods	L23, L24	Homework 11 assigned
<b>Week 14</b> <b>Nov 21</b>	Rayleigh-Ritz Method Viscoelasticity: elasticity vs viscoelasticity, constitutive models, Viscoelastic creep	L25, L26	<b>Last week of Class !!!!</b>
<b>Week 15</b> Nov 28	Viscoelasticity (cont) Plasticity, elasticity vs plasticity, contributing properties, Yield Criteria	L26, 27	Homework 12 assigned
<b>FINAL</b> <b>Dec7-13</b>	<b>Final Date Dec 12 or TBA</b> For the tentative date and time of the final for this class, consult the USC <i>Schedule of Classes</i> at <a href="http://classes.usc.edu/">classes.usc.edu/</a> .		

## Statement on Academic Conduct and Support Systems

### Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” [policy.usc.edu/scampus-part-b](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, [policy.usc.edu/scientific-misconduct](http://policy.usc.edu/scientific-misconduct).

### Support Systems:

*Student Health Counseling Services - (213) 740-7711 – 24/7 on call*  
[engemannshc.usc.edu/counseling](http://engemannshc.usc.edu/counseling)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call*  
[suicidepreventionlifeline.org](http://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 – 24/7 on call*  
[engemannshc.usc.edu/rsvp](http://engemannshc.usc.edu/rsvp)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED) | Title IX - (213) 740-5086*  
[equity.usc.edu](http://equity.usc.edu), [titleix.usc.edu](http://titleix.usc.edu)

Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

*Bias Assessment Response and Support - (213) 740-2421*  
[studentaffairs.usc.edu/bias-assessment-response-support](http://studentaffairs.usc.edu/bias-assessment-response-support)

Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

*The Office of Disability Services and Programs - (213) 740-0776*  
[dsp.usc.edu](http://dsp.usc.edu)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Support and Advocacy - (213) 821-4710*  
[studentaffairs.usc.edu/ssa](http://studentaffairs.usc.edu/ssa)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity at USC - (213) 740-2101*

[diversity.usc.edu](http://diversity.usc.edu)

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

*USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu), [emergency.usc.edu](http://emergency.usc.edu)

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

*USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu)

Non-emergency assistance or information.