CE 543 Structural Instability and Failure
Units: 4
Spring—Day—Time: Tuesday, 6-9:40 PM
Location: RTH 115

Instructor: Qiming Wang
Office: BHE 222
Office Hours: Tuesday, Friday 3-5 PM
Contact Info: qimingw@usc.edu

Teaching Assistant: TBD
Office:
Office Hours:
Contact Info:

IT Help: TBD
Hours of Service:
Contact Info:
Course Description

Catalogue Description
Stability analysis of columns, frames, plates, circular rings, and shells; Energy-based method; Dynamic analysis of structural stability; Elastic fracture mechanics; Small-strain plasticity.

Extended Course Description
CE543 - Structural Instability and Failure presents a full range of theoretical topics with the goal of providing students with a fundamental understanding of instabilities and failures of engineering structures. Students will learn the stability analysis of columns, frames, plates, circular rings, and shells, energy-based methods to analyze stability problems, and dynamic analysis of structural stability. Students will also learn the elastic fracture mechanics and small-strain plasticity.

Learning Objectives and Outcomes
Loading-bearing engineering structures widely exist in areas of civil, mechanical, and aerospace engineering. Their instabilities and failures are key safety issues that should be considered during the design and analysis of these engineering structures. Therefore, it is critical that engineers and managers have a fundamental understanding of instabilities and failures of engineering structures to facilitate their engineering design, analysis, prediction, assessment, and management. Upon completing of the course, students will be able to determine the instability and failure conditions of structural systems, and use such information to enhance the design and analysis process for diverse problems in civil, mechanical and aerospace engineering.

Recommended Preparation: Undergraduate strength of materials class on the level of CE 225.

Course Notes
Lecture notes written by the instructor will be distributed to students through the blackboard system prior to the corresponding lectures. The lecture notes will cover the essential contents and supplementary information of the lectures. The lecture notes will be treated as reading materials to support the lectures.

Reference Materials
The following optional textbooks can be supplementary materials for the course:

Description and Assessment of Assignments
Each assignment will include 2-3 problems related to the corresponding lecture. The assignment may take one of the following three forms: (1) analysis problems with analytical answers, (2) analysis problems with numerical and graphical answers, or (3) writing essays or report on structural instability and failure issues. These assignments will allow students to integrate the lecture and reading materials to demonstrate their knowledge of structural instability and failure. The grading rubric will follow 10 points for each assignment.
Grading Breakdown

<table>
<thead>
<tr>
<th>Content</th>
<th>Points</th>
<th>% of Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>10x13=130</td>
<td>30</td>
</tr>
<tr>
<td>Midterm exam</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>Final exam</td>
<td>100</td>
<td>40</td>
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<tr>
<td>TOTAL</td>
<td></td>
<td>100</td>
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Grading Scale
Course final grades will be determined using the following scale
A    95-100
A-   90-94
B+   87-89
B    83-86
B-   80-82
C+   77-79
C    73-76
C-   70-72
D+   67-69
D    63-66
D-   60-62
F    59 and below

Assignment Rubrics
10 points for each assignment

Assignment Submission Policy
The assignment should be submitted in the hand-writing paper during the class or electronic PDF via email before the deadline described in the course schedule table.

Grading Timeline
The assignment will be graded and returned to the students following the course schedule table.

Additional Policies
Late assignments will not be accepted. Students should email the instructor in advance when they are absent for a lecture. Absences for reasons of a religious holiday, serious illness, death in the student’s immediate family, or required participation in university-sponsored activities are, with the appropriate documentation, considered excused absences.
# Course Schedule: A Weekly Breakdown

<table>
<thead>
<tr>
<th>Week</th>
<th>Tuesday</th>
<th>Topics</th>
<th>Readings</th>
<th>HW assign</th>
<th>HW due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/14</td>
<td>Basic concept of structural</td>
<td>Lecture note 1, Simites Ch 2</td>
<td>HW 1</td>
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<tr>
<td></td>
<td></td>
<td>stability I</td>
<td></td>
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<tr>
<td>2</td>
<td>1/21</td>
<td>Basic concept of structural</td>
<td>Lecture note 2, Simites Ch 2</td>
<td>HW 2</td>
<td>HW 1</td>
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<tr>
<td></td>
<td></td>
<td>stability II</td>
<td></td>
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<tr>
<td>3</td>
<td>1/28</td>
<td>Elastic buckling of columns I</td>
<td>Lecture note 3, Simites P47-67</td>
<td>HW 3</td>
<td>HW2</td>
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<tr>
<td>4</td>
<td>2/4</td>
<td>Elastic buckling of columns II</td>
<td>Lecture note 4, Simites P72-79,</td>
<td>HW 4</td>
<td>HW 3</td>
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<td></td>
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<td>Timoshenko P76-82</td>
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<tr>
<td>5</td>
<td>2/11</td>
<td>Elastic buckling of frames I</td>
<td>Lecture note 5, Simites P103-111,</td>
<td>HW 5</td>
<td>HW4</td>
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<td>Timoshenko P59-62</td>
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<td>6</td>
<td>2/18</td>
<td>Elastic buckling of frames II</td>
<td>Lecture note 6, Simites P112-126,</td>
<td>HW 6</td>
<td>HW 5</td>
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<td>Timoshenko P62-76</td>
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<tr>
<td>7</td>
<td>2/25</td>
<td>Energy-based method I</td>
<td>Lecture note 7, Simites Ch 5</td>
<td>HW 7</td>
<td>HW 6</td>
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<td>8</td>
<td>3/3</td>
<td>Energy-based method II</td>
<td>Lecture note 8, Simites Ch 6</td>
<td>HW 8</td>
<td>HW 7</td>
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<td>9</td>
<td>3/10</td>
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<td></td>
<td>Midterm exam</td>
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<tr>
<td>10</td>
<td>3/17</td>
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<td>Spring Recess</td>
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<tr>
<td>11</td>
<td>3/24</td>
<td>Buckling of plate I</td>
<td>Lecture note 9, Timoshenko Ch 8-9</td>
<td>HW 9</td>
<td>HW 8</td>
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<tr>
<td>12</td>
<td>3/31</td>
<td>Buckling of plate II</td>
<td>Lecture note 10, Timoshenko Ch 8-9</td>
<td>HW 10</td>
<td>HW 9</td>
</tr>
<tr>
<td>13</td>
<td>4/7</td>
<td>Dynamic analysis of stability</td>
<td>Lecture note 11, Simites Ch 12</td>
<td>HW 11</td>
<td>HW 10</td>
</tr>
<tr>
<td>14</td>
<td>4/14</td>
<td>Plastic buckling</td>
<td>Lecture note 12, Timoshenko Ch 3</td>
<td>HW 12</td>
<td>HW 11</td>
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<tr>
<td>16</td>
<td>4/28</td>
<td>Elastic fracture mechanics II</td>
<td>Lecture note 14, Anderson P60-107</td>
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<td>HW 13</td>
</tr>
<tr>
<td>17</td>
<td>5/5</td>
<td>Study day</td>
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<tr>
<td>18</td>
<td>5/12</td>
<td>Final exam</td>
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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. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Student Health Counseling Services - (213) 740-7711 – 24/7 on call 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
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
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, 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
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
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/ssaa
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
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, 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
Non-emergency assistance or information.