Part I Course Organization
GENERAL INFORMATION

Through lectures and laboratory work, this course focuses on the broad field of Experimental Mechanics with emphasis on the experimental study of the mechanical behavior of engineering materials. The theoretical background and techniques used for testing are extensively discussed in class, alongside the lab sessions. The lab work involves several lab projects as well as various testing demonstrations. The majority of the projects involve specimen design, analysis, instrumentation, theoretical prediction, testing, and discussion. The class is divided into groups, with each group responsible for all aspects of a particular project. The course is concluded by presentations of various group final projects.

Class Website:

Blackboard (https://blackboard.usc.edu/) is used as the main source of communication between instructors and students. Class material including announcements, notes, handouts, assignments, and projects will be available on Blackboard during the semester. Students are responsible for downloading the material in a timely manner and printing their own hard copies, if desired. Students are expected to visit the class Blackboard site frequently for updates and announcements.

Text:

Class and lab will be based primarily on lecture notes. There is no required text. However, the following books are relevant reference text books.


Grading:

The breakdown of the course final grade is as follows:

- 5% Attendance record for lecture and lab
- 25% Homework assignments and lab reports
- 35% Midterm exam
- 35% Final project report and presentation
<table>
<thead>
<tr>
<th><strong>Location</strong></th>
<th><strong>Time</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lecture</strong></td>
<td>KAP 144</td>
</tr>
<tr>
<td></td>
<td>Monday 3:30-6:10 PM</td>
</tr>
<tr>
<td><strong>Lab</strong></td>
<td>KAP B39</td>
</tr>
</tbody>
</table>
|              | Monday 12:00-2:50 PM  
|              | Tuesday 11:00-1:50 PM  
|              | Tuesday 2:00-4:50 PM  
|              | Wednesday 1:00-3:50 PM  
|              | Thursday 11:00-1:50 PM  
|              | Thursday 2:00-4:50 PM  |

**Professor:**  
Sami F Masri ([masri@usc.edu](mailto:masri@usc.edu))  
Office: KAP 206A  
Tel. (213) 740-0602

**Lab Manager:**  
Lance Hill ([lhill@usc.edu](mailto:lhill@usc.edu))  
Office: KAP B28; Tel. (213) 740-0599

**TAs:**  
Ali Bolourchi ([bolourch@usc.edu](mailto:bolourch@usc.edu))  
Tel. (213) 740-0305, Office: KAP 239  
Office Hours: Thursday, 2:30 p.m. – 4:30 pm  
Lab Session: T, 11:00 am – 1:50 pm  
Lab Session: T, 2:00 - 4:50 pm;

Miguel Hernandez-Garcia ([miguelrh@usc.edu](mailto:miguelrh@usc.edu))  
Tel. (213) 740-0305, Office: KAP 239  
Office Hours: Wednesday, 10:00 am – 12:00 pm  
Lab Session: M, 12 - 2:50 pm;  
Lab Session: Th, 11 am - 1:50 pm;

Ramakrishna Tipireddy ([tipiredd@usc.edu](mailto:tipiredd@usc.edu))  
Tel. (213) 740-0305, Office: KAP 239  
Office Hours: Friday, 10 a.m. – 12 p.m.  
Lab Session: F, 1:00 - 3:50 pm;
Course Outline

- Overview of Course Coverage and Organization; Overview of Experimental Mechanics; lab tour
- Assessment and presentation of experimental data; uncertainty analysis; error propagation
- Review of structural and material behavior; characterization, stress-strain, failure criteria
- Sensors for static and dynamic measurements
- Data acquisition, signal conditioning, and virtual instruments (LabVIEW)
- Elements of digital signal processing and data analysis
- Measurement and analysis of stress and strain
- Measurement of motion
- Loading systems and laboratory techniques, scale models, similitude
- Structural Control and Structural Health Monitoring
- Vision-based approaches for structural condition assessment
- Theoretical overview and background material for each (semi-weekly) lab test
- Class project (semester duration)

Notes:

1) The following schedule is tentative and is subject to change during the semester.
2) See “CE334L Lab Weekly Schedule” (available on Blackboard) for detailed information on lab sessions.
## Class Schedule and Project Assignments

<table>
<thead>
<tr>
<th>week</th>
<th>Notes</th>
<th>Lab Project</th>
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</thead>
<tbody>
<tr>
<td>01. M 26-AUG-2013</td>
<td></td>
<td>(no individual labs during 1st week) laboratory tour on M 26-AUG-2013 at end of class</td>
</tr>
<tr>
<td>* M 02-SEP-2012</td>
<td>Labor Day holiday</td>
<td>Project 1: <strong>Tensile Tests of Metal Bars</strong>; (conducted by TA’s); measuring stress and strain relationship and strength of different materials using tensile tests; test machine data provided for analysis</td>
</tr>
<tr>
<td>02. M 09-SEP-2013</td>
<td>Final Project topic due by end of week</td>
<td>Project 2.1: <strong>Strain Gauge and Transducer</strong>; Wire Strain Gauge (mounting, wiring)</td>
</tr>
<tr>
<td>03. M 16-SEP-2013</td>
<td></td>
<td>(continue: Project 2.2; perform testing and analysis) use Wheatstone Bridge; static cantilever beam test; also use LabVIEW to directly acquire data on PC/laptop</td>
</tr>
<tr>
<td>04. M 23-SEP-2013</td>
<td></td>
<td>Project 3: <strong>Static Bending Test of Mild Steel Bar</strong>; determine plastic moment and first yield moment; compare to theory</td>
</tr>
<tr>
<td>05. M 30-SEP-2013</td>
<td></td>
<td>Project 4.1: <strong>Stress Analysis of Steel Beam</strong>; (mounting and wiring strain gauges); use LabVIEW for data acquisition</td>
</tr>
<tr>
<td>06. M 07-OCT-2013</td>
<td></td>
<td>Continue: Project 4.2; perform testing; analyze: principal strain, shear strain, angles</td>
</tr>
<tr>
<td>07. M 14-OCT-2013</td>
<td></td>
<td>Project 5.1: <strong>Concrete Mixing and Testing</strong>; (Casting concrete)</td>
</tr>
<tr>
<td>08. M 21-OCT-2013</td>
<td>Midterm Exam</td>
<td>(continue: Project 5.2; do 7-day concrete testing)</td>
</tr>
<tr>
<td>09. M 28-OCT-2013</td>
<td></td>
<td>Project 6: <strong>Structural Control of a Multistory Building Model</strong>; investigate a variety of approaches for vibration mitigation</td>
</tr>
<tr>
<td>10. M 04-NOV-2013</td>
<td></td>
<td>Project 7: <strong>Structural Health Monitoring and Damage-Detection in a Multistory Building Model</strong>; conduct studies of vibration-based approaches for change detection in structural systems</td>
</tr>
<tr>
<td>11. M 11-NOV-2013</td>
<td></td>
<td>(continue: Project 5.3; concrete 28-day testing)</td>
</tr>
<tr>
<td>12. M 18-NOV-2013</td>
<td></td>
<td>Project 8: <strong>Computer-Vision Approaches for Detecting and Quantifying Cracks in a Concrete Structure</strong></td>
</tr>
<tr>
<td>13. M 25-NOV-2013</td>
<td><strong>Course Project Presentations</strong></td>
<td>*(Monday Lab session to finish last week’s Project) No other labs this week; <em>(Thanksgiving Holiday)</em></td>
</tr>
<tr>
<td>14. M 02-DEC-2013</td>
<td><strong>Course Project Presentations</strong></td>
<td>(no labs this week)</td>
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Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TAs) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one’s own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.
Part II  Detailed Course Objectives
**Course Information, Textbook, and Supplementary Materials**

**Course Description:** The course involves lectures and laboratory work. The course is focused on the study of actual mechanical behavior of engineering materials through experimental methods. The theoretical background and technique for testing are extensively discussed, in parallel with the lab sessions. The lab work involves several class projects as well as various testing demonstrations. Most of the projects involve specimen design, analysis, instrumentation, theoretical prediction, etc. The class is divided into groups, with each group responsible for all aspects of particular projects. The course is concluded by a student led Annual Workshop on Construction Materials with presentations of various individual or group final projects.

**Required for:** BSCE, BSCE-Structural, BSCE-Bldg. Science, and BSCE-ENE

**Prerequisites:** CE 225 Mechanics of Deformable Bodies, or ME 204

**Co-Requisites:** None

**Required Textbook:** Class and lab will be mainly based on lecture notes (available online). There is no required text; however, the followings are relevant reference texts:


<table>
<thead>
<tr>
<th>Topics Covered</th>
<th>Learning Outcomes</th>
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</table>
| Mechanical behavior of materials used in civil engineering; basic experimental methods as a companion means of analysis applied in solving real world structural problems | Students will be able to understand and perform analysis and testing in the following areas of study:  
1. Atomic bonding and micro structures  
2. Basic mechanical properties (Young’s modulus, Poisson’s ratio, shear and bulk modules, and strength)  
3. Basic mechanic tests (specimens, methods and types)  
4. Electrical resistance strain gauge  
5. Cement, water, aggregates and their functions in concrete  
6. Mix design of concrete  
7. Basic properties of fresh and hardened concrete  
8. Basic tests used in define properties of concrete  
9. Class project, project report and presentation  
10. Understand categories of engineering materials, fundamentals of atomic bonding, microstructures, crystalline and defects.  
12. Determine strength and failure of metals in combined stress conditions, using maximum shear.  
13. Understand basic means to apply force, and types of basic mechanical testing machines.  
14. Conduct basic tensile tests to experimentally define basic mechanical properties, such as modulus of elasticity, Poisson’s ratio, strength, etc., for metals.  
15. Conduct other types of basic tests and define associated properties, such as, compression, bending, hardness, impact, etc.  
16. Understand concepts and techniques used in deformation measurement.  
17. Use electrical resistance strain gauges to measure strains.  
19. Design proportion mix for normal strength concrete.  
20. Conduct basic tests to define properties of concrete and its composites. |

**Construction materials**
Topics Covered | Learning Outcomes
--- | ---
Conduct a class project | 21. Work in a team on an open-end project  
22. Define objectives, design experimental program, prepare and conduct tests, analyze data and discuss results.  
23. Write technical report or project paper.  
24. Make technical presentation.

Lecture and Lab Schedule

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sessions per Week</td>
<td>Duration per Session</td>
</tr>
<tr>
<td>1</td>
<td>1.5 hours</td>
</tr>
</tbody>
</table>

Contribution of Course to Meeting the Professional Component

**Engineering Topics**
In this class, students will understand the mechanical behavior of materials used in civil engineering; basic experimental methods as a companion means of analysis applied in solving real world structural problems and perform basic mechanical tests.

**Engineering Topics | Other**
**Constraints and Considerations.** Students will understand the diverse constraints and considerations that are representative of what they will encounter in an engineering practice. Although this course introduces all of the following subjects, it covers *economics and manufacturability* with more emphasis:

- Economic  |  Environmental  |  Sustainability  |  Manufacturability  |  Ethical  |  Energy

Relation of Course Objectives to Program Outcomes

<table>
<thead>
<tr>
<th>Course Contribution to Program Outcomes (a-k)</th>
<th></th>
<th>Key</th>
</tr>
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<tbody>
<tr>
<td>The Civil Engineering program is designed to teach beyond the technical content of the curriculum and prepare the students to utilize what they learn in a professional setting. This course contributes to the program outcomes as outlined in the adjacent table</td>
<td>b. An ability to design and conduct experiments, as well as to analyze and interpret data.</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>d. An ability to function on multi-disciplinary teams.</td>
<td>✓</td>
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<td></td>
<td>g. An ability to communicate effectively.</td>
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<td></td>
<td>k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
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Prepared by: Dr. Yan Xiao  
Professor of Civil Engineering

Date: Fall 2013