UNIVERSITY OF SOUTHERN CALIFORNIA
AME 408, Computer-Aided Design of Mechanical Systems
Fall 2017

Time and Location:  T 6:30 PM to 9:20 PM  SAL 127 (Section 1, 28758)
Th 6:30 PM to 9:20 PM  SAL 127 (Section 2, 28759)

Instructor:  Babak Boloury
bboloury@hotmail.com

Office Hours:  Before and after class on TTh, by appointment only
SAL 127

Web site:  https://blackboard.usc.edu/

TA:  TBA, SAL general computer area

•  For office hours, please see blackboard.

Textbook:  There is no official textbook for the course. Handouts will be
distributed on Blackboard as necessary. An official textbook may be
announced later.

Reference and Supplemental books:

**SolidWorks:**

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>ISBN</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. SolidWorks 2012 Part 2 – Advanced Techniques</td>
<td>Tran</td>
<td>978-1-58503-700-1</td>
</tr>
<tr>
<td>5. Parametric Modeling with SolidWorks 2012*</td>
<td>Schilling &amp; Shih</td>
<td>978-1-58503-699-8</td>
</tr>
<tr>
<td>7. Engineering Design with SolidWorks 2012*</td>
<td>Planchard</td>
<td>978-1-58503-697-4</td>
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</table>

**SolidWorks Simulation:**

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>ISBN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engineering Analysis with SolidWorks Simulation 2012</td>
<td>Kurowski</td>
<td>978-1-58503-710-0</td>
</tr>
<tr>
<td>2. Introduction to FEA Using SolidWorks Simulation 2012</td>
<td>Shih</td>
<td>978-1-58503-704-9</td>
</tr>
</tbody>
</table>

All reference books are from SDC Publications (www.schroff.com)
Goals: To develop student’s understanding of the design of mechanical systems using advanced graphics techniques; design optimization, solids modeling and FEA methods. The course will develop the ability to effectively utilize commercial CAE software as a tool for better productivity in design. This semester SolidWorks and SolidWorks Simulation (CosmosWorks) packages will be used.

Prerequisites: AME 308, Statics, Strength of Materials, Stress Analysis, Heat Transfer, Dynamics and Vibrations, Matrix Algebra, Senior Standing

Grading:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Final Project</td>
<td>20%</td>
</tr>
<tr>
<td>Exams #1</td>
<td>12%</td>
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<tr>
<td>Exams #2</td>
<td>22%</td>
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<tr>
<td>Projects</td>
<td>28%</td>
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<tr>
<td>Labs</td>
<td>18%</td>
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</table>

Late lab reports and projects will not be accepted under any circumstances. Also, make-up exams will not be given under any circumstances.

Every week, labs will be assigned. However, not all problems will be graded. Only a handful of them will be graded randomly throughout the semester. You are required to turn in all lab problems. I will not announce in advance which problems will be graded. All labs are due Thursday of the following week, at or before the start of the class.

Contesting of grading of all assignments and exams must be done within one week after the graded assignment or exam is returned. After 7 days, the work will not be re-graded.

The two exams are closed note and consist of modeling problems.

- For the first exam, you are required to draw parts and assemblies parametrically and correctly with all design intents being met. It is modeled after the SolidWorks certification exam. When the dimensions of the object changes, the object should adjust accordingly and build without any errors. The problems will ask for the physical properties of the object, such as weight, moment of inertia, centroid, etc. The questions do not carry any partial credit.

- The second exam is usually made up of finite element analysis questions. You will be asked to mesh the part or assembly correctly with a proper type of element. Then find the stress, displacement, temperature, frequency, etc. There are also conceptual (theoretical) questions. This exam usually has partial credit.
• Tentative Dates for the two exams:
  Both exams will \textbf{not} be during regular class meetings. The exams will be on either a Monday, Wednesday, Friday or possibly Saturday whenever a computer lab is found to accommodate the class. We should know the availability of a room (and the exact confirmed dates) by no later than the 4\textsuperscript{th} week of classes. The tentative dates are:
  
  \begin{itemize}
  \item Exam I: \ 8\textsuperscript{th} week of instructions (Saturday, October 14, 2017, 9:30-11:50 AM); or
  \item Exam I: \ 8\textsuperscript{th} week of instructions (Wednesday, October 11, 2017, 7:30-9:50 AM);
  \item Exam II: \ 12\textsuperscript{th} week of instructions (Saturday, November 11, 2017, 9:30-11:50 AM); or
  \item Exam II: \ 12\textsuperscript{th} week of instructions (Wednesday, November 8, 2017, 7:45-9:50 AM)
  \end{itemize}

The final project is a group project. You will be asked to design a part with certain restrictions, such as size, stress, displacement, etc.

\textbf{Other Issues:}

Be respectful to your classmates and the instructor. Students are expected to be on time for class and to remain once class starts. Cell phones and pagers should be turned off during class. The class hours are dedicated to AME 408 only. Therefore, during class and lab, you are not supposed to surf the web, play games on the web nor do homework for other classes. If you are caught doing so, you will be asked to leave the class.

Regular class attendance is obviously recommended.

\textbf{Course Outline:}

\begin{enumerate}
\item Introduction
\item Introduction to CAD (Solid Modeling) and FEA
\item Part and assembly modeling using SolidWorks
\item Basic concepts of engineering analysis
\item Linear Static Analysis
\item Adaptive Analysis and Mesh Control
\item Dynamic Analysis
\item Linear Buckling Analysis
\item Thermal Analysis
\item Design Optimization
\end{enumerate}

\textbf{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 TA) 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. Website and contact information for DSP:

http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX), ability@usc.edu.
Statement on Academic Integrity

Cheating of any kind, no matter how small, will not be tolerated in this class and academic integrity will be enforced to the highest possible level. 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, (www.usc.edu/scampus or http://scampus.usc.edu) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A (http://scampus.usc.edu/files/2015/03/appendix_a.pdf). Should there be any suspicion of academic dishonesty, no matter how small or remote, an automatic grade of F will be given for the given assignment or exam and students will be referred to the Office of Student Judicial Affairs and Community Standards for further review. The Review process is described at: http://www.usc.edu/student-affairs/SJACS/pages/students/review_process.html

Emergency Preparedness/Course Continuity in a Crisis

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.
<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Labs</th>
<th>Assignments</th>
</tr>
</thead>
</table>
| 1    | 1- Introduction  
2- Check Computers and SW  
3- Options in SW  
4- SW basic  
5- Sketches, cursor feedback  
6- Dimension  
7- Extrude, Cut | 1- SW Tutorial: Lesson 1, 3  
2- SW Tutorial: Advance drawing  
3- Set 1-4: Exercises 1, 2, 5 (do not use multi-contours), 8, 10  
Tag Name: Lab1 | 1- Read Chapters 1, 2 |
| 2    | 1- Constant radius fillet  
2- Multi-Contour sketches  
3- Arc, Tangent Arc  
4- Trim  
5- Offset & Convert Entities  
6- Mirror in a sketch  
7- Copy & paste features  
8- Link Values  
9- Draft while Extruding  
10- Drawing | 1- Set 1-4: Exercises 3, 4, 5 (use multi-contours), 6, 7, 9, 11, 12, 13, 14, 16, 17, 19, 20, 21b, 15, 21a  
Tag Name: Lab2 | 1- Project 1 - Assigned  
2- Read Chapters 3, 4 |
| 3    | 1- HandWheel example (Ch 5)  
2- 3 Point Arc  
3- Diameter Dimension  
4- Plane at end of Curve  
5- Sweep  
6- Circular Pattern  
7- Section Properties  
8- Roll Back & Re-order  
9- Revolve Feature  
10- Chamfer Feature  
11- Density and Mass Properties  
12- Equations  
13- Go over Idler Arm (Guide, Ex. 20)  
14- SW98 Plus Demo  
15- Dynamic Mirror  
16- Linear Pattern  
17- Variable Fillet | 1- Set 5-6: Exercises 22, 23, 24, 25, 26, 27, 29a-e  
2- Appendix 1, Appendix 3  
Tag Name: Lab3 | 1- Project 2 - Assigned  
2- Read Chapter 5  
3- Read SW Tutorial: Revolves & Sweeps |
<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Labs</th>
<th>Assignments</th>
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<tbody>
<tr>
<td>4</td>
<td>1- Draft Feature</td>
<td>1- Set 5-6: Exercises 28, 30a, 30b, 32a, 32b, 33, 34, 35, 36, 37a</td>
<td>1- Read Chapters 6, 7</td>
</tr>
<tr>
<td></td>
<td>2- Shell</td>
<td>2- Set 7: Exercises 38, 39, 40, 41</td>
<td>2- Read SW Tutorial: Pattern Features</td>
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<td></td>
<td>3- Planes</td>
<td>Tag Name: <strong>Lab4</strong></td>
<td>3- Try Set 5-6: Exercises 31, 32c</td>
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<td>4- Rib</td>
<td>4- Try Set 5-6: Exercise 37b</td>
<td>4- Try Set 5-6: Exercise 37b</td>
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<td>5- Mirror Feature</td>
<td>6- Text</td>
<td>5- Multi-Thickness Shell</td>
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<tr>
<td></td>
<td>6- Text</td>
<td>7- Re-order of Features</td>
<td>9- Hole Wizard</td>
</tr>
<tr>
<td></td>
<td>7- Re-order of Features</td>
<td>8- Multi-Thickness Shell</td>
<td>10- Configurations</td>
</tr>
<tr>
<td></td>
<td>8- Multi-Thickness Shell</td>
<td>9- Hole Wizard</td>
<td>11- Design Table</td>
</tr>
<tr>
<td></td>
<td>9- Hole Wizard</td>
<td>10- Configurations</td>
<td>11- Design Table</td>
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<tr>
<td></td>
<td>10- Configurations</td>
<td>11- Design Table</td>
<td>12- Design Table</td>
</tr>
<tr>
<td>5</td>
<td>1- Loft Feature</td>
<td>1- SW Tutorial: <strong>Loft</strong></td>
<td>1- Project 3 - Assigned</td>
</tr>
<tr>
<td></td>
<td>2- Split Entity</td>
<td>2- Set 9: Exercises 51, 52, 53</td>
<td>2- Read Chapters 9, 8a</td>
</tr>
<tr>
<td></td>
<td>3- Loft with Guide Curves</td>
<td>3- <strong>Appendix 2</strong></td>
<td>3- Try Set 8a: Exercises 45, 43</td>
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<tr>
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<td>4- Curve through XYZ</td>
<td>4- Set 8a: Exercises 42, 44, 46, 47</td>
<td>4- Try Set 8a: Exercises 45, 43</td>
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<tr>
<td></td>
<td>5- Ellipse</td>
<td>Tag Name: <strong>Lab5</strong></td>
<td>5- Try Set 8a: Exercises 45, 43</td>
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<td>6- Sweeps with Guide Curves</td>
<td>6- Project Curves onto a Face</td>
<td>6- Project 8a: Exercises 55, 56</td>
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<tr>
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<td>7- Project Curves onto a Face</td>
<td>7- SW Tutorial: 3D Sketching with Planes</td>
<td>7- SW Tutorial: Advanced Design</td>
</tr>
<tr>
<td>6</td>
<td>1- 3D Curves</td>
<td>1- Set 8b: Exercises 48, 49, 50</td>
<td>8- Exam # 1</td>
</tr>
<tr>
<td></td>
<td>2- Basic Assemblies</td>
<td>2- SW Tutorial: 3D Sketching</td>
<td>2- Introduction to FEA</td>
</tr>
<tr>
<td></td>
<td>3- Bottom-Up Assemblies</td>
<td>3- SW Tutorial 3D Sketching with Planes</td>
<td>3- Brief overview of CW interface</td>
</tr>
<tr>
<td></td>
<td>4- Collision Detection</td>
<td>4- Set 10: Exercises 54, 55, 57, 58</td>
<td>3- Brief overview of CW interface</td>
</tr>
<tr>
<td></td>
<td>5- Basic Exploded View</td>
<td>Tag Name: <strong>Lab6</strong></td>
<td>3- Brief overview of CW interface</td>
</tr>
<tr>
<td></td>
<td>6- Advanced Assemblies</td>
<td>6- Project 4 - Assigned</td>
<td>4- Read Chapter 11</td>
</tr>
<tr>
<td></td>
<td>7- Top-Down Assemblies</td>
<td>2- Read Chapters 8b, 10a, 10b</td>
<td>4- Read Introduction to FEA (Theory)</td>
</tr>
<tr>
<td></td>
<td>8- Creating parts in the context of an assembly</td>
<td>3- Try Set 10: Exercise 56</td>
<td>5- Work on Project 4</td>
</tr>
<tr>
<td></td>
<td>9- Assembly Features</td>
<td>5- Work on Project 4</td>
<td>6- CW Tutorial: Static Analysis of a part (only if rusty on CW)</td>
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<tr>
<td></td>
<td>10- Work on Project 4</td>
<td>6- CW Tutorial: Static Analysis of a part (only if rusty on CW)</td>
<td>7- CW Tutorial: Static Analysis of a part (only if rusty on CW)</td>
</tr>
<tr>
<td>7</td>
<td>1- Advanced Assemblies</td>
<td>1- Read Chapter 11</td>
<td>8- CW Tutorial: Static Analysis of a part (only if rusty on CW)</td>
</tr>
<tr>
<td></td>
<td>2- Top-Down Assemblies</td>
<td>2- SW Tutorial: Advanced Design</td>
<td>9- CW Tutorial: Static Analysis of a part (only if rusty on CW)</td>
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<tr>
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<td>3- Creating parts in the context of an assembly</td>
<td>Tag Name: <strong>Lab7</strong></td>
<td>10- CW Tutorial: Static Analysis of a part (only if rusty on CW)</td>
</tr>
<tr>
<td></td>
<td>4- Assembly Features</td>
<td>4- Try Set 10: Exercise 56</td>
<td>11- CW Tutorial: Static Analysis of a part (only if rusty on CW)</td>
</tr>
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<td>5- Work on Project 4</td>
<td>5- Work on Project 4</td>
<td>12- CW Tutorial: Static Analysis of a part (only if rusty on CW)</td>
</tr>
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<td>1- <strong>Exam # 1</strong></td>
<td>1- Read Introduction to FEA (Theory)</td>
<td>1- Read Introduction to FEA (Theory)</td>
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<td>2- Introduction to FEA</td>
<td>2- Read Introduction to FEA (Theory)</td>
<td>2- Read Introduction to FEA (Theory)</td>
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<tr>
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<td>3- Brief overview of CW interface</td>
<td>3- Read Introduction to FEA (Theory)</td>
<td>4- Read Introduction to FEA (Theory)</td>
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<tr>
<td>Week</td>
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<td>Labs</td>
<td>Assignments</td>
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</table>
| 9    | 1- More on CW Interface  
2- Creating More Than 1 Study  
3- Local & Global Mesh Controls  
4- Convergence Plots  
5- Split Face  
6- Loads and BC in Local Directions  
7- Probe Command  
8- Iso & Section Plots  
9- Cosmos File Structure | 1- Set 1: Exercises 1, 2, 3, 8a, 8b, 8c  
Tag Name: Lab9 | 1- Project 5 - Assigned  
2- Read Linear Static Analysis Properties (Theory)  
3- Read Failure Criteria (Theory)  
4- Read Chapters 1, 2, 3 |
| 10   | 1- FEA Modeling Strategies  
2- Shell Meshing  
3- Symmetry  
4- Linear vs. Quadratic Elements  
5- Helix  
6- Prescribed Displacement  
7- Soft Spring | 1- CW Tutorial: Static Analysis of a Sheet Metal Part  
2- CW Tutorial: Static Analysis of an Assembly  
3- Set 1: Exercise 5, 6, 10  
4- Set 2: Exercises 5, 6, 7, 4, 10, 3  
5- Set 2: Exercises 1, 2, 8, 9 (See if you know how to do these)  
Tag Name: Lab10 | 1- Project 6 - Assigned  
2- Read FEA Modeling Strategies (Theory)  
3- Read Chapters 4, 5A, 5B, 6  
4- CW Tutorial: Symmetry Restraints  
5- CW Tutorial: Mixing Solids and Shells |
| 11   | 1- Structural Members  
2- Beam Meshing | 1- Set 2: Exercises 11, 12, 13, 14  
2- SW Tutorial: Weldments  
3- CW Tutorial: Beam Diagrams  
4- CW Tutorial: Truss Structure  
5- CW Tutorial: Creating Surfaces from Solid Geometry  
6- CW Tutorial: Converting a Thin Solid Body into Sheet Metal and Surface Body  
Tag Name: Lab11 | 1- Final Project - Assigned  
2- CW Tutorial: Bearing Loads  
3- CW Tutorial: Non-Uniform Pressure  
4- CW Tutorial: Spot Weld Connectors |
| 12   | 1- Exam #2  
2- Frequency and Buckling Analyses | 1- CW Tutorial: Frequency Analysis  
2- Set 3: Exercises 1, 2, 3, 9, 11, 14, 15, 16, 17  
Tag Name: Lab12 | 1- Project 7 - Assigned  
2- Read Frequency Analysis (Theory)  
3- Read Linear Buckling Analysis (Theory)  
4- Read Chapters 7, 8 |
<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Labs</th>
<th>Assignments</th>
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</thead>
</table>
| 13   | 1- Thermal Analysis  
2- Transient & Steady State  
3- Thermal Stress Analysis | 1- CW Tutorial: Thermal Analysis  
2- CW Tutorial: Thermal Stress Analysis  
3- CW Tutorial: Transient Thermal Stress Analysis  
4- Work on the final project  
Tag Name: Lab13 | 1- Project 8 - Assigned  
2- Read Heat Transfer Analysis (Theory)  
3- Read Chapter 9 |
| 14   | 1- Shape Optimization  
2- Work on Final Project  
3- Thanksgiving | 1- Set 4: Exercises 1, 2, 3  
2- CW Tutorial: Shape Optimization  
Tag Name: Lab14 | 1- CW Tutorial:  
Parameters and Design Scenarios  
2- CW Tutorial: Advanced Design Scenarios |
| 15   |                                            |                                           | 1- CW Tutorial:  
Thermostat  
2- Look at Set 4: Exercise 7 |