UNIVERSITY OF SOUTHERN CALIFORNIA

AME 408, Computer-Aided Design of Mechanical Systems

Spring 2019

Time and Location:	T 6:30 PM to 9:10 PM	SAL 127 (Section 2, 28759)
	Th 6:30 PM to 9:10 PM	SAL 127 (Section 1, 28758)

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: SAL general computer area

- For TA's name and 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:

Title	Author	ISBN
1. Beginner's Guide to SolidWorks 2012 - Level I	Reyes	978-1-58503-698-1
2. Beginner's Guide to SolidWorks 2012 Level II	Reyes	978-1-58503-701-8
3. SolidWorks 2012 Part 1 – Basic Tools	Tran	978-1-58503-696-7
4. SolidWorks 2012 Part 2 – Advanced Techniques	Tran	978-1-58503-700-1
5. Parametric Modeling with SolidWorks 2012*	Schilling & Shih	978-1-58503-699-8
6. SolidWorks 2012 Tutorial*	Planchard	978-1-58503-702-5
7. Engineering Design with SolidWorks 2012*	Planchard	978-1-58503-697-4
8. Assembly Modeling with SolidWorks 2012*	Planchard	978-1-58503-708-7

SolidWorks Simulation:

Title	Author	ISBN
1. Engineering Analysis with SolidWorks Simulation 2012	Kurowski	978-1-58503-710-0
2. Introduction to FEA Using SolidWorks Simulation 2012	Shih	978-1-58503-704-9

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:

Final Project:	20%
Exams #1	5%
Exams #2	25%
Projects:	28%
Labs:	22%

- Late lab reports will not be accepted under any circumstances.
- Late projects loses 50% of its value per day (or fraction of) that is late.
- 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. This exam is modeled after the SolidWorks certification exam. When the dimensions of the object change, 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 ***not*** be during regular class meetings. The exams are tentatively scheduled for:

  Exam I: 8th week of instructions (Wednesday, February 27, 2019, 7:30-9:50 AM);

  Exam II: 12th week of instructions (Wednesday, April 3, 2019, 7:30-9:50 AM);

  These are times that a computer lab is found to accommodate the class.

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

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.

Course Outline:

1. Introduction
2. Introduction to CAD (Solid Modeling) and FEA
3. Part and assembly modeling using SolidWorks
4. Basic concepts of engineering analysis
5. Linear Static Analysis
6. Adaptive Analysis and Mesh Control
7. Dynamic Analysis
8. Linear Buckling Analysis
9. Thermal Analysis
10. Design Optimization

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.

Week	Topics	Labs	Assignments
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

Week	Topics	Labs	Assignments
4	1- Draft Feature 2- Shell 3- Planes 4- Rib 5- Mirror Feature 6- Text 7- Re-order of Features 8- Multi-Thickness Shell 9- Hole Wizard 10- Configurations 11- Design Table	1- Set 5-6: Exercises **28**, 30a, 30b, **32a**, 32b, 33, **34**, 35 **36**, **37a** 2- Set 7: Exercises 38, **39**, **40**, 41 Tag Name: **Lab4**	1- Read Chapters 6, 7 2- Read SW Tutorial: Pattern Features 3- Try Set 5-6: Exercises 31, 32c 4- Try Set 5-6: Exercise 37b
5	1- Loft Feature 2- Split Entity 3- Loft with Guide Curves 4- Curve through XYZ 5- Ellipse 6- Sweeps with Guide Curves 7- Project Curves onto a Face	1- SW Tutorial: **Loft** 2- Set 9: Exercises **51**, 52, 53 3- **Appendix 2** 4- Set 8a: Exercises 42, **44**, 46, 47 Tag Name: **Lab5**	1- Project 3 - Assigned 2- Read Chapters 9, 8a 3- Try Set 8a: Exercises 45, 43
6	1- 3D Curves 2- Basic Assemblies 3- Bottom-Up Assemblies 4- Collision Detection 5- Basic Exploded View	1- Set 8b: Exercises **48**, 49, **50** 2- SW Tutorial: 3D Sketching 3- SW Turorial 3D Sketching with Planes 4- Set 10: Exercises **54**, 55, **57**, 58 Tag Name: **Lab6**	1- Project 4 - Assigned 2- Read Chapters 8b, 10a, 10b 3- Try Set 10: Exercise 56
7	1- Advanced Assemblies 2- Top-Down Assemblies 3- Creating parts in the context of an assembly 4- Assembly Features 5- Work on Project 4	1- Set 11: Exercises 59, **60**, 61, 63, 62 2- SW Tutorial: Advanced Design Tag Name: **Lab7**	1- Read Chapter 11
8	1- **Exam # 1** 2- Introduction to FEA 3- Brief overview of CW interface	1- CW Tutorial: Static Analysis of a part (only if rusty on CW)	1- Read Introduction to FEA (Theory)

Week	Topics	Labs	Assignments
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
No Class - Spring Break			
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

Week	Topics	Labs	Assignments
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	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