ITP 308 – Computer-Aided Design for Bio-Mechanical Systems

Units: 3
Spring 2021 – Wednesday – 5:00pm-7:50pm

Instructor: Raymond Kim
Office: Virtual through Zoom
Office Hours: TBD
Contact Info: raymonmk@usc.edu

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

IT Help: Provided by Viterbi IT
Hours of Service: 8am–5pm M-F
Walk-in: DRB 205
Contact Info: (213) 740-0517
Email: engrhelp@usc.edu

Course Description

Concepts of computer-aided design in 2-diemsions and 3-dimensions. Creating advanced parts using extrusions, surfaces, and equating driven sketches. Forming assemblies, and sub-assemblies, for motion analysis.

Learning Objectives

This course will introduce you to one of the CAD tools widely used in industry today. The tool will be SolidWorks. This tool will introduce the concepts of sketching, part assembly, drawings, assemblies, motion tools, and a finite element analysis tool. The course will implement the SolidProfessor teaching content designed to aid in the self-learning of concepts, preparing students for the Certified SolidWorks Associate Develop certification.

Course Objectives:

1. Utilize the solid modeling package SolidWorks to design complex parts and assemblies for manufacturing and production.
2. Analyze designs through the use of a Finite Element Analysis simulation for stress analysis and design optimization.
3. Work collaboratively and efficiently in a group setting to design and analyze a complex physical system.
4. Utilize modeling and design principles to satisfy functional requirements in creative and novel ways.
5. Communicate designs and findings through proposal writing and presentations

Prerequisite(s): None

Co-Requisite(s): None

Concurrent Enrollment: None

Recommended Preparation: MATH 245 and some strength of materials knowledge.

Course Notes

All lecture slides, homework and lab assignments will be posted to the course Blackboard page. External content will be posted to the SolidProfessor website (requires a paid SolidProfessor account).

Technological Proficiency and Hardware/Software Required

Students are expected to be able to perform the following tasks before the course begins:

- **Create a ZIP file that contains one or more files**
- **UnZIP a file that contains one or more files**
- **Submit files through Blackboard's submission page**

	Student Outcomes*						
Course Objectives	1	2	3	4	5	6	7
Obj 1	x						x
Obj 2	x						x
Obj 3					x		
Obj 4	x	x					x
Obj 5			x		x		
All Objectives	x	x	x		x		x

*Student Outcomes as defined by ABET Accreditation. See Page 7

Grading Breakdown

You will be graded on the following

ITEM	% of Grade	
Lab Assignments	25	
Homework Assignments	20	
Mini Project	25	
Final Project	30	
TOTAL	100	

Grading Scale

Course final grades will be determined using the following scale

A	93+
A-	90 - <93
B+	87 - <90
B	83 - <87
B-	80 - <83
C+	77 - <80
C	73 - <77
C-	70 - <73
D+	67 - <70
D	63 - <67
D-	60 - <63
F	<60

Mini Project

The mini project will be an individual modeling project that will have a set of requirements and will test all the material learned from the first 7 weeks of the semester. It will be work 25% of the overall grade.

Requirements:
Students will create a project based around functional requirements given by the instructor in Week 3. It must make use of at least 1 assembly comprised of at least 3 parts with 4 unique features per part. The assembly must be constrained to physical limitations and mated properly. Students must also present technical drawings of all parts and any and all assemblies. For each assembly drawing, there should be a BOM and an exploded view showing how the parts are assembled. Students will give a short (~5min) presentation on their project during class.

Students must show that their project meets the functional requirements set forth by the instructions. Grading will be based on the following distribution:

10 points – Meets Functional Requirements
50 points – Parts and Assembly files
20 points – Presentation
20 points – Technical Drawings

100 points total

Final Project

The final project will be a cumulative project that requires the use of learned material during the semester. The project will be worth 30% of the overall grade and can be done in a group of up to 3 members.

Requirements:
A group of up to 3 students will create an assembly of their choice. The assembly must feature at least 4 different parts per student, with at least 8 different features (cuts, extrusions, surfaces, etc.) for each part. The assembly must be completely constrained with physical limitations accounted for (colliding parts, over-rotation, etc.).

Each group must submit a proposal that outlines their final project along with a list of parts that make up the assembly. Preliminary sketches or photographs must be provided as well as any supporting documentation for your build.

Each group will create a photo-realistic render of the assembly and create an animation of the assembly. Final projects will be presented during the assigned final time, including a discussion of the design process along with any trade studies that were conducted.

Anonymous peer evaluations will be submitted as well as evaluations of your project made by the other groups. Each will be taken into consideration when calculating the final project grade.

Total points: 100

20 Points – Proposal
20 Points – Presentation
50 Points – Assembly and Part Files
10 points – Evaluations

Assignment Submission Policy

Homework and lab assignments will be given weekly. Students will submit all of their homework assignments and labs through Blackboard only. No email submissions will be counted towards a student's grade.

Late work will be accepted up to two days after the due date of the assignment or lab.

0 – 24 hours Late: 80% maximum credit
24 – 48 hours Late: 65% maximum credit
>48 hours late: 0% maximum credit.

Grading Timeline

Grading of labs will be done by the end of the week on which the lab was assigned.
Grading of homework will be done within one week of the deadline.

Accessing SolidWorks

Students can access SolidWorks in several ways. Below is a list of ways to access the software in order of preference (first option being the most reliable and stable connection):

1. Request a loaner laptop from ITP to borrow for the duration of the semester. It will come preloaded with SolidWorks 2020. You will be shipped a laptop if you cannot physically pick it up from the ITP office (all shipping fees will be paid for by ITP).
2. Installing SolidWorks SDK on your personal computer. SolidWorks runs only on a Windows operating system so you will either need a PC, or have your Mac run a Windows OS using a partition drive (Bootcamp) or a virtual machine. This SDK does not include some of the components that we will need for the final project, but you can do mostly everything else in the SDK.

3. Accessing the Virtual Desktop Interface (VDI). You can use a virtual machine that has SolidWorks installed on it through your web-browser or through an application you install on your computer. This connection requires a stable internet connection. This method works on Mac and Windows.
4. Accessing the Viterbi Lab Remote Desktop Connection through myViterbi. You can request a session with a physical computer on campus using a Remote Desktop Protocol (RDP) connection. This works on Mac and Windows computers. You will need to securely connect to the Virtual Private Network (VPN) to access the connection.

Course Schedule: A Weekly Breakdown

	Topics	Readings	Labs/Homework
Week 1	SolidWorks interface; sketches; parts; extrusions; boss/bass; sweeps	**Suggested Outline: Section 1-2**	**Lab1: Sketching** **Assignment 1: Basic Extrusions**
Week 2	Tabs; fillets; mirroring; materials; mass properties	**Suggested Outline : Section 3**	**Lab2: Symmetry and Patterns** **Assignment 2: Functional Design** **Assignment 1 Due**
Week 3	Revolves; ribs/shells; chamfer; planes; assemblies	**Suggested Outline : Section 4-5**	**Lab3: Circular/Cylindrical Symmetry** **Assignment 3: Reference Geometry** **Assignment 2 Due** **Mini Project Requirements Assigned**
Week 4	Drawings; section views; annotations; BOM	**Suggested Outline: Section 6**	**Lab4: Drawing Views/Configurations** **Assignment 4: GD&T** **Assignment 3 Due**
Week 5	3D sketching; derived sketches; auto trace	**Advanced Parts: Advanced Sketching**	**Lab5: 3D Sketching** **Assignment 5: Functional Design Assemblies** **Assignment 4 Due**
Week 6	Lofts; boundary features	**Advanced Parts: Sweeps, Lofts, Boundary**	**Lab6: Lofting Bodies** **Assignment 6: Advanced Part Creation** **Assignment 5 Due**
Week 7	CSWA Practice	**Suggested Outline: Lesson 7-13**	**Lab7: CSWA Practice Part** **Assignment 7: CSWA Practice Assembly** **Assignment 6 Due** **Proposal Due**
Week 8	Modeling and Design Intent	**Efficient Modeling and Design Intent**	**Assignment 7 Due**
Week 9	Mini Project Presentations		**Mini Project Due**
Week 10	Simulation Xpress; simulation of loads; FOS	**SimulationXpress**	**Lab8: Simple Load Analysis** **Assignment 8: Trade Study Design**
Week 11	Surfaces	**Surfacing Essentials**	**Lab9: Surfacing** **Assignment 9: Combining Surfaces and Solids** **Assignment 8 Due**
Week 12	Assembly features; component patterns; advanced mates	**Advanced Assemblies: Assembly Features, Component Patterns,**	**Assignment 10: Advanced Assembly Creation** **Assignment 9 Due**
Week 13	Scenes; lights; cameras; motion and animation	**Visualization and Appearances; Motion and Animation**	**Work on Final Project** **Assignment 10 Due**
Week 14	Designing Springs; Advanced Animation Techniques		**Work on Final Project**
Week 15	Decals; material properties	**Material Properties, Adding Decals, Giving a concise, useful, technical Talk**	**Work on Final Project**
FINAL			Date: For the date and time of the final for this class, consult the USC *Schedule of Classes* at www.usc.edu/soc.

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" https://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, http://policy.usc.edu/scientific-misconduct

In this class, all homework submissions will be compared with current, previous, and future students' submissions. If your work is found to be a copy of another person's work, or if you submit someone else's work as your own, the instructors will not hesitate to file a report with SJACS with a recommended penalty of an F in the course.

Do not give other student's your SolidWorks files. This is the easiest way to avoid plagiarism. In the case that files have been shared, all students involved will receive the same penalty and no distinction will be made between those who submitted another person's work, and those who shared the file.

Support Systems:
Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

National Suicide Prevention Lifeline - 1-800-273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. http://www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. https://engemannshc.usc.edu/rsvp/

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. http://dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic https://studentaffairs.usc.edu/ssa/

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. https://diversity.usc.edu/

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, http://emergency.usc.edu

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.
Provides overall safety to USC community. http://dps.usc.edu

BME Student Outcomes

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. An ability to communicate effectively with a range of audiences

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.