ME 471

COMPUTER-AIDED ENGINEERING APPLICATIONS

COURSE SYLLABUS

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Office Hours: M-F 13:00 – 14:00 MDT[1] (BYU)

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[1] BYU enters Mountain Standard Time (MST) on 6 Nov 2011. Classes move from UTC -6hrs to UTC -7hrs.

LECTURE HOURS:	TUE. & THUR.	9:00 – 9:50	UBC
		10:00 – 10:50	**MDT**[1] BYU (250 CTB)
		11:00 – 11:50	UIA
			ITESM-TOLUCA
		12:00 – 12:50	WAYNE STATE
		13:00 – 13:50	USP
	WED. & FRI.	0:00 – 0:50	TONGJI
		0:00 – 0:50	NTU
		1:00 – 1:50	HONGIK

NX LAB HOURS:	WED.	9:00 – 10:50	UBC
		10:00 – 11:50	**MDT**[1] BYU (413 CB)
		11:00 – 12:50	UIA
			ITESM-Toluca
		12:00 – 1:50	Wayne State
		13:00 – 13:50	USP
	THUR.	0:00 – 1:50	Tongji
		1:00 – 2:50	Hongik

CATIA LAB HOURS:	FRI.	10:00 – 11:50	**MDT**[1] BYU (413 CB)
	SAT.	0:00-1:50	NTU

COURSE DESCRIPTION AND PHILOSOPHY: This course deals with extended principles and procedures of multi-dimensional computer-aided engineering applications. This course teaches students how to solve real world engineering problems using the capabilities of commercial CAx tools and systems.

*This class is a junior/senior level engineering course and as such it will on average require **3** hours outside of class for every **1** hour in class or lab. If you choose to invest this amount of time you will master the topics covered. Few engineering Bachelor of Science graduates ever learn or practice the advanced capabilities and engineering applications of commercial CAx systems during their program. However, modern engineering firms are constantly seeking students who have a strong understanding of the engineering fundamentals as well as excellent skills and a working knowledge of parametric CAx tools. Students who excel in this class have found exciting internships and full-time employment within aerospace, automotive, energy and consumer product companies.*

COURSE OUTCOMES:

1. An understanding of Product Lifecycle Management (PLM) methods and techniques for enabling distributed teams to collaborate on a shared design.

2. An understanding of the underlying mathematics of topology optimization, its CAx methods, and the role topology optimization plays in conceptual, preliminary and detail product design.
3. An understanding of the mathematics of curves, surfaces and solids, and a mastery of both surface and solid modeling techniques found in a modern commercial CAD package.
4. The ability to create robust parametric CAD models of mechanical components and assemblies.
5. An understanding of the underlying mathematics of Mass Properties, FEA, CFD, animation and motion analysis; their CAx methods, and the role these methods and applications plays in preliminary and detail component and assembly design.
6. An understanding of the process for preparing CAD models for Rapid Prototyping.
7. Experience practicing team based design engineering.
8. An understanding of the following global competences,
    a. Experience working in or directing a team of ethnic and cultural diversity.
    b. Understand cultural influences on product design, manufacture and use.
    c. Understand how cultural differences affect how engineering tasks are performed.

COURSE OBJECTIVES:

- Understand ten of the most relevant engineering applications available on modern parametric CAx tools and systems.
- Prepare students for meaningful and productive employment within an automated engineering, design and manufacturing environment.
- Provide exposure to the broad range of PLM and CAx engineering applications.
- Train students in the process of idea synthesis, and its logical extension to the physical realization of parts, components, and systems that satisfy the assigned problem set.
- Stimulate interest in and reinforce the need for engineering applications software development.
- Motivate students to accept the task of maintaining an attitude of life-long learning as it relates to CAx tools.

PREREQUISITES: You must (**no exceptions**) have successfully completed an Engineering Graphics—Principles and Applications course or Fundamental Wireframe, Surface and Solid Modeling CAD Course (at BYU the prerequisite is ME 172). You are also required to have completed Engineering Mechanics and Dynamics courses (at BYU these prerequisites are CE 203 and 204).

TEXT (REQUIRED): Mastering CAD/CAM, by Ibrahim Zeid, Publisher McGraw Hill, 2005.

You are also encouraged to use the basic and advanced vendor-prepared *User Manuals and Tutorials*. I recommend getting familiar with the Web based on-line documentation and tutorials for the CAx tools you are learning. When the text and online materials need to be supplemented, the instructor will distribute other materials.

SUPPLEMENTAL READINGS/COURSES: If you need additional insight on a particular topic covered in lecture, you are encouraged to check a book out from the library that covers this topic in detail. Libraries typically have dozens of books, theses, journals, etc. that discuss or present topics covered by this course. For those interested in mastering the CAx Applications area you will find a wealth of knowledge and foundational research dealing with the applications discussed in this class. At BYU one can find technical elective courses that go into greater depth and detail regarding the physics and application of many of the CAx applications introduced in this class. These classes generally assume you already have the model prepared for the analysis. Thus this class and any supplemental readings you choose to do are intended as preparation for taking advanced FEA, CFD, Motion, Dynamics, etc. classes.

TA HOURS: Are given above and will be posted on the class TcC site. BYU has many CAD TAs; most of them have been hired to help the freshman level ME 172 class. For the BYU students, these TAs can be a resource to you if you have been away from the CAD systems for a semester or two. TAs assigned specifically to this class will be available in room 450 CTB for approximately 15 hours per week. Please plan your work so that you can seek help during one or more of these scheduled times. *Note: during their scheduled hours, the ME 471 TAs will be logged into Skype so they can assist non-BYU students as well.*

CLASS ORGANIZATION: Each Tuesday and Thursday class lectures originates from BYU and are broadcast live via a video conference link to the BYU Tandberg Bridge (IP Address:128.187.0.69, Video Conference: 25905#) or asynchronously via the ME 471 YouTube channel, http://www.youtube.com/user/byume471. In lecture we discuss selected topics and chapters from the Mastering CAD/CAM textbook. Students are encouraged to read the assigned chapters *before* they are scheduled to be discussed in lecture. The lectures will focus more on the underlying mathematics of the particular application than on the execution of this application or method using some graphical user interface (GUI) within a CAx tool. GUIs of CAx systems will change three or four times during your career, but their underlying mathematics will not. Learning the underlying foundation of how CAx tools function will make it easier to adopt or transition to other CAx tools once you graduate.

Each Wednesday (for NX) and Friday (for CATIA) labs will originate from BYU, broadcast live or asynchronously in the same manner as the lectures. In lab students learn the process and procedure of using CAx tools to do parametric modeling, analysis, and manufacturing. These labs will focus more on the step-by-step procedures for doing the particular modeling, analyses and/or manufacturing application covered in previous lectures. With an understanding of the CAx application and the foundational materials presented in the lectures, students are challenged to apply their new knowledge and CAx skill to their semester project.

LAB ASSIGNMENTS: The labs are written so that you and your team should be able to complete each exercise within the hours allotted, ***if you divide and conquer and work smart.*** **Remember: each member of your team should be contributing ~5 hours per week modeling, performing analysis, or prototyping. In addition each of you should be dedicating ~3 hours to reading and preparing for class lectures. I have found that there is no upper limit on the amount of time required of the unprepared or unorganized student, especially when it comes to the proficient and correct use of CAx tools.**

HOMEWORK: Homework will be assigned in lecture and has two purposes: 1) it is to help you understand and reinforce the CAD, CAE, and CAM theory and techniques discussed in lecture, and 2) it is to have you gather the necessary information, data, and files that will make your lab session more effective. It should be noted that the assigned homework problems are very representative of the types of problems that will appear on the scheduled exams.

PERSONAL CLASS JOURNAL (OPTIONAL): A personal class journal is recommended for tracking the events related to this class. Your journal is an excellent place to record class notes, planning sessions on how to solve a particular modeling assignment or problem, minutes and notes related to team meetings, questions you wish to ask the TA's or professor, a log of times dedicated to class activities, etc. One can also find ways of including graded homework, quizzes, tests, etc. that will stand as a record of your progress and achievements.

TEAMWORK: BYU students will be assigned into teams based largely on language skills. Each team will consist of three (3) BYU students pared with three (3) students from another university. The intent is that BYU team members will study together and, where possible, find times to study, discuss, and review the lecture material with remote team members. It is also expected that team members will hold ***regular*** (at least 30 minutes per week) ***project planning meetings*** and work collaboratively (as much as possible) using Skype, TcC application sharing, etc. to complete the group lab assignments. I envision team members (local and remote) sitting at adjacent workstations being linked together via collaborative technologies to the workstations of each remote team member. Each team member would be working on their own part, analysis, etc., but be able to instantly share their knowledge or insights with other team members struggling with a design, analysis, or software problem. ***When doing group assignments, it is acceptable*** to build one model as a team and turn in ***one group lab assignment***. The only way to learn CAE/CAD/CAM tools and techniques is to get into the text, on-line help, and use the systems with your fingers on the keyboard.

COMPUTERS: BYU students will need a CAEDM account, which gives access to workstations in rooms 450 CTB, 425 CB, and 308 CB running the Linux or Windows operating system. These systems support many different CAD, CAE, CAM packages, Mathematica, Maple, Matlab, programming in C/C++, etc. BYU students are expected to use these systems to accomplish the assigned modeling, analysis, and manufacturing activities.

Remote students will be given a supplement to this syllabus that describes how and where to get access to the computers that have been configured for your use.

CALCULATORS: Are useful in this class and lab, and are always allowed during ME 471 **tests**.

HONOR CODE: Dr. Karl G. Maeser said, "I trust you all. I give you my confidence. I hope you will do nothing to weaken that confidence. I put you on your word of honor." I echo his sentiments. It is common knowledge that old ME 471 tests, labs, and homework assignments are available from former students. ***You are on your honor not to refer to these materials. Why? You will find that this CAx course is constantly improving and being upgraded to newer software releases and thus old tests and quizzes are much less effective test preparation materials than your personal notes and assignments.***

The work you turn in must be your own work or the work of your team and must reflect your own level of understanding. If you do not participate in a team assignment then your name should not be on that assignment regardless the fact that you are by name a part of the team. In the real world of work, "no work means no pay," in the ME 471 class "no participation on a team project mean no credit."

When doing an individual assignment, it is acceptable for a team of students to work side-by-side on their individual models, each sharing the benefits of his experiences with the others, but ultimately turning in their own work.

For the BYU ME 471 students, ***I expect all of you to abide by the BYU Dress and Grooming Standards,*** whether you are attending lectures, in labs, or just working in the open CAEDM labs.

LATE POLICY: After an assignment has been graded and returned, no late submittals of this assignment will be accepted, unless prior written (via email) approval has been given. Any assignment turned in after the appointed due date and before the grading of the assignment is completed will be penalized *10% per day* that it was late (not counting Sundays). Portions of assignments CANNOT trickle in—part on-time and part late. If **unusual circumstances arise** which will prevent you from turning work in on-time, contact me (via email) **before** the assignment is due and I will, if warranted, grant an extension. Otherwise, late work will be marked down according to the policy above. Please note that the computers or printers, on average, go down for at least a portion of one day during any given week. This is unfortunate but somewhat standard operating procedure (sigh!) and does not justify turning an assignment in late. Please plan your work so that you will not be adversely affected by this unfortunate, but typical, situation.

GRADING: Grades will be computed based on; 100% — 90% (A — A-), 89% — 80% (B+ — B-), 79% — 70% (C+ — C-), 69% — 60% (D+ — D-) scale. The 1300 points possible will be assigned as follows:

Homework	180 points
Individual Labs	280 points
Group Project	400 points
Midterm Exam	150 points
Final Presentation	140 points
Final Exam	150 points
Total	**1300 points**

Homework		**Individual**
1.)	Personal Info	10 points
2.)	Skype and Google Accounts	10 points
3.)	Modeling Standards Naming Convention	10 points
4.)	Vehicle Specifications and Parameters	10 points
5.)	Culture Grams	10 points

6.) Assembly Control Skeleton Identification of Hardware	10 points
7.) Design Envelopes Loads Constraints Material Properties	10 points
8.) Data Exchange	10 points
9.) Mathematics of Wireframe Control Sketches	10 points
10.) Mathematics of Surfaces	10 points
11.) Mathematics of Solids	10 points
12.) Mathematics of FEA Loads Constraints Material Properties	10 points
13.) Mathematics of Mass Properties	10 points
14.) Mathematics of Motion	10 points
15.) Mathematics of CFD	10 points
16.) Mathematics of Visualization	10 points
17.) PMI	10 points
18.) Rapid Prototyping	10 points
Individual Homework	180 points

Labs	**Individual**
1.) Teambuilding I	20 points
2.) PLM & Teambuilding II	20 points
3.) Team Organization & Teambuilding III	20 points
4.) Assembly Parametrics	20 points
5.) Topology Optimization	20 points
6.) Data Transfer, Wireframe Modeling & Reparameterization	20 points
7.) Parametric Surface Modeling	20 points
8.) Vehicle Surface Modeling	20 points
9.) FEA	20 points
10.) Assembly FEA	20 points
11.) Visualization	20 points
12.) Mass Properties	20 points
13.) Motion Analysis	20 points
14.) CFD	20 points
Individual Labs	280 points

NOTES:

• I always give the highest grades I can, commensurate with a student's level of learning and understanding. Let us all end the semester in the 90% and above range.

• Remember, I always look forward to talking with students in my office or lab about the concepts discussed in class. Remote students can reach me via Skype (c.greg.jensen or search for my email cjensen@byu.edu) during my office hours.

• If you are having trouble, please come see me as soon as possible.