Western Michigan University
College of Engineering and Applied Sciences
Engineering Design, Manufacturing, and Management Systems (EDMMS)

EDMM 4480: Computer-Aided Analysis

- Catalog Description: Understanding and application of Computer-Aided Design (CAD) principles for design analysis of conceptual designs. Exposure to and utilization of commercial software packages for computer-based design analysis techniques (e.g., Finite Element Analysis – FEA, simulation) and customized design evaluation (e.g., symbolic evaluation). Interaction with, and among, selected drafting/modeling and design/analysis packages. Lecture/Lab (2 – 3), Credit: 3 hrs.

- Prerequisites by Courses:
  EDMM 3480: Designing for Production

- Prerequisites by Topic:
  1. Understanding Equilibrium Principle for 2-D and 3-D situations
  2. Ability to apply Equilibrium Conditions to 2-D and 3-D situations
  3. Comprehension of the different types of body stresses in a mechanical and/or structural component
  4. Capability to determine the magnitudes of the existing body stresses in 2-D and 3-D situations
  5. Fundamental understanding of thermodynamics laws and the related parameters
  6. Fundamental understanding of conservation of energy and mass principles applied to fluid mechanic's problems
  7. Capability to define and follow algorithmic approaches to problem solving

- Textbook:

  Creo Simulate Tutorial Release 3.0 Structural and Thermal, by R. Toogood, Schroff Development Corporation, Mission, KS, 2015.

  Catia V5 FEA Tutorials – Release 21, Nader G. Zamani, Schroff Development Corporation, Mission, KS, 2012.

- References:
  User's Manuals. Various commercial software packages.

  Introduction to Finite Element Analysis and Design, Nam-Ho Kim and B. V. Sankar, John Wiley and Sons, Inc., New York, 2009.

- Course Instructor/Lab Instructor:

- Course: Jorge Rodriguez, PhD, MBA, Parkview Campus E-224, (269) 276-3374, jorge.rodriguez @wmich.edu.

- Objectives/Performance Criteria:
  Based on the above stated course description, at the conclusion of the semester the student should be able to:

Course Objectives	**Performance Criteria[1]**
1. Identify and model the analysis conditions of 2-D and 3-D mechanical and structural components	(A2) Understand and apply modeling issues for computer-aided analysis of components
2. Numerically analyze and solve solid mechanics problems using computer-aided engineering tools	Properly specify constraints that reflect functionality of modeled components/systems in CAD
3. Perform critical and creative analysis for redesign of existing mechanical and structural components	(F2) Perform design changes to fulfill specified requirements for components
4. Report and present individual and group engineering analysis results	(G2) Identify and obtain analysis results that properly illustrate the design process applied
5.	

- Topics:
  Lectures
  - Design. Design Methodologies. Creative and Basic Design (1/2 week)
  - Principles of Computer-Aided Design (CAD), Computer-Aided Engineering (CAE) and Concurrent Engineering (CE) (1/2 week)
  - Analysis of Trusses (1 week)
  - Models for Design Process. Design Cycle. Evaluation and Re-evaluation of Design (1 week)
  - Introduction to Finite Element Analysis. 2-D Components (2 weeks)
  - Beam Theory and Analysis of Statically Indeterminate Beams (3 weeks)
  - Axisymmetric Components and Shells (3 weeks)
  - Pressure Fits (1 week)
  - Analysis of 3-D components (1 week)

  Labs
  - Truss Analysis (2 week)
  - Creo Simulate Intro Plane Stress/Strain (2 weeks)
  - Creo Simulate – Beams and Frames (2 weeks)
  - Creo Simulate – Axisymmetric & Shell/Solids (2 weeks)
  - Catia FEA – Intro – Trusses (2 weeks)
  - Catia FEA – Beam Analysis (2 weeks)
  - Catia FEA – 2-D and 3-D analysis of solids (1 week)
  - Analysis Project (1 week)

- Evaluation:
    1. Exams and Quizzes: 30%
    2. Homework 15%
    3. Lab assignments 40%
    4. Projects 10%
    5. Attendance, Participation 5%

- Computer Usage:
  Extensive use of computer hardware and software is required in this course.

- Laboratory Projects:
  A Final Project consisting of the analysis and evaluation of results for a mechanical component/device is required. At least one of the FEA softwares utilized during the lab sessions needs to be used for the project. A complete analysis and redesign is expected.

- Oral and Written Communications:
  Written reports are required for all lab exercises and for the project. Each report must include theory and evaluation sections. Graphics must be included to show representative and important results. No handwritten submissions are accepted.
  A paper review (summary and critique) is required. A minimum of two articles on Computer-Aided Analysis should be selected and reviewed. A two-page-minimum report needs to be submitted.
  A six-minute presentation of the Final Project will take place the last week of classes. Use of MS PowerPoint (or similar) is required.

- Calculus Usage:
  Basic use and understanding of differentials and integrals is required to follow the theory on Finite Element Analysis.

- Library Usage:
  Use of the Library is expected for proper references on all written reports.

- Comments:
  - Lecture quizzes are written ones. Lecture quizzes could be previously announced or not.
  - Lab quizzes/exams are written and/or hands-on.
  - There is at least one exam during the semester, and one final exam.
  - All homework is due at the beginning of the following lecture of the same type (i.e., lecture or lab), unless indicated otherwise.
  - Lab tutorials, exercises and homework will be given during lab sessions. The tutorials are due at the end of the lab session. Some exercises are due at the end of the lab session as well. Homework is due the following lab session.
  - Complete lab reports are required for all lab projects.
  - Written evaluations are due after each software/textbook is covered. The software evaluations are your opinion (provide likes and dislikes) on the software (i.e., Creo Simulate and Catia FEA).

- A mid-semester course evaluation will be given, where you will be asked to provide feedback on what you would like to see changed and kept, and any recommendations or suggestions you might have to improve the course and the learning.

- Electronic submission (eLearning) of lab work, and some lecture work, will be required.
- You must create proper directories and name your files in a sequential fashion according to the instruction that will be given during class/lab. The set of folder that need to be created (suggestion) in your account is as follows: ime4480> analysis1 to analysis3; creosim1 to creosim6; catia1 to catia6; project; quizzes; and papers.
- E-mail and eLearning will be used during the semester.

- All work should be done individually, unless indicated otherwise.
- Presentation is important. Hand-written reports are not acceptable.
- Strict control of the due dates will be kept. Penalty applies to any late submission of work. The penalties are: 25% for submission during the same session, 50% for submission the same day, 75% next day, 100% any subsequent day.
- Some of the grading will take place during the lab sessions. No work will be accepted after the assignment has been graded.
- Make up exams and lab quizzes will be allowed only for verified extreme circumstances.
- Use of personal computer/laptops/device is permitted during lectures/lab only for class-related activities. No use of any other personal electronic devices is allowed during lecture/lab.

Grades: Based on average and standard deviation for the group. A good estimate of grade is that average score is a high CB, and each standard deviation is one letter grade, up and down. A minimum score of 50 is required to get a passing grade (i.e., D and above).

Note: These are basic guidelines. If you have any questions or doubts about something, please ask about it. I will be more than willing to explain or clarify your doubts. Do not assume or expect anything.

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