ME-738 COMPUTER AIDED ENGINEERING

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Office Hours: will be announced in class and posted in instructor's website – see **Instructor Schedule Grid**

Textbooks and Notes:

- Instructor's Lecture Notes

References:

- User's Guide of software packages used in the course
- Computational Fluid Dynamics by T.J. Chung, Cambridge University Press, 2002 ISBN 0-521-59416-2

Course Description:

This course covers advanced CAD (Computer Aided Design) and CAE (Computer Aided Engineering) tools for visual computing simulation and analysis (virtual prototyping). Topics include modeling, assembly, CAD data exchange by exporting and importing various CAD model formats, computer simulation and analysis of structure, thermal, fluid and animation of the results of analysis. The structural analysis component includes linear static with failure criteria, modal frequencies, harmonic analysis and random vibration, large deflection, boundary (contact) and material nonlinearities, buckling, impact using explicit dynamics and fatigue analysis based on Soderberg, Goodman and Gerber theories. Both steady state and transient analyses are included in thermal design. Modern computational fluid dynamics (CFD) based on Finite Volume Methods (FVM) formulation is applied to solve design problems that involve inviscid, laminar and turbulent fluid flows. Multi-physics analyses such as thermal-structure, electric-thermal-structure in MEMS and fluid-structure interactions are studied. The laboratory component involves use of most current commercial CAD/CAE.

Software Packages:

1. Creo Parametric and Simulate by PTC Inc.
2. ANSYS by ANSYS Inc.

Prerequisites: ME-635 or department approval.

Course Outline: Lectures

Week Number:	TOPICS
1	Software package: **Creo Parametric and Simulate** Introduction to the course - Computer Aided Engineering. • STRESS CONCENTRATION PROBLEM: Rectangular Plate with Circular Hole • LARGE DEFLECTION ANALYSIS: Nonlinear analysis of a plate. • LINEAR STATIC AND LARGE DEFLECTION (NON-LINEARITY): Tractor Suspension
2	Software package: **Creo Parametric and Simulate** • OPTIMIZATION: Structural static analysis with design sensitivity studies and optimization - bracket. • WELD ANALYSIS: Static Analysis of Spot Weld Assembly • THERMAL ANALYSIS: A Steel Cooling Spine
3	Software package: **Creo Parametric and Simulate** • 3D CONTACT ANALYSIS: Latch Mechanism • STEADY-STATE, TRANSIENT THERMAL AND STATIC STRUCTURAL ANALYSIS: Chips Assembly PROJECT. • BUCKLING ANALYSIS: Buckling of Plate with Ribs as Stiffeners.
4	Software package: **Creo Parametric and Simulate & ANSYS APDL (Classic)** • FATIGUE ANALYSIS: Fatigue Analysis of Piston – PROJECT • CYCLC SYMMETRY STUCTURAL ANALYSIS: Impeller Cyclic Symmetry Analysis – PROJECT • NON-LINEAR ANALYSIS: Plate – ANSYS APDL (Classic)
5	Software packages: **ANSYS Classic & Workbench Static Structural** • MULTIPHYSICS: Coupled-Field Multiphysics Analysis of a MEMS Thermal Actuator • STRUCTURAL STATIC ANALYSIS: Pump Assembly • PLASTICITY: Suspension Bracket – PROJECT
6	Software packages: **ANSYS Workbench: Thermal & Contact** • STEADY STATE THERMAL: Thermal Analysis of Pump Housing. • NON-LINEAR CONTACT: Spring and Plate Assembly Contact Analysis • STEADY STATE, TRANSIENT AND THERMAL STRESS: Analysis of Circuit Board

7 Software packages: **ANSYS Workbench: Contact, Fatigue & Vibration**

- CONTACT ANALYSIS: Bolted Joint Assembly - PROJECT
- FATIGUE: Fatigue Analysis of Connecting Rod
- MODAL AND HARMONIC ANALYSIS: AC Unit

8 Software packages: **ANSYS Workbench: Vibration, Explicit Dynamic & Thermal Radiation**

- RANDOM VIBRATION: Random Vibration Analysis of Circuit Board2- PROJECT
- IMPACT ANALYSIS: High Speed Impact of a Soda Can - PROJECT
- THERMAL RADIATION: Steady State Thermal Analysis of a Spot Light Assembly with Radiation

9 Software packages: **ANSYS Workbench: Optimization, Non-Linear Material and CFD - Fluid Flow CFX**

- OPTIMIZATION: Cantilever Support Optimization – PROJECT
- EXPLICIT DYNAMICS: Oblique Projectile Impact of a Bullet
- NON-LINEAR MATERIAL: Non-Linear Contact of an O-Ring - PROJECT
- COMPUTATIONAL FLUID DYNAMICS (CFD): Simulating Flow in a Cyclone

10 Software packages: **ANSYS Workbench Fluid Flow CFX**

- CFD: Flow Through a Butterfly Valve
- CFD: Simulation Flow in an Electronic Enclosure Assembly
- CFD: Turbulent Flow Over a Blimp – PROJECT

11 Software packages: **ANSYS Workbench Fluid Flow CFX an Fluent**

- CFD: Dust Cyclone – PROJECT
- FLUID STRUCTURE INTERACTION (FSI): Baffled Tank - FSI
- CONJUGATE HEAT TRANSFER AND FSI: T - Junction

12 Software packages: **ANSYS Workbench Fluid Flow Fluent**

- CFD: Turbulent Flow in a Compact Heat Exchanger
- CFD: Turbulent Flow in Wavy Channel - PROJECT
- CFD: Turbulent Flow and Heat Exchanger in Mixing Elbow 3D

13 Software packages: **ANSYS Workbench Fluid Flow Fluent**

- CFD: Turbine Cascade
- CFD: Wind Tunnel Simulation of a Sport Car -PROJECT
- CFD: Centrifugal Blower - PROJECT

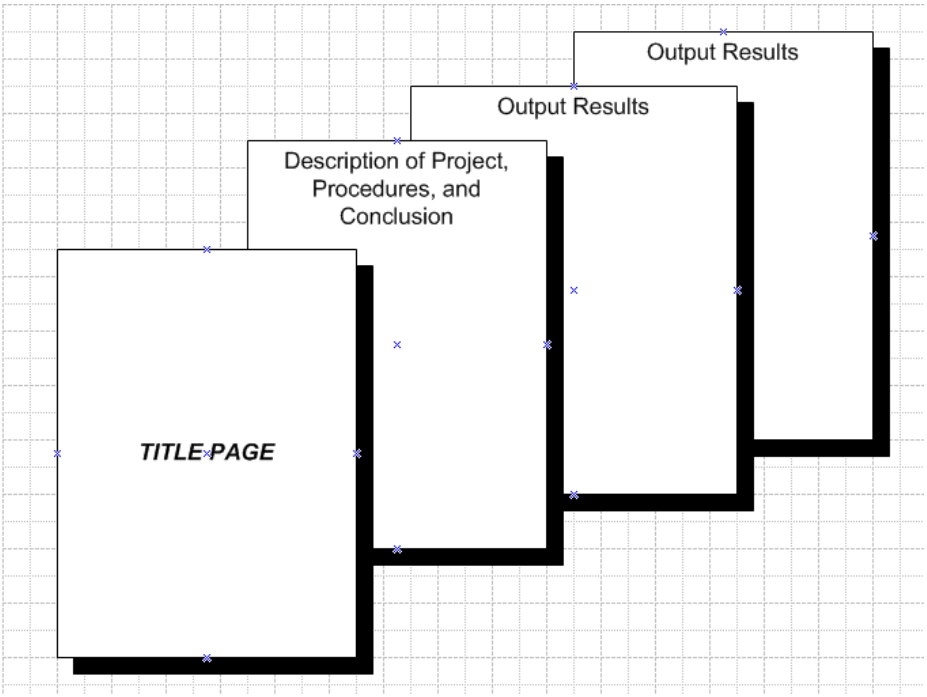
14	Software packages: • *Review*	

Homework related to the lectures will be assigned, collected and graded.

The laboratory will be in the MIE Computer Lab MEC-219, and will have hands-on sessions to cover the topics of the course.

SUBMITTED ASSIGNMENT FORMAT:

Projects / assignments should be submitted according to the following format:



Grading Scheme:

The grade will be based on the following:

Lab Works - Assignments	30%
Projects	40%
Final Exam	30%
Total	100%