

ENS-309 COMPUTER-AIDED ENGINEERING

Fall 2020

Instructor:	Eralp Demir
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Class hours:	Thursday 15:40-17:30 Friday 10:40-11:30
Zoom link:	https://zoom.us/j/4653244758?pwd=SVZzdTFvUXFkZmFzNGZSRFkvRll1dz09
Meeting ID:	465 324 4758
Zoom Passcode:	6MepDb

Office Hours: After class, or by appointment

Main References:

- Paul M. Kurowski, *Engineering Analysis with SOLIDWORKS® Simulation* 2019, SDC Publications, 2019.
- Shanin S. Nudehi, John R. Steffen, *Analysis of Machine Elements Using SOLIDWORKS® Simulation* 2019, SDC Publications, 2019.
- Paul M. Kurowski, *Vibration Analysis with SOLIDWORKS® Simulation* 2019, SDC Publications, 2019.
- Paul M. Kurowski, *Thermal Analysis with SOLIDWORKS® Simulation* 2019 and *Flow Simulation* 2019, SDC Publications, 2019.
- John Matsson, *An Introduction to SOLIDWORKS® Flow Simulation* , SDC Publications, 2019.

Objectives: Course teaches how to perform engineering analysis using a computer software. Basics descriptions for analysis will be defined. A brief theoretical background will be provided at the beginning of each topic. Students will learn how to perform engineering analysis using a computer software. The design and analysis aspects will be discussed concerning the manufacturing constraints. All the concepts will be illustrated on worked examples.

Prerequisites:

- ENS-209 Computer-Aided Design
- IE-309 Manufacturing Processes-I (optional)

Learning Outcomes:

- Mathematical background for computer aided analysis
- Master a computer software for analysis simulations
- Mechanical analysis: static structural analysis, assembly analysis (joints, interference fits, etc.), analysis of machine elements, and vibration analysis
- Thermal analysis: problems involving conduction, convection, radiation, steady-state and transient heat flow problems

- Fluid analysis: fluid flow analysis, steady-state and time-dependent flows, thermofluid analysis (i.e. heat exchanger design)

Tentative Course Outline:

Week 1: Basics

Basic descriptions

- What is Finite Element Analysis?
- Finite Element Analysis used by Design Engineers
- Objectives of FEA for Design Engineers
- What is SOLIDWORKS® Simulation?
- Fundamental steps in an FEA project Errors in FEA
- A closer look at finite elements: mesh, elements, nodes, etc.
- What is calculated in FEA?
- How to interpret FEA results
- Units of measure
- Using online help
- Limitations of Static studies

Weeks 2-4: Mechanical - static structural

- Static equilibrium - force balance (Newton's 2nd Law)
- Example applications: a hollow plate, L-bracket, link
- 2D problems

Weeks 5-7: Mechanical - joining elements

- Curved beam analysis
- Stress concentration analysis
- Thin and thick walled pressure vessels
- Contact analysis
- Interference fit analysis
- Bolted joint analysis
- Design optimization

Weeks 8-10: Vibration Analysis

- Dynamic equilibrium (Newton's 2nd Law)
- Introduction to modal analysis

- Time response and frequency response of discrete systems
- Frequency response
- Vibration absorption

Week 10-12: Thermal analysis

- Energy balance equation
- Heat transfer by conduction, convection, radiation
- Steady-state and transient thermal analysis
- Examples: hollow plate, L-bracket, round bar, thermal analysis of a coffee mug

Week 12-14: Fluid analysis

- Continuity equation
- Introduction to fluid analysis using SOLIWORKS® Flow Simulation
- Examples: Flat plate boundary layer, flow past a sphere and a cylinder, flow over a rotating cylinder, flow past an airfoil, pipe flow
- Thermofluid analysis: flow across a bank of cylinders, heat exchanger design

Week 14-15: Topology optimization

Use of topology optimization tool at introduction to design for 3D printing.

Computer Programming: SOLIDWORKS® Simulation, Flow Simulation (2019 or higher)

Grading Policy: Lab assignments (30%), Project (20%), Midterm (20%), Final (30%).

Important Dates:

Midterm **November 26th, 2020 @ 15:40-17:30**
Final Exam will be announced

Class Policy:

- Attendance to at least 70% of the online laboratory sessions is mandatory.