COURSE NUMBER: ME 4053, 4 credits	**COURSE TITLE:** Engineering Modeling
TERMS OFFERED: Fall, Spring	**PREREQUISITES:** ME3331, ME3332, ME3333, AEM2021, AEM3031, ME3281, ME3221, ME3222
TEXTBOOKS/REQUIRED MATERIAL: Web-based tutorials, lecture notes, video-casts	**PREPARED BY:** A. Aksan, Ph.D. **DATE OF PREPARATION:** March 27th, 2017
COURSE LEADER(S): A. Aksan, Ph.D.; F. Kelso, Ph.D.	**CLASS/LABORATORY SCHEDULE:** 4x50 min lectures/week **CONTRIBUTION OF COURSE TO MEETING PROFESSIONAL OBJECTIVES**: 100% Engineering Fundamentals and Applications
CATALOG DESCRIPTION: This course is aimed at teaching undergraduate students mechanical engineering modeling, technical analysis and technical design capabilities from a non-compartmentalized perspective. The course focuses on, (i) modeling complex, multi-disciplinary mechanical engineering problems by identifying critical elements of a problem, (ii) design and development of analysis tools using analytical and numerical techniques and (iii) developing optimized solutions/designs to problems/challenges.	**COURSE TOPICS:** 1. Review of mechanical engineering fundamentals (Thermodynamics, Heat Transfer and Fluid Mechanics, Controls, Dynamics, and Strength of Materials) from the unified perspective of analysis-based engineering design. 2. Modeling of complex engineering systems through scaling and force analysis, determination of design constraints, assumptions, and the critical parameters of the problem. 3. First-order modeling and analysis as a first step for detailed analysis. 4. Fundamentals of numerical analysis techniques, and algorithms including finite-difference and finite-element/volume techniques. 5. Introduction to numerical solvers (e.g. Matlab, share/freeware, ANSYS) 6. Case studies on different mechanical engineering sub-disciplines with special emphasis on analyzing and solving multi-disciplinary and cross-disciplinary cases.

COURSE OBJECTIVES	Students learn: 1. To understand mechanical engineering fundamentals from a unified perspective of analysis-based design and engineering problem solving. 2. To apply engineering modeling to the design and analysis of complex mechanical engineering systems. 3. To conduct dimensional analysis to determine the relevant phenomena in an engineering problem/system and to develop simplified models of that system. 4. The fundamentals and application of numerical analysis, algorithm development and simulation. 5. A variety of numerical solvers and acquire the ability to select appropriate solution tools for the specific problem at hand. 6. To model and analyze complex engineering problems starting with a first-order analysis then progressing towards construction of detailed models and application of analysis tools. 7. To intelligently search, identify, and utilize the tools and information widely available through code libraries, free/share-wares and the web.
COURSE OUTCOMES	**(Letters shown in brackets are linked to program outcomes a-k)** At the conclusion of the course, students will have: 1. An ability to simplify, model, simulate, and analyze complex engineering problems and conduct analysis. [a, e, i, j, k] 2. An ability to perform dimensional analysis to identify and bound the principal drivers of an engineering problem. [a, e, j, k] 3. An ability to find or develop a variety of numerical solution algorithms and simulation tools and learn to select and use the one suitable for their specific problem. [a, c, e, i, j, k] 4. An understanding of the ethical and legal consequences of applying third-party software to the solution of engineering problems. [f, h] 5. A basic working level knowledge of all mechanical engineering sub-disciplines that could play a role in a real life analysis. [a, e, i, j, k] 6. An ability to conduct a structured analysis, which begins with first-order models and progresses toward more complex and computationally expensive models. [a, e, i, j, k] 7. An ability to tackle real world problems in the capstone design course. [c, e, h]
ASSESSMENT TOOLS:	1. Midterm exam 2. Homework 3. Case studies

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