1. ME 4053, Mechanical Engineering Modeling

2. 4 credits, 4 contact hours


   a. Other supplemental materials: Web-based tutorials, lecture notes, video-casts.

5. Specific course information:
   a. Catalog description: Analysis-driven design of integrated thermal-fluid-mechanical systems from a non-compartmentalized perspective: modeling complex, multi-disciplinary engineering problems by identifying critical elements of a problem; designing/developing analysis tools using analytical and numerical techniques; developing optimized solutions to problems/challenges.
   b. Prerequisites: ME 3331, ME 3332, ME 3333, AEM 2021, AEM 3031, ME 3221, ME 3222, ME 3281.
   c. Elective course for freshmen entering the program before June 2018 or students entering the mechanical engineering program before December 31, 2019; required course for freshmen entering the program after June 2018 or students entering the mechanical engineering program after January 1, 2020.

6. Course outcomes (related ABET student outcomes indicated in square brackets):
   a. An ability to simplify, model, simulate, and analyze complex engineering problems and conduct analysis. [1,4,6,7]
   b. An ability to perform dimensional analysis to identify and bound the principal drivers of an engineering problem. [1,6,7]
   c. 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. [1,2,7]
   d. An understanding of the ethical and legal consequences of engineering analysis, reporting and decision-making. [4]
   e. A basic working level knowledge of all mechanical engineering sub-disciplines that could play a role in a real life analysis. [1,6,7]
   f. An ability to conduct a structured analysis, which begins with first-order models and progresses toward more complex and computationally expensive models. [1,7]
   g. An ability to tackle real world problems in the capstone design course. [1,2,4,7]
   h. An ability to document results in an engineering memo. [3]
   i. An ability to function on an engineering team. [5]

7. Course topics:
b. Modeling of complex engineering systems through scaling and force analysis, determination of design constraints, assumptions, and the critical parameters of the problem.
c. First-order modeling and analysis as a first step for detailed analysis.
d. Fundamentals of numerical analysis techniques, and algorithms including finite-difference and finite-element/volume techniques.
e. Introduction to numerical solvers (such as Matlab, share/freeware, ANSYS).
f. Case studies on different mechanical engineering sub-disciplines with special emphasis on analyzing and solving multi-disciplinary and cross-disciplinary cases.