Course alpha, number, title: ME 391 Mechanical Engineering Analysis

Required or elective: Required

Course (catalog) description: Analytical and numerical methods for the modeling and analysis of mechanical engineering systems. Applications to vibrating elements, heat transfer, linear springs, and coupled spring-mass systems.

Prerequisite(s): (MTH 235 or MTH 255H or LBS 220)

Textbook(s) and/or other required material:

Class/Lab schedule:
- Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered:
(a) The principle of work, potentials, and conservation of mass.
   i. Vector calculus, including divergence and curl and the directional derivative
(b) Forced spring-mass-damper systems
   i. Ordinary differential equations
   ii. Laplace Transforms (including delta functions)
(c) Coupled systems (spring-mass systems and/or compartment models)
   i. Linear algebra
   ii. Eigenvectors and eigenvalues
(d) The heat, wave, and Laplace equations
   i. Partial differential equations
   ii. Boundary value problems
   iii. Eigenvalue problem
   iv. Fourier series

Course learning objectives:
Upon successful completion of this course, students can:
1. State the work, heat, wave, Laplace, forced spring-mass-damper equations.
   [L: Knowledge] [M: Question in Exam]
2. Formulate the conservation of mass and coupled systems equations.
   [L: Synthesis] [M: Question in Exam]
3. Solve all of the above equations using analytical (and some numerical) techniques;
   [L: Analysis] [M: Question in Exam]
4. Use suitable approximations, make quantitative comparisons, and interpret the solutions.
   [L: Evaluation] [M: Question in Exam]

Key: L – Level of Learning, M- Method of Measurement

Relationship of course to ME program outcomes:
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—0
(d) an ability to function on multidisciplinary teams—0
(e) an ability to identify, formulate, and solve engineering problems—0
(f) an understanding of professional and ethical responsibility—0
(g) an ability to communicate effectively—0
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —0
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

**Contribution to professional component:**

33% Engineering Science 0% Engineering Design 67% Math and Basic Science

**Person(s) who prepared this description**

Indrek Wichman and Maureen Blazer-Adams (original, 2009)
Indrek Wichman and Geoffrey Recktenwald (updated, 2014)

**Date of Preparation**

2014