

Syllabus
AEM 3101
Mathematical Modeling and Simulation in Aerospace
Engineering
2 Credits

Catalog Description:

Mathematical modeling of engineering systems and numerical methods for their solution. Use of MATLAB. Focuses on systems found in aerospace engineering and mechanics.

Course Web Address:

<http://www.aem.umn.edu/courses/aem3101/>

Prerequisites by Topic:

1. Differential equations and linear algebra (Math 2373)

Text:

Numerical Methods for Engineers and Scientists: An Introduction with Applications Using MATLAB, by Amos Gilat and Vish Subramiam. Wiley. (ISBN 978-0470565155).

Format of Course:

2 Lectures per week

Computer Usage:

MatLab

Course Objectives:

The aim of this course is to: (1) Teach students how to mathematically model engineering systems and (2) Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in aerospace engineering and mechanics.

Course Outcomes:

Students who successfully complete this course will demonstrate the following outcomes by tests, homework, and written reports:

1. An ability to apply knowledge of math, science, and engineering. This will be accomplished by applying these disciplines to various problems in AEM.
2. An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various problems in AEM.
3. An ability to use the techniques and skills of modern engineering tools necessary for the engineering practice. This objective will be accomplished by using Matlab.

Relationship of course to program objectives:

This course develops the students' skills in using modern engineering tools and relates the usage to simulation of systems in aerospace engineering and mechanics.

Relationship of course to program outcomes:

This course provides the following outcomes:

1. Apply math
2. Identify engineering problems
3. Engineering tools

Direct Measures

Outcome: Engineering Tools

Performance Criteria: Students demonstrate they can use MatLab to simulate various systems in AEM.

Assessment Method: Final grade in course (all assignments will measure this outcome)

Course Outline:

Lecture (Hrs, approx.)	Topics
6	Introduction MATLAB & Data Presentation: Vectors, Matrices, Vector/Matrix Operations & Manipulations. Functions vs scripts. Making clear and compelling plots.
4	Linear Algebra and Least Squares: Solving systems of linear equations numerically and symbolically. Least squares regression and curve fitting.

4	Root Finding: Linearization and solving non-linear systems of equations. The Newton-Rapson method.
2	Computer Representation of Numbers: Integers and rational numbers in different bases. Floating point numbers. Round off and errors in basic arithmetic. Significant digits when reporting results.
4	Ordinary Differential Equations: Numerical integration and solving 1 st order, ordinary differential equations (Euler's method, Heun's method and Runge-Kutta). Use of ODE function in MATLAB
4	System of Ordinary Differential Equations: Converting 2 nd order and higher ODEs to systems of 1 st order ODEs. Solving systems of ODEs via Euler's method, Heun's method and Runge-Kutta)
2	Non-Linear Differential Equations: Solving single and systems of non-linear differential equations by linearization. Use of the function ODE in MATLAB to solve differential equations.
2	Partial Differential Equations: The one-dimensional heat equation. Fourier series solution.

Outcome Measurement:

Accomplished through homework and final project

Student Survey Questions:

This course improved my ability to do the following:

1. Apply knowledge of math, science, and engineering.
2. An ability to use modern engineering tools such as MatLab.

Please answer the following questions regarding this course:

3. Use modern engineering tools necessary for engineering practice.
4. The textbook was a useful reference and appropriate for the course.
5. The final project was interesting, challenging, and appropriate for the course.

In this course I acquired the following:

6. A knowledge of MatLab usage for simulations
7. An understanding of how systems are modeled and simulated

Last modified:

2012-11-28