

MAE 107
Computational Methods in Engineering (4 units)

Class/Laboratory Schedule: four hours of lecture, eight hours outside preparation.
12 hours/week total

Course Coordinator(s): Prabhakar Bandaru, William McEneaney, Alison Marsden

Textbooks/Materials:

1. Chapra and Canale, Numerical Methods for Engineers

Catalog Description: Introduction to computers and computing with Matlab; numerical linear algebra; linear equations, nonlinear equations and iterative methods with engineering applications; function interpolation, differentiation, approximation and integration, data regression, numerical solution of ordinary differential equations.

Prerequisites: Admission to the engineering major and grades of C- or better in MAE 8 or 9 and Math 20F.

- Required Course
- Technical Elective Course
- Other: _____

Performance Criteria:

Objective 1

1.1 Students will demonstrate aptitude in standard numerical techniques for solving various classes of problems. For example, LU decomposition and Newton's method for solving systems of equations, Runge-Kutta methods for solving initial-value problems .

1.2 Students will learn the theory underlying the derivation of standard numerical techniques and the development of algorithms. For example, accuracy and stability of time-integration methods for initial value problems; obtain error estimates for numerical derivative formulae.

Objective 2

2.1 Modeling of engineering problems drawn from different disciplines of mechanical engineering. For example, heat transfer computations in a material treatment process, force computations in a truss.

Objective 3

3.1 Students will analyze and fit data.

Objective 4

4.1 Students will demonstrate ability to program in a mid-level language such as Matlab, C or FORTRAN.

Course Objectives:

(Numbers in parenthesis refer to MAE and AE Program Outcomes)

Objective 1: To teach students the design and application of numerical methods for solving mathematical models of problems in engineering. (1a, 5e, 8h)

Objective 2: To enable students to formulate and solve engineering problems that are not amenable to analytical methods. (5e, 8h)

Objective 3: To demonstrate the application of numerical methods to data analysis and optimal design. (1a, 5e)

Objective 4: To prepare the students for reading and adding to existing code. (7g, 8h, 10j, 11k)

Course Topics:

1. Introduction to numerical computation and computer programming with Matlab
2. Systems of linear equations with engineering applications
3. Systems of nonlinear equations.
4. Interpolation and differentiation with applications in CAD/CAM.
5. Numerical integration.
6. Function approximation, regression, and least-squares methods.
7. Ordinary differential equations.

Prepared by: C. Pozrikidis, March 2007

Revised: A. Marsden and M. C. de Oliveira Jun 2009 via Teaching Work Group Meeting

Reviewed: TWG, June 2010; August 2011

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