MAE 107
Computational Methods in Engineering

Designation: Required course for ME and AE.

Catalog Data:
MAE 107 Computational Methods in Engineering (4)

Course Description (40 word maximum):
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 9 or 10 and Math 20F.

Textbook, Required Materials: C. Pozrikidis, Numerical Computations in Science and Engineering, Oxford University Press, 1998. Access to miscellaneous Online Material posted on the class web site (http://pozrikidis.ucsd.edu)

Prerequisites by Topics: Integral and differential calculus, differential equations, computer programming.

Class/Laboratory Schedule: 4 lecture hours per week

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.

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)

Methods of Evaluation:
1. Homeworks and computer programming projects assigned every two weeks.
   Any computer language is acceptable.

2. Two mid-term exams and one final exam.

Performance Criteria:
(Numbers in parentheses refer to the methods of evaluation used to assess student performance.)

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)

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. (1,2)

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. (1,2)

Objective 3
3.1 Students will analyze and fit data. (1,2)

Objective 4
4.1 Students will demonstrate ability to program in a mid-level language such as Matlab, C or FORTRAN. (1,2)

Contribution of Course to Professional Component:
Engineering Science

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Revised: C. Pozrikidis, and H. Murakami April 2008 via Teaching Work Group Meeting