**CMPSC/MATH 456**

**Introduction to Numerical Analysis II**  
Elective in Computer Science and Computer Engineering

**Catalog Data:**  
Introduction to Numerical Analysis I (3)  
Floating point computation, numerical rootfinding, interpolation, numerical quadrature,  
direct methods for linear systems. Students may take only one course for credit from  
CMPSC/MATH 451 and CMPSC/MATH 455. Prerequisite: CMPSC/MATH 455.

**Typical Textbook:**  

**Course Objectives:**  
Numerical analysis is the science of understanding computer methods for solving  
mathematical problems. The sequence CMPSC/MATH 455-456 introduces these  
methods, explains how they work, and discusses how they can fail. It is intended  
primarily for mathematics and computer science majors, but qualified students majoring  
in scientific or engineering disciplines are encouraged to enroll. CMPSC/MATH 455  
teaches beginning topics, whereas CMPSC/MATH 456 teaches more advanced topics.

**Primary Course Outcomes:**  
Upon completion of the course, students should possess the following skills:

- Problem Definitions: An understanding of how numerical problems are posed and solved.
- Problem Synthesis: Use of different numerical methods to solve a scientific problem.
- Eigenvalue Problems: Basics of eigenvalue methods and analysis. Understanding of power, inverse power, and QR algorithms.
- Optimization: Should have some understanding of methods for linear programming. If time permits, concepts on more advanced optimization topics could be learned.

**Relationship to Undergraduate Program Outcomes:**  
CMPSC/MATH 456 is the second in the sequence of numerical analysis courses  
(CMPSC/MATH 455 is the first) which collectively support the following program outcomes:

- Demonstrate an ability to analyze the space/time complexity of algorithms using discrete mathematics, including the appropriate use of O-notation and recurrence relations.
- Analyze algorithms or computer code for correctness and efficiency.

**Required Topics:**  
(38 hrs. total)

- Orthogonal Transformations and Least Squares Problems. May include discussion of fast Fourier transforms (7 hours).
- Eigenvalue and Singular Value Problems (8 hours).
- Iterative Methods for Large Systems of Equations (6 hours).
- Ordinary Differential Equations (9 hours).
- Linear Programming (8 hours).

**Class Format:**  
Threes lectures per week. Each lecture/lab is 50 minutes.

**Professional Component:**  
CMPSC/MATH 456 is designed to aid in the professional development of engineers and scientist by developing skills in problem solving, critical thinking, algorithm design, and program implementation.

**Evaluation:**  
20%  Homeworks (including MATLAB programming assignments)  
40 %  Quizzes (about 4)  
40%  Final Project

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