Fayetteville State University
College of Art and Sciences
Department of Mathematics and Computer Science
Fall Semester – 2010

I. Locator Information:

Instructor: **Dr. Nicoleta Bila**
Course # and Name: **MATH 440 – Applied Numerical Methods** Office Location: **LS 329/SBE 307C**
Semester Credit Hours: **3**
Office hours: **MW 2:45 p.m. – 3:50 p.m. & TR 4:00 p.m. – 5:50 p.m.**
Day and Time Class Meets: LSA 130 Office Phone: **910-672-2204**
Total Contact Hours for Class: **40**
Email address: **nbila@uncfsu.edu**

FSU Policy on Electronic Mail: Fayetteville State University provides to each student, free of charge, an electronic mail account (username@uncfsu.edu) that is easily accessible via the Internet. The university has established FSU email as the primary mode of correspondence between university officials and enrolled students. Inquiries and requests from students pertaining to academic records, grades, bills, financial aid, and other matters of a confidential nature must be submitted via FSU email. Inquiries or requests from personal email accounts are not assured a response. The university maintains open-use computer laboratories throughout the campus that can be used to access electronic mail.
Rules and regulations governing the use of FSU email may be found at http://www.uncfsu.edu/PDFs/EmailPolicyFinal.pdf

II. Course Description

A course on numerical methods including topics such as: nonlinear equations, linear systems, interpolation and polynomial approximation, curve fitting numerical differentiation, numerical integration, numerical optimization, solution of differential equations. Mathematical software such as Maple, Matlab, and Mathematica will be used.

Prerequisite: Math 431

III. Textbook

Brian Bradie - A Friendly Introduction to Numerical Analysis, Christopher Newport University,
Publisher: Prentice Hall, 2006
Mathematical Software: Maple, Matlab, or Mathematica

IV. Course Objectives

To extend students' understanding of calculus and differential equations by introducing them to numerical methods for modeling and analysis of certain applied mathematical models. This course is designed for students in mathematics, computer science, engineering, physics, chemistry, and other science fields. Upon successful completion of this course, students should be able to apply numerical techniques for solving linear and nonlinear equations and differential equations arising in real-world applications.

V. Course Competencies

Competencies (DPI)

(11.1) Develop and analyze algorithms for computational efficiency.

(11.2) Develop skills in using interactive and recursive techniques in solving problems.

(11.3) Use computers to approximate solutions to equations

(11.4) Use computers to explore mathematical concepts.

NCATE Standards

(1.1.1) Use a problem-solving approach to investigate and understand mathematical concept.

(1.1.2) Formulate and solve problems from both mathematical and everyday situations.

(1.2.1) Communicate mathematical ideas in writing, using everyday and mathematical language, including symbols.

(1.3.0) Make and evaluate mathematical conjectures/arguments and validate their own mathematical thinking.

(1.4.1) Show an understanding of interrelationships within mathematics.

(1.4.2) Connect mathematics to other disciplines and real-world situations.

(1.5.2) Understand and apply numerical computational and estimation techniques and extend them to algebraic expressions.

(1.6.1) Use calculators in computational and problem-solving situations.

(1.6.2) Use computer software to explore and solve mathematical problems.

(2.2.0) Use computers and other technologies as tools for teaching.

(2.4.0) Use a variety of resource materials such as software, print materials, technology, and activity files to enhance the learning of mathematics.

(2.5.0) Select appropriate mathematical tasks that will stimulate students' development of mathematical concepts and skills.

VI. Evaluation Criteria

Two chapter tests will be given throughout the course. A comprehensive final will be given at the conclusion of the course. All tests will be weighted the same. A letter grade will be assigned as follows:

Exams - 60% Final Exam 10% Homework 20% Class Commitment- 10%

A = 92-100%, B = 83-91%, C = 73-82%, D = 64-72%, F= below 64%

Note. Students will receive up to 10 extra credit points for turning in specific Matlab codes or problems assigned by their instructor.

VII. Course requirements

1. Students are expected to attend all class sessions. Excessive absences may result in a reduction of your final grade.

2. Students are expected to enter the class room on time, and remain for the full class period. Students should not make other appointments in conflict with their class schedule. Three late arrivals and early departures will constitute an absence from the class.

3. All tests will be announced prior to their administration. A make-up exam will be given only if the

student has a documented and valid written justification for unavoidable absence from the exam. There is no more than one make-up exam for each student during the semester. Each student is required to attend the departmental colloquium at least three times during the semester as part of the project.

4. The Instructor's office hours are times when you may seek assistance without prior appointment. You are encouraged to seek help as needed.

5. Students must refrain from smoking, eating and drinking in the classroom. The rights of others must be respected at all times.

6. Students are encouraged to ask questions of the instructor in class and to respond to those posed by the instructor. They should not discourage others from asking or answering questions.

7. Students are expected to complete all class assignments, to spend adequate time on their class work, and to read each topic prior to class discussion to insure that the course outcomes are met. At least two hours of home study is expected for each class.

8. Talking in class between students is strictly prohibited. Discussions should be directed to the instructor. Unacceptable behavior in the class will result in a reduction of your final grade.

9. Dishonesty on graded assignments will not be tolerated. Students must neither give nor receive help on any work to be graded. The university policy on cheating will be applied to any violations. The minimum penalty will be a grade of zero on the assignment.

VIII. References

1. Arieh Iserles, *A First Course in the Numerical Analysis of Differential Equations*, Cambridge Texts in Applied Mathematics, Cambridge University Press, 1996
2. Curtis F. Gerald and Patrick O. Wheatley, *Applied Numerical Analysis*, 7th edition, Addison-Wesley, 2003
3. Laurene V. Fausett, *Applied Numerical Analysis Using MATLAB*, Prentice Hall, 1999
4. Won Young Yang, Wenwu Cao, Tae-Sang Chung, John Morris, *Applied Numerical Methods Using MATLAB*, John Wiley & Sons Inc, 2005
5. Richard Haberman, *Applied Partial Differential Equations with Maple 10*, Prentice Hall, 2006

IX. Teaching Strategies:

The majority of the material of the course will be given in lecture format. There is a short review before and after each lecture. There will be a comprehensive review after the completion of each chapter. Maple, Matlab or Mathematica will be used in the class to help students develop a firm grasp of the underlying mathematical concepts.

X. Course Outline with Assignment Schedule

The following topics will be covered in this course. The instructor reserves the right to change this syllabus according to the needs except for the grading scale. Students will be made aware of the changes.

Chapter 1 – Getting Started
Algorithms.
Convergence.
Mathematics in the Computer: Floating Point Number Systems.
Mathematics in the Computer: Floating Point Arithmetic
Chapter 2 - Rootfinding
Bisection Method.
The method of False Position.
Fixed Point Iteration Schemes.
Newton's Method.
Secant Method.
Accelerating Convergence.
Roots of Polynomials.
Chapter 3 – Systems of Equations
Gaussian Elimination.
Pivoting Strategies.
Vector and Matrix Norms.
Error Estimates and Condition Number.
LU Decomposition
Direct Factorization.
Special Matrices.
Iterative Techniques for Linear Systems: Basic Concepts and Methods.
Conjugate-Gradient Method.
Nonlinear Systems of Equations.
Review
TEST 1
Chapter 5 – Interpolation (and Curve Fitting)
Lagrange Form of the Interpolating Polynomial.
Neville's Algorithm
The Newton Form of the Interpolating Polynomial.
Optimal Points for Interpolation.
Piecewise Linear Interpolation.
Cubic Spine Interpolation.
Hermite and Hermite Cubic Interpolation
Regression
Chapter 6 – Differentiation and Integration
Numerical Differentiation Part I
Numerical Differentiation Part II
Richardson Extrapolation
Numerical Integration – The Basics and Newton-Cotes Quadrature
Continuous Theory and Key Numerical Concepts.
Chapter 7- Initial Value Problems of Ordinary Differential Equations
Key Numerical Concepts and Elements of Continuous Theory
Euler's Method
Higher-Order One-Step Methods: Taylor Methods
Runge-Kutta Methods
Multisteps Methods

Convergence and Stability Analysis
Error Control and Variable Step Size Algorithms
Systems of Equations and Higher-Order Equations
Absolute Stability and Stiff Equations
Review
Test 2
Review for the final examination
Final Exam – October 13

REVISION OF GRADES – STUDENT RESPONSIBILITIES
The following revisions become effective on August 16, 2007.

WN GRADE DISCONTINUED:

- **WN - Withdrawal due to non-attendance - discontinued, effective August 16, 2007.**

STUDENTS: Do not expect faculty to withdraw you for non-attendance. Drop or withdraw* from classes according to the deadlines published in the catalog. *See warning below about class withdrawals.

NEW TYPE OF GRADE: INTERIM GRADES – (New name for "midterm grade," with additional purposes). Interim grades will be assigned from the first week of the semester until the deadline for class withdrawals. Interim grades are used for informational and warning purposes only; they are not part of your permanent transcript and have no effect on your GPA. Instructors may assign interim grade of F to warn students of poor academic performance or they may assign "X" or "EA" grades. (See below for explanations) After midterm, faculty will assign all students an interim grade of A – F to inform students of their academic status as of midterm.

- **INTERIM GRADE X = NO SHOW – Assigned to students who are on a class roster, but never attend class. For warning purposes only; NOT a final grade.**

STUDENTS: Check interim grades early in the semester. If you have an X grade, either begin attending the class or withdraw* from it. *See warning below about class withdrawals. If you do not take action in response to an X grade, you will receive a final grade of FN. (See "FN" below)

- **INTERIM GRADE EA = EXCESSIVE ABSENCES - Assigned to students whose class absences exceed 10% of the total contact hours. For warning purposes only, NOT a final grade.**

STUDENTS: Check your interim grades often. If you have an "EA" grade for a class, you are in jeopardy of failure if you do not take immediate actions. Either resume attending the class or withdraw from it. *See warning below about class withdrawals.

NEW FINAL GRADE:

- **FN = FAILURE DUE TO NON-ATTENDANCE – Assigned to students who are on class roster, but never attend the class. An FN grades is equivalent to an F grade in the calculation**

of the GPA.

STUDENTS: You must attend (or withdraw* from) all the classes for which you are enrolled. **See warning below about class withdrawals.*

WARNING ABOUT CLASS WITHDRAWALS:

- **When you withdraw from a class, you are wasting your money and time. You receive no refund for withdrawing from individual classes and you slow your progress toward degree completion.**
- **If you withdraw from or fail more than one-third of your classes, you will no longer be eligible for financial aid.**
- **STRIVE TO EARN CREDIT FOR ALL THE CLASSES IN WHICH YOU ENROLL; WITHDRAW FROM CLASSES ONLY WHEN IT IS ABSOLUTELY NECESSARY!**