

Math 4340/5340: Numerical Methods

Section 20370/20371 – Fall 2015

TTh 8:00-9:15 AM, MCS 212

Instructor: Clarence Burg

Office: MCS 225

Office Phone: 501-450-5654

email: clarenceb@uca.edu website: <http://faculty.uca.edu/clarenceb>

Final Exam: 8:00-10:00 AM, Thursday, December 10, 2015

Office Hours: MWF 10:00-10:50 AM, TTh 9:25-10:40 AM

Required Text: Numerical Methods Using MatLab, Fourth Edition, Mathews and Fink, Pearson Prentice Hall.

Prerequisites: Math 3320 Linear Algebra and Math 2441 Mathematical Computation.

Course Description: This course is a survey course of some of the more common numerical methods used for finding solutions to complicated mathematical and physical problems that can not be fully investigated using analytic techniques.

Student Learning Outcomes: Upon successful completion of this course, the student will be able to:

1. Determine the sources of errors within a numerical calculation;
2. Identify the theoretical and observed orders of accuracy of a numerical method;
3. Develop and analyze approximations to the derivative and the integral;
4. Use several methods for identifying the root of a function and the minimum of a function;
5. Use several methods for approximating the solution to ordinary differential equations numerically;
6. Understand the process and the computational cost of solving linear systems of equations.

Grading: Grades will be based on the standard 10 point scale (A – 90-100%, B – 80-89%, C – 70-79%, D – 60-69%, F – below 60%). The grade will be determined as follows:

Homework Average	15%
Programming Assignments (5@5% each)	25%
Tests (2@15% each)	30%
Final Exam	30%

Attendance and Withdraw Failing Policy: Attendance is expected. If the instructor determines that the student has intentionally stopped attending class (i.e., missing classes, missing exams and not informing instructor about the reason), then the student will be dropped. Absences for officially sanctioned university activities are allowed – please inform the instructor prior to these absences.

Homework: Homeworks will be assigned on a regular basis, collected and graded. Homeworks will be returned prior to the tests. Late homeworks will **not** be accepted after the test over that material has been given.

Programming Assignments: There will be six programming assignments throughout the semester, focusing on the following topics:

1. Numerical differentiation
2. Numerical integration
3. Numerical solutions of a single differential equation
4. Finding the roots and extrema of functions of one variable
5. Numerical methods for solving matrix equations
6. Numerical methods for determining the eigenvalues of a matrix

These assignments will require moderate modifications of existing numerical codes, written in class by students and instructor in R. Students can use the programming language of their course. Our textbook contains several programs written in MatLab. Written reports will be required for each assignment, following a five section outline, to be described in class. Numerical results using computer algebra systems, such as Mathematica, are inappropriate for this class.

Tests: There will be two tests covering the material from class, homeworks and programming assignments. **No make-up tests.** Tests may be taken early with prior arrangements – please contact the instructor as early as possible.

Final Exam: The final exam will be comprehensive, covering all material taught in the course. **There is no make-up final exam.** The final exam grade can replace the lowest test grade. If you miss the final exam, you will either receive a 0 for the final exam or will receive an incomplete for the course, at the discretion of the instructor.

Grades: University regulations prohibit me from discussing your grades over the phone or communicating with you about your grades via email. I can communicate with you about your grade through your UCA cub account. If you need to discuss your grades, please come by my office.

Content:

Topic 1: Introduction to Numerical Methods

- Binary numbers
- Sources of errors
- Observed and theoretical order of accuracy

Topic 2: Numerical Differentiation (Chapter 6)

- Error analysis using Taylor series
- Finite difference approximations
- Richardson extrapolation

Topic 3: Numerical Integration (Chapters 7)

- Composite trapezoid rule, Simpson's rule, Boole's rule, midpoint rule
- Gauss Quadrature

Topic 4: Numerical Solutions of Differential Equations (Chapter 9)

- Euler's method and Runge-Kutta methods
- Adams-Bashforth methods

Topic 5: Root Finding Methods (Chapter 2)

- Bisection method, Newton's method and secant method
- Rates of convergence

Topic 6: Solution of Equations (Chapters 3 and 11)

- Solving linear systems via Gaussian elimination
- Iterative methods for solving linear systems
- Approximating eigenvalues via the power method

University policy on Academic Integrity and Academic Misconduct: The University of Central Arkansas affirms its commitment to academic integrity and expects all members of the university community to accept shared responsibility for maintaining academic integrity. Students in this course are subject to the provisions of the university's Academic Integrity Policy, approved by the Board of Trustees as Board Policy No. 709 on February 10, 2010, and published in the *Student Handbook*. Penalties for academic misconduct in this course may include a failing grade on an assignment, a failing grade in the course, or any other course-related sanction the instructor determines to be appropriate. Continued enrollment in this course affirms a student's acceptance of this university policy.

Plagiarism: Plagiarism can be defined as the use of someone else's words without proper acknowledgement of that use. If you use someone else's words or the written words of the instructor in the assignment, you must put them in quotations and provide a reference for the source. Paraphrasing the words of others by only changing a few words is also considered plagiarism. For more information about plagiarism, please see UCA's statement on plagiarism at <http://uca.edu/academicaffairs/files/2012/08/Plagiarism.pdf>. Plagiarism is academic misconduct and will result in appropriate disciplinary action.

The Americans with Disabilities Act statement: The University of Central Arkansas adheres to the requirements of the Americans with Disabilities Act. If you need an accommodation under this Act due to a disability, please contact the UCA Disability Resource Center, 450-3613. If the instructor of this class needs to be informed of your disability in order to assist with any appropriate accommodations, please contact the instructor during the first week of classes.

Building Emergency Plan statement: An Emergency Procedures Summary (EPS) for the building in which this class is held will be discussed during the first week of this course. EPS documents for most buildings on campus are available at <http://uca.edu/mysafety/bep>. Every student should be familiar with emergency procedures for any campus building in which he/she spends time for classes or other purposes.

The Title IX disclosure: If a student discloses an act of sexual harassment, discrimination, assault, or other sexual misconduct to a faculty member (as it relates to "student-on-student" or "employee-on-student"), the faculty member cannot maintain complete confidentiality and is required to report the act and may be required to reveal the names of the parties involved. Any allegations made by a student may or may not trigger an investigation. Each situation differs and the obligation to conduct an investigation will depend on those specific set of circumstances. The determination to conduct an investigation will be made by the Title IX Coordinator. For further information, please visit: <https://uca.edu/titleix>. **Disclosure of sexual misconduct by a third party who is not a student and/or employee is also required if the misconduct occurs when the third party is a participant in a university-sponsored program, event, or activity.*

Departmental Policy: Use of cell phones (including texting), MP3 players, web browsers, ear buds/plugs is NOT ALLOWED during class time. Cell phones must be set to silent/vibrant mode while in class. Instructors may also disallow use of any other technology not relevant to the instruction. Use of any type of laptop during class time requires consent of the instructor.

Other Policies: Students should familiarize themselves with all policies listed in the UCA *Student Handbook*, such as the Sexual Harassment Policy and Academic Policies.