Numerical Analysis (CRN: 15950/15951)
Spring 2022
MATH 375.01/675.01 (3 credits), _Tu_Th_, 09:25A-10:40A, Wickersham 218

Prerequisites: Grades of C- or better in each of MATH 311 (*Calculus III*), MATH 322 (*Linear Algebra I*), and CSCI 161 (*Introduction to Computing I*) are the prerequisites for this course.

Instructor: Dr. Buchanan
Office: Wickersham 217-1, Phone: 871-7305, FAX: 871-7948
Office Hours: 01:00P–02:00P (MTuWThF), or by appointment
Email: Robert.Buchanan@millersville.edu

Textbook: *Tea Time Numerical Analysis*, 3rd edition, Leon Q. Brin, Southern Connecticut State University, 2020.

Objectives: MATH 375 is intended to be an introduction to modern approximation techniques. Development of algorithms, their precise mathematical analysis, and an analysis of their errors will be emphasized. Students will apply and extend their knowledge of calculus and linear algebra, and use their skills of programming in Java to develop algorithms for useful numerical routines. As often as possible "real world" problems will be introduced and discussed.

Course Contents:

- Mathematical preliminaries (Chap. 1)
  - Review of calculus
  - Round–off errors and computer arithmetic
  - Errors in scientific computation
- Root Finding (Chap. 2)
  - Bisection method
  - Fixed–point iteration
  - Newton–Raphson method
  - Secant method
  - Error analysis for iterative methods
  - Accelerating convergence
- Direct methods for solving linear systems
  - Linear systems of equations
  - Gaussian elimination
  - Pivoting strategies
  - Linear algebra and matrix inversion
  - Matrix factorization
- Interpolation (Chaps. 3 and 5)
  - Interpolation and the Lagrange Polynomial
  - Divided differences

  - Cubic spline interpolation
- Numerical Calculus (Chap. 4)
  - Numerical differentiation
  - Basic quadrature rules
  - Composite quadrature rules
  - Gaussian quadrature
  - Adaptive quadrature methods
- Approximation Theory
  - Discrete least squares approximation
  - Orthogonal polynomials and least squares approximation
  - Rational function approximation
  - Trigonometric polynomial approximation
- Ordinary Differential Equations (Chap. 6)
  - Motion of a pendulum
  - Taylor Methods
  - Runge-Kutta Methods
  - Error analysis
  - Adaptive Runge-Kutta Methods

If time permits, other topics may be covered as well.

Attendance: Students are expected to attend all class meetings per the University Approved Guidelines. If you cannot regularly attend class due to a time conflict with another class or activity, you should change to a different section of this course or wait until a later semester to take this course. You may not remain on the class roster but attend a different section of this course merely for the convenience of your schedule. If you must be absent from class you are expected to complete class requirements (*e.g.* homework assignments) prior to the absence. If you know you will be absent on the day of a test, you must notify me **before** the time the test is scheduled in order to receive permission to take a make-up test. Students who miss a test should provide a valid excuse, otherwise you will not be allowed to make up the test. No final exam exemptions.

Homework: Homework assignments will consist of a mixture of pencil and paper written assignments and programming assignments. Programming assignments must be submitted electronically through the Dropbox found in the Desire2Learn (D2L) course management software. If you need a Java software development package (editor, compiler, runtime environment, *etc*) for your personal computer you may download one from the Eclipse Foundation.

Students are expected to do their homework and participate in class. Students should submit all homework by the date due. Late homework will not be accepted without valid excuse. Discussion and collaboration between students on homework assignments is encouraged, but homework submitted for grading should be written up separately. Submitted written homework and programming assignments should not be merely identical copies of other students' work (changing a variable name in a program, deleting source code comments, *etc.* does not make a program unique or original).

Tests: A test will be given after completing the material from each of Chapters 2, 5, and 6. The exact dates of the tests will be announced in class one week before they are given (earlier if possible). The final exam scheduled for Wednesday, May 4, 2022, 02:45P-04:45P will be comprehensive.

Grades: Course grade will be calculated as follows.

Tests	45%
Homework	35%
Exam	20%

I keep a record of students' test, homework, and exam scores. Students should also keep a record of graded assignments, tests, and other materials. The course letter grades will be calculated as follows.

90-92	A−	93-100	A		
80-82	B−	83-86	B	87-89	B+
70-72	C−	73-76	C	77-79	C+
60-62	D−	63-66	D	67-69	D+
		0-59	F		

Course Repeat Policy: An undergraduate student may not take an undergraduate course of record more than three times. A course of record is defined as a course in which a student receives a grade of A, B, C, D, (including + and −) F, U, Z or W. The academic department offering a course may drop a student from a course if the student attempts to take a course more than three times.

The last day to withdraw from a course (and receive the W grade) is April 1, 2022 at 4:30P. Course withdrawals are submitted online.

Inclement Weather Policy: If we should miss a class day due to a school closing because of a delay or cancellation due to weather, any activities planned for that missed day will take place the next time the class meets. For example, if a test is scheduled for a day that class is canceled on account of snow, the test will be given the next time the class meets.

Cell Phones: Silence (or better yet, turn off) all cellular telephones upon entering the classroom. Leaving class to initiate or receive a telephone call will not be tolerated and students doing so will not be re-admitted to the classroom until the following class meeting. Texting or tweeting during class interferes with the learning process. Students distracted by their cell phones are not engaged in class and will find, over the course of the semester, that learning and course grade will suffer.

Title IX Reporting Responsibilities: Millersville University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment and to comply with Title IX of the Education Amendments of 1972, 20 U.S.C. §1681, *et seq.*, and act in accordance with guidance from the Office for Civil Rights, the University requires faculty members to report incidents of sexual violence shared by students to

the University's Title IX Coordinator. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University protection of minors policy.

Information regarding the reporting of sexual violence, and the resources that are available to victims of sexual violence, is available at https://www.millersville.edu/titleix.

Final Word: Math is not a spectator sport. What you learn from this course and your final grade depend mainly on the amount of work you put forth. Daily contact with the material through homework assignments and review of notes taken during lectures is extremely important. Organizing and conducting regular study sessions with other students in this class will help you to understand the material better.

No one can guarantee you success in this course. Your responsibilities and the instructor's expectation are outlined above. There will be no second chances, "do-overs", or extra credit assignments.