

Numerical Analysis (CRN: 6616)

Spring 2026

MATH 375.01/675.01 (3 credits), _Tu_Th_, 08:00-09:15A, Wickersham 101

Prerequisites: Grades of C- or better in each of MATH 311 (*Calculus III*), MATH 322 (*Linear Algebra 1*), and CSCI 161 (*Introduction to Computing 1*) are the prerequisites for this course.

Description: Numerical methods for solving systems of linear equations, solving nonlinear equations, integration, interpolation, approximation and least squares curve fitting. Error theory.

Instructor: Dr. Buchanan

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Office Hours: 10:50–11:50A (M–F), or by appointment

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Textbook: *Numerical Methods with Applications*, Autar K. Kaw, *et al.*, University of South Florida, LibreTexts, 2023.

You may access the textbook for free online at the website nm.mathforcollege.com. There are PDFs of the individual textbook sections available for free download. The principal author of the textbook has made [video lectures](#) of the textbook topics available online. These may supplement (but not replace) the face-to-face interaction with your professor.

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
 - Review of calculus
 - Round-off errors and computer arithmetic
 - Errors in scientific computation
- Numerical Differentiation
 - Preliminaries of numerical differentiation
 - Numerical differentiation of continuous functions
 - Numerical differentiation of functions defined at discrete points
 - Applications of numerical differentiation
- Root Finding
 - 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
 - Interpolation and the Lagrange Polynomial
 - Divided differences
 - Cubic spline interpolation
 - Applications of interpolation
- Numerical Integration
 - Preliminaries of numerical integration
 - Basic quadrature rules
 - Composite quadrature rules
 - Gaussian quadrature
 - Adaptive quadrature methods
 - Integrating functions defined at discrete points
- Approximation Theory
 - Discrete least squares approximation
 - Orthogonal polynomials and least squares approximation
 - Rational function approximation
 - Trigonometric polynomial approximation
- Ordinary Differential Equations
 - 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 and to participate in the learning and assessment process. Merely attending class will not earn you a passing grade. Regular class attendance (see [Class Attendance Policy](#)) includes being on time to class and actively engaging and participating in classroom activities. It does not include texting, listening to personal music players, browsing the internet, playing video games, checking email, *etc.* Students engaging in these types of activities may be asked to leave the classroom. Students wearing headphones over their ears or ear buds within their ears will be judged to be not actively attending class. Please do not wear headphones or ear buds during class. Do not

expect a warning or announcement of these sanctions. If you cannot regularly attend class due to a time conflict with another class or activity, you should wait until a later semester to take this course. If you must be absent from class you are expected to keep up with the course materials covered and homework assigned during your absence. After each class meeting, copies of the materials presented in class will be available through the online component of this course. Students who miss a test should provide a valid excuse, otherwise you will not be allowed to make up the test. Tests should be made up within one week of their scheduled date. No final exam exemptions.

Homework: As sections of the textbook are completed, I will assign a selection of exercises from the homework exercises following the section. Homework assignments will consist of a mixture of pencil-and-paper written assignments and programming assignments. To enhance their understanding of the material, students should work these pencil-and-paper exercises even though they will not be collected and graded. Worked out solutions to the exercises will be made available under the course shell hosted on D2L. Programming assignments will be graded and 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).

Students should expect to spend a *minimum* of twelve hours per week reviewing notes taken during class and working assigned homework exercises. Preparation for the tests and final exam will require additional hours of study. Students will find it beneficial to review all lecture notes and other relevant material collected from the beginning of the semester until the present time at least once per week.

Tests: There will be three in-class 75-minute tests and a comprehensive 120-minute final examination.

Test 1	Thursday, February 12, 2026
Test 2	Tuesday, March 17, 2026
Test 3	Thursday, April 16, 2026

The comprehensive final examination is scheduled for Tuesday, May 5, 2026, 02:45–04:45P. I will not “curve” test or exam grades.

Students who engage in academically dishonest behavior on a test or final examination will receive a grade of 0 for the assessment activity.

Grades: Course grade will be calculated as follows.

Tests	60%
Exam	30%
Homework	10%

Tests and the final examination will be graded individually on a 100-point scale. Programming assignments will be graded on a scale of 0–10 (0 = nothing submitted or did not compile, 10 = compiled, ran, and produced correct results). If a student believes that an error was made in the grading of an assignment or test, the student should explain *in writing* why they believe an error exists and submit the graded material and the explanation of the possible error to me within 3 class periods of the graded test or homework being returned to the student. In no cases will adjustments to grades of less than 3 points be made. I keep a record of students' test and exam scores. Students should also keep a record of graded assignments, tests, and other materials. As an example of the calculation of the numerical course grade, suppose a student's three test grades were 87, 78, and 67 (out of a maximum of 100 points on each test), the student's final examination grade was 75 (again, out of a maximum of 100). Suppose the average programming assignment grade was 9.10. This hypothetical student's numerical course grade would be calculated according to the formula

$$\frac{87 + 78 + 67}{3} \cdot 0.60 + 75 \cdot 0.30 + 9.10 = 46.40 + 22.50 + 9.10 = 78.00.$$

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 ([Academic Policy: Undergraduate Studies COURSE REPEATS](#)). 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. If this is your fourth or greater attempt to complete this course, you may appeal this policy to the chair of the [Department of Mathematics](#).

The last day to withdraw from a course (and receive the W grade) is April 3, 2026 at 11:59P. Course withdrawals are submitted online.

Inclement Weather Policy: It is the intent of the University to remain open and adhere to full operations, including normal class schedules, whenever possible. Irrespective of the university's decision to suspend operations, cancel classes, or modify class starting/ending times, students, faculty and staff are urged to use their discretion and best judgment during severe weather conditions in deciding whether they can safely commute to work or classes ([Policy on Delays & Cancellations](#)). If we should miss a class day due to a school closing because of 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 and 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's Protection of Minors policy](#). Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at: www.millersville.edu/titleix.

Academic Honesty: Students are required to avoid plagiarism, falsification of their work, cheating (including assisting others in cheating), and other forms of academic misconduct. For more information including definitions and examples of academic dishonesty, please see the [Academic Honesty Policy](#). Additional information can be found in the article, [What is Academic Integrity?](#)

Land Acknowledgement: Millersville University would like to recognize the Native peoples of the lower Susquehanna River basin, those known and those unknown to us, who have stewarded the land, upon which Millersville University sits, for thousands of years. We acknowledge that the land on which we gather, study, and work is the ancestral land of the Conestogas, Susquehannocks, Shawnee, and others. One group, the Shenks Ferry people, had a village adjacent to the campus. We pay our respects to the traditional occupants and caretakers of this land.

Other University Policies: Students may wish to consult the links provided below outlining Millersville University's policies on:

- [Inclusion Statement](#)
- [Chosen names](#)
- [Student rights under FERPA](#)
- [Student conduct and community standards](#)

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.