

MAT 362 Sec. 007 - Spring 2019: Introduction to Numerical Analysis
MWF 11:30 AM - 12:20 PM, Room: Adel Mathematics, Rm 163

Instructor: Dr. Bhagya Athukorallage

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Course webpage: <https://buathukorala.github.io/numerical362/>

Office: AMB 104

Office Hours: 10:00 AM - 11:00 AM and TuTh 9:30 AM – 10:30 AM or by appointments (send email to book one).

Phone: 806-543-8291

Textbook: “Numerical Analysis” by Burden and Faires, 10th ed., 2016

NAU has an Emergency Textbook Loan Program for First Generation students.

See <https://nau.edu/first-generation/textbook-loan-program/> for details

Prerequisites: A grade of C or better in MAT 239 and knowledge of a computer language, as evidenced by a C or better in (CIS 220, CS 112, CS 122H, CS 123, CS 126, or EE 222).

Course Description: Algorithms, computational errors, root finding, curve fitting, interpolation, numerical differentiation and integration, numerical solutions of differential equations and linear systems of equations.

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

1. Explain basic algorithms for solving numerical problems including how they work, and their strengths and weaknesses.
2. Implement the algorithms in a programming language (such as MATLAB).
3. Produce coherent reports explaining the implementation of these algorithms and results on sample problems.
4. Express an understanding of the limitations of coded algorithms related to error analysis, convergence rates and criteria, memory usage, and ease of implementation.

Structure and Approach:

The course will use any or all of: lecture, discussion, student presentations, in-class work, or group work. In addition students will use technology (e.g., MATLAB).

Course Outline:

1. Taylor polynomial expansion, intermediate-value theorem, mean-value theorem.
2. Errors and Algorithms: Error analysis, Convergence rates of algorithms
3. Coding algorithms in MATLAB and presenting results graphically.

4. Root Finding: Bisection, Fixed point iteration, Newton's method.
5. Interpolation: Lagrange interpolation and cubic spline approximation.
6. Numerical Differentiation: simple, higher order, error formulas. Numerical Integration: simple, composite, multiple.
7. Differential Equations: initial value problems: Euler's and Runge-Kutta; boundary value problems, nonlinear methods, PDE: Heat and Laplace Equations.
8. Linear Algebra: Matrix/vector operations, Solving Linear Systems Numerically: Gaussian elimination, Jacobi and Gauss-Seidel; eigenvalues/eigenvectors, the power method.

Grade Distribution:

Attendance: 5% of the final grade (see the 'Attendance Policy' section)

Quizzes: 5% of the final grade

Written Homework: 15% of the final grade

MATLAB Assignments: 10% of the final grade

Exam 1: 15% of the final grade

Exam 2: 15% of the final grade

Exam 3: 15% of the final grade

Comprehensive Final exam: 20% of the final grade

Assessment of the Learning Outcomes:**Written Homework:**

Sets of practice problems will be posted on the course website, generally one set for each section covered in class. For each set, some of the problems will be graded thoroughly while partial credit will be given for completion of the rest of the problems. Homework should either be written by hand very neatly (well-organized and well-written) or by typed in L^AT_EX (encouraged).

Clarity in writing and presentation will be taken into account in grading.

MATLAB Assignments:

Each assignment will contain coding of some numerical techniques.

Quizzes:

Quiz date will be announced in class (expect at least one quiz every week,); the quiz will be at the immediate start of class and students will have 10 minutes to finish the quiz.

Examinations:

Exam 1: Monday, February 25th

Exam 2: Wednesday, March 29th

Exam 3: Friday, April 26th

Final exam: Wednesday May 8th from 10:00 am – 12:00 pm

Grading Policy: Below 60% F, 60–69% D, 70–79% C, 80–89% B, 90–100% A

Attendance Policy:

Attendance is mandatory!

The primary reason for poor performance of students on tests and homework is repeated failure to attend class.

Attendance:

$N \leq 6 \rightarrow 5\% \text{ of FG}$ $6 < N < 10 \rightarrow 3\% \text{ of FG}$ $N \geq 10 \rightarrow 0\% \text{ of FG}$

(N = Number of missed classes; FG- final grade)

- I expect that students will read each section of the textbook in advance of the lecture. If you miss a class, it is your responsibility to find out what you missed (announcements, assignments, notes, ...).
- This course moves very fast. If you fall behind, even by one section, you may not be able to catch up, since each section generally depends very heavily on the ones before.
- Classes start and end always on time. Students are not allowed to leave the class before the end of the class without authorization.
- Why is it so important to be on time?
 - Students who arrive late inevitably **disrupt their classmates** and disturb the flow of the lecture.
- **During the class time it is not allowed to text, chat, and sleep. All cell phones are to be turned off upon entering the classroom.**

Make ups:

There are NO make ups for the examinations except for a VALID reason. I shall give make-ups only for tests and only if I am both notified of your absence in advance and am given some kind of proof once you return to class.

Important dates:

Last day to drop delete (Course will not appear on transcripts): January 24th

Last date to drop:

Academic Honesty is a must: Please see NAU Academic Policies and Academic Dishonesty Policies.

http://www2.nau.edu/gradcol/UGC_2013-14/6_021214/AcademicIntegrity_PolicyHear011314.pdf

Extra Help: Do not hesitate to come to my office during office hours or by appointment to discuss a homework problem or any aspect of the course.

How to Succeed in This Course: Read the textbook and lecture notes before and after class. Do homework diligently. Ask for help when stuck. Participate in class. Make sure you connect the theory learned in class to homework and especially to programming questions.

Students are requested to attend at least three session of office hours during the course.

Disclaimer: This syllabus provides a general plan; deviations may be necessary.

NORTHERN ARIZONA UNIVERSITY
DEPARTMENT OF MATHEMATICS AND STATISTICS
UNIVERSITY AND DEPARTMENT POLICIES – Spring 2019

Course Pre-requisites and Placement: Prior to enrollment in a course in the Department of Mathematics and Statistics a student must have completed the course pre-requisites or have proper placement for the course. It is the student's responsibility to check that they are properly enrolled in a course and to drop the course if they are not. Failure to do so could result in the student receiving no credit for the course. The department may cancel student's registration in a course in which they are not properly enrolled. It is students' responsibility to monitor their own enrollment.

Administrative Drops: An instructor may administratively drop from a course any student who is absent **one or more times** from class during the first week without contacting the instructor and receiving approval. Students who have not met all prerequisites for a course may be administratively dropped. It is students' responsibility to monitor their own enrollment.

Class Attendance: Students are expected to assume full responsibility for class attendance and are accountable for work missed because of absences. Instructors are under no obligation to make special arrangements for students who have been absent unless such absence has been excused by a formal institutional excuse. Institutional excuses permit a student to be absent from classes to represent the University in athletics and extracurricular or academic activities. Institutional excuses must be hand-delivered to the instructor and arrangements made for the work missed prior to the planned absence from class.

Dropping/Auditing a Course: The last day you may drop/delete a course (*without the class appearing on your transcript*) is **January 24, 2019**. The last day you may drop a course (and receive a **W**) is **March 25, 2019**. Academic policy requires that a student who never attended class or stopped attending class receive an **F** should the student fail to officially drop the course. The deadline to change from credit to audit or vice versa is **January 25, 2019**. Once a student has registered and completed a class as an auditor, the audit grade cannot be changed to a credit-earning grade. The grade of **AU** is awarded to auditors for satisfactory attendance. See the most recent *Academic Catalog* for more information at: <http://catalog.nau.edu/>.

The Grade of Incomplete: A grade of **I** is given by an instructor only if a student is unable to finish a course due to extraordinary, unforeseeable circumstances, and the deadline to drop has passed. An incomplete is only given to a student who was passing the course with a grade of **C** or higher at the time the student was forced to stop attending. Before a grade of **I** can be given the student and instructor must complete the official department form indicating the work to be completed, as well as the date(s) by which the work must be completed. All work must be completed within one year. After one year, a grade of **I** automatically reverts to a grade of **F**.

Final Examinations: Final examinations are required in all classes and must be given at the scheduled times and dates indicated in the university final exam schedule. An exception to the official final examination schedule can be made if a student is scheduled to take more than two examinations in a 24-hour period. For more information, see the schedule at: <https://in.nau.edu/registrar/spring-2019/>.

NAU Policy Statements: Students are responsible for the following policies: Safe Environment, Students with Disabilities, Institutional Review Board, Academic Integrity, and Academic Contact Hour. A copy of these policies may be downloaded from the web site <http://www2.nau.edu/prh/bio320/policy.html>.

Department Policy on Use of Portable Electronic Devices: Cell phones, mp3 players and portable electronic communication devices, including but not limited to smart phones, cameras, and recording devices must be turned off and inaccessible during in-class tests. Any violation of this policy will be treated as a violation of the student academic integrity policy.

ACADEMIC INTEGRITY

NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people's ideas or contributions. Acting with academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU's online academic integrity workshop available in the E-Learning Center and should review the full academic integrity policy available at <https://policy.nau.edu/policy/policy.aspx?num=100601>.

COURSE TIME COMMITMENT

Pursuant to Arizona Board of Regents guidance (Academic Credit Policy 2-224), for every unit of credit, a student should expect, on average, to do a minimum of three hours of work per week, including but not limited to class time, preparation, homework, and studying.

DISRUPTIVE BEHAVIOR

Membership in NAU's academic community entails a special obligation to maintain class environments that are conducive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not breach the peace, interfere with normal class activities, or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of "W". For additional information, see NAU's disruptive behavior policy at <https://nau.edu/university-policy-library/disruptive-behavior>.

NONDISCRIMINATION AND ANTI-HARASSMENT

NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, or veteran status. Due to potentially unethical consequences, certain consensual amorous or sexual relationships between faculty and students are also prohibited. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's Safe Working and Learning Environment (SWALE) policy. EAO also assists with religious accommodations. For additional information about SWALE or to file a complaint, contact EAO located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011, or by phone at 928-523-3312 (TTY: 928-523-1006), fax at 928-523-9977, email at equityandaccess@nau.edu, or via the EAO website at <https://nau.edu/equity-and-access>.

TITLE IX

Title IX is the primary federal law that prohibits discrimination on the basis of sex or gender in educational programs or activities. Sex discrimination for this purpose includes sexual harassment, sexual assault or relationship violence, and stalking (including cyber-stalking). Title IX requires that universities appoint a "Title IX Coordinator" to monitor the institution's compliance with this important civil rights law. NAU's Title IX Coordinator is Pamela Heinonen, Director of the Equity and Access Office located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011. The Title IX Coordinator is available to meet with any student to discuss any Title IX issue or concern. You may contact the Title IX Coordinator by phone at 928-523-3312 (TTY: 928-523-1006), by fax at 928-523-9977, or by email at pamela.heinonen@nau.edu. In furtherance of its Title IX obligations, NAU will promptly investigate and equitably resolve all reports of sex or gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. Additional important information about Title IX and related student resources, including how to request immediate help or confidential support following an act of sexual violence, is available at <http://nau.edu/equity-and-access/title-ix>.

ACCESSIBILITY

Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), 928-523-6906 (TTY), 928-523-8747 (fax), or dr@nau.edu (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at <https://nau.edu/disability-resources/student-eligibility-process> or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU's Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at jamie.axelrod@nau.edu.

RESPONSIBLE CONDUCT OF RESEARCH

Students who engage in research at NAU must receive appropriate Responsible Conduct of Research (RCR) training. This instruction is designed to help ensure proper awareness and application of well-established professional norms and ethical principles related to the performance of all scientific research activities. More information regarding RCR training is available at <https://nau.edu/research/compliance/research-integrity>.

SENSITIVE COURSE MATERIALS

University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In their college studies, students can expect to encounter and to critically appraise materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.