Math 4311: Numerical Analysis
Course Syllabus

This syllabus is current and accurate as of its posting date, but it will not be updated. For the most complete and up-to-date course information, contact the instructor.

Contact Information

Instructor: Dr. Dennis Hall
Office: MCS 220J
Office Hours: MWF 10:00-12:00; T&Th 11:00-12:30; and by appointment
E-mail: dennis.hall@angelo.edu
Phone: 325-486-5426

Course Information

Course Description: Number representations, error analysis; roots of equations; numerical integration, approximation, and differentiation; systems of equations; approximation by spline functions; ordinary differential equations; Monte Carlo methods and simulation.


Course Content: The following chapters and topics will be covered.

- **Introduction to Python and Monte Carlo Simulation.** General Information, Core Python, Functions and Modules, Writing and Running Programs, Monte Carlo Simulation.
- **Interpolation and Curve Fitting.** Polynomial interpolation, interpolation with cubic spline, least-squares fit.
- **Roots of Equations.** Incremental Search, Bisection, Newton-Raphson Method, Linear Interpolation, and Other Methods
- **Numerical Differentiation.** Finite Difference Approximations, Richardson Extrapolation, Derivatives by Interpolation
- **Numerical Integration.** Newton-Cotes Formulas, Romberg Integration, Gaussian Integration
- **Initial Value Problems.** Euler’s Method, Runge-Kutta Methods, Stability and Stiffness.
Course Evaluation

Your grade for this course will be determined by your performance on exams, homework, and projects. Final grades will be based on a standard 10-point grading scale.

Midterm Exam (25%): There will be a midterm examination on Friday, October 19. This examination may involve a combination of written questions and questions intended to be answered using Python.

Final Exam (25%): There will be a midterm examination on Friday, October 19. This examination may involve a combination of written questions and questions intended to be answered using Python.

Projects (35%): There will be several projects assigned throughout the semester. These will typically be more involved than the homework problems and require some insight to complete. Students are not allowed to work together on the projects but may consult the instructor or media resources.

Homework (15%): Homework sets will be assigned most days and will typically be due at the beginning of the following class. You may work with other students on the homework, but your final submission should be your own work and not be virtually identical to another student’s. On homework problems requiring the use of a computer, please include comments in your computer program or output to indicate important steps or information. Do not simply submit a printout of data with no explanation. Late homework will not be accepted.

Other Information

Student Absence for Observance of Religious Holy Days:

A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. See ASU Operating Policy 10.19 Student Absence for Observance of Religious Holy Day for more information.

Incomplete Grade Policy:

It is policy that incomplete grades be reserved for student illness or personal misfortune. Please contact faculty if you have serious illness or a personal misfortune that would keep you from completing course work. Documentation may be required. See ASU Operating Policy 10.11 Grading Procedures for more information.

Academic Integrity

Students are expected to maintain complete honesty and integrity in all work. Any student found guilty of any form of dishonesty in academic work is subject of disciplinary action and possible expulsion from ASU.

The College of Science and Engineering adheres to the Statement of Academic Integrity

Student Disability Services:
ASU is committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs or activities of the university, or be subjected to discrimination by the university, as provided by the Americans with Disabilities Act of 1990 (ADA), the Americans with Disabilities Act Amendments of 2008 (ADAAA), and subsequent legislation.

The Office of Student Affairs is the designated campus department charged with the responsibility of reviewing and authorizing requests for reasonable accommodations based on a disability, and it is the student’s responsibility to initiate such a request by contacting:

Ms. Dallas A. Swafford

Director of Student Disability Services

325-942-2047

Dallas.swafford@angelo.edu

Houston Harte University Center

Title IX:

Angelo State University is committed to the safety and security of all students. If you or someone you know experience sexual harassment, sexual assault, domestic or dating violence, stalking, or discrimination, you may contact ASU’s Title IX Coordinator:

Michelle Nicole Boone, J.D.

Director of Title IX Compliance

325-486-6357

mailto:Dallas.swafford@angelo.edu

https://www.angelo.edu/map/?Mayer%20Administration%20Building

Plagiarism

Plagiarism is a serious topic covered in ASU’s Academic Integrity policy in the Student Handbook. Plagiarism is the action or practice of taking someone else’s work, idea, etc., and passing it off as one’s own. Plagiarism is literary theft.

In your discussions and/or your papers, it is unacceptable to copy word-for-word without quotation marks and the source of the quotation. It is expected that you will summarize or paraphrase ideas giving appropriate credit to the source both in the body of your paper and the reference list.

Papers are subject to be evaluated for originality via Turnitin. Resources to help you understand this policy better are available at the ASU Writing Center.
General Policies Related to This Course

All students are required to follow the policies and procedures presented in these documents:

Angelo State University Student Handbook
Angelo State University Catalog

Copyright Policy

Students officially enrolled in this course should make only one printed copy of the given articles and/or chapters. You are expressly prohibited from distributing or reproducing any portion of course readings in printed or electronic form without written permission from the copyright holders or publishers.

Student Learning Outcomes

The student will demonstrate factual knowledge including the mathematical notation and terminology used in this course. Students will read, interpret, and use the vocabulary, symbolism, basic definitions used in numerical analysis including those related to topics learned in calculus and algebra and revisited in this course; limits, continuity, numerical integration, numerical differentiation, ordinary differential equations, and polynomial interpolation.

The students will describe the fundamental principles including the laws and theorems arising from the concepts covered in this course. Students will identify and apply the properties and theorems that result directly from the definitions as well as statements discovered in calculus and extended in this course; for example, Rolle’s Theorem, Mean Value Theorem, Intermediate Value Theorem, Taylor’s Theorem, theorems on convergence and existence and their error terms.

The students will apply course material along with techniques and procedures covered in this course to solve problems. Students will use the facts, formulas, and techniques learned in this course to develop and use algorithms and theorems to find numerical solutions and bounds on their error to various types of problems including root finding, polynomial approximation, numerical differentiation, numerical integration.

The students will develop specific skills, competencies, and thought processes sufficient to support further study or work in this field or related fields. Students will gain the ability to use a software package such as MATLAB to solve numerical problems and acquire a level of proficiency in the fundamental concepts and applications necessary for further study in academic areas requiring numerical analysis as a prerequisite for graduate work or for work in occupational fields. These fields might include further study in mathematics, engineering, computer science, or the physical sciences.
Weekly Schedule

Below is a tentative schedule, but it is likely to change throughout the semester.

Week 1: Introduction to Python
Week 2: Monte Carlo Simulation
Week 3: Interpolation
Week 4: Curve Fitting
Week 5: Richardson Extrapolation
Week 6: Derivatives by Interpolation
Week 7: Newton-Cotes Formulas
Week 8: Midterm Exam
Week 9: Romberg and Gaussian Integration
Week 10: Euler’s Method
Week 11: Runge-Kutta Methods
Week 12: Stability and Stiffness
Week 13: Additional topics as time permits
Week 14: Additional topics as time permits
Week 15: Additional topics as time permits
Week 16: Final Exam

Important Dates

August 27: First day of class
September 3: No Class (Labor Day)
October 19: Midterm Exam
November 1: Last day to drop a class
November 21-23: No Class (Thanksgiving Break)
December 12: Final Exam (8-10am)