University of Zimbabwe
Faculty of Science
Mathematics & Computational Sci

Course Outline

HMTHCS 212: Numerical Analysis

Block D, 2022

Lecturer: Dr. Shelvean Kapita
E-mail: shelveankapita@gmail.com
Office: Mathematics
Office Hours: By appointment
Phone: +263.787.506.555

Course Description

To explore complex systems, mathematicians, engineers and scientists require numerical methods since mathematical models are rarely solvable algebraically. Numerical analysis deals with the design, analysis, and computer implementation of techniques to give approximate but accurate solutions of mathematical problems. In this course, you will learn how to apply numerical methods to find zeros of nonlinear equations, approximate continuous or smooth functions using polynomial interpolation, solve large systems of linear equations by direct or iterative methods, differentiate and integrate complicated functions, and solve initial value problems of ordinary differential equations. We will pay particular attention to numerical errors and computational efficiency of the algorithms.

Key Learning Outcomes

- ❏ Develop an understanding of common numerical methods and how they are used to solve mathematical problems which arise in mathematics, engineering, finance, natural or social sciences, and other subjects.

Course Objectives

- ❏ Derive numerical methods for various mathematical tasks such as the solution of nonlinear equations, interpolation, differentiation, integration, solution of large linear systems of equations, and the solution of differential equations.
- ❏ Understand sources of error in the application of numerical methods to mathematical tasks.
- ❏ Analyse and evaluate the accuracy of common numerical methods.
- ❏ Implement numerical methods in MATLAB/Octave.

Required Background and Prerequisite Knowledge

Students taking HMTHCS 212 are required to have completed at least a one year university level sequence in single variable calculus including infinite series. Some exposure to linear algebra (matrices and vectors) and differential equations is advantageous, but is not required.

Assessment

There will be one Final Exam, worth 50% of the total grade for this unit. The remaining 50% is made up of assignments.

Notes and Constraints

- ☞ In order to pass the course, students must take time to read the assigned book chapters, and do the assigned exercises.
- ☞ Late work is not accepted unless with prior arrangement with the lecturer.
- ☞ Assignments and tests are demonstrated in class to provide feedback before exams.
- ☞ Students will be informed of the exact date of the final exam in advance.

Course Policies

Class Policy and Rules of Conduct

- **Cell phones strictly prohibited during classes**. Electronic devices must be turned off (🔕) and placed in your bags (not on the desk just in front of you).
- **Headphones** should be removed all the time.
- **During lectures**, students must turn off their monitors and take notes.
- Video or audio recordings and taking photographs are NOT permitted.
- Persistent talking, whispering or any disruptive attitude will not be tolerated.

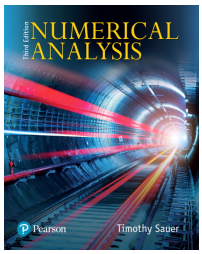
Evaluation Procedures

Course Component	Overall Weight	Tentative Period
Homework		
Assignments	50%	Weeks 1-3
Final Exam		
Final	50%	Week 4

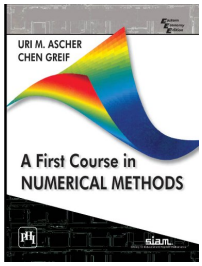
Textbooks and Course Materials

Online Resources: Lecture notes, assignments, and group exercises will be provided to students throughout the block.

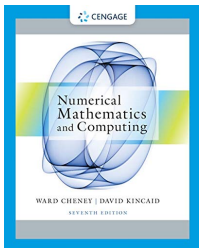
textbook: There is no required textbook for this course. However, the following is a list of textbooks that are strongly recommended for this course:



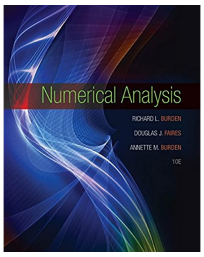
Title: Numerical Analysis, 3rd Edition
Author: Timothy Sauer
Publisher: Pearson, publication year: 2019
ISBN: 9780134696454



Title: A First Course In Numerical Methods
Author: Uri M. Ascher & Chen Greif
Publisher: SIAM; publication year: 2011
ISBN-13: 9788120346864



Title: Numerical Mathematics & Computing, 7th Edition
Author: Ward Cheney & David Kincaid
Publisher: Cengage Learning; publication year: 2012
ISBN-13: 9781133103714



Title: Numerical Analysis, 10th Edition
Author: Richard L. Burden, J. Douglas Faires & Annette M. Burden
Publisher: Cengage Learning; publication year: 2015
ISBN-13: 978-1305253667

Tentative Course Content

Week	Topics & Assignments
1	Course outline discussion Topic: Errors in numerical methods Absolute and Relative errors, basic sources of error, loss of significance Topic: Roots of nonlinear equations Bisection Method, Newton's method, Secant method, Fixed Point Iteration Assignment 1 open
2	Topic: Solutions of linear systems Gaussian elimination, LU decomposition, Jacobi iteration, Gauss-Seidel method Topic: Polynomial interpolation Lagrange's polynomial interpolation, Newton's divided differences, Newton's interpolating polynomials Assignment 1 due Assignment 2 open
3	Topic: Numerical differentiation and integration deriving formulas using Taylor series, Trapezoidal rule, Simpson's rule, composite numerical integration, Gaussian quadrature Topic: Numerical solutions of ordinary differential equations Euler's method, Explicit & Implicit methods, Runge Kutta methods Assignment 2 due Assignment 3 open
4	Assignment 3 due **Final Exam**

NOTE: The above actual dates may be modified due to the requirements of the class. Also, the indicated dates may be moved backward or forward depending on class progress. **Exact dates and instructions will be announced online.**