UNIVERSIDADE DO ESTADO DE SANTA CATARINA
CENTRO DE CIÊNCIAS TECNOLÓGICAS – CCT
Department of Mathematics

Syllabus

Numerical Analysis ANN0001

I. COURSE FEATURES

Program: Computer Science		
Course: Numerical Analysis		
Prerequisites: Differential and Integral Calculus II CDI2001 or equivalent		
Duration: 72 hours	Academic year: 2023/1	Phase: 3th, 4th
Instructors: Prof. Fernando Deeke Sasse		
Email: fernando.sasse@udesc.br		

II. SUMMARY

Numerical analysis: features and importance. Digital machines: precision, accuracy, and errors. Floating point arithmetic. Numerical systems. Linear systems of equations. Algebraic and transcendental equations. Nonlinear systems of equations. Function approximation: polynomial interpolation, splines, curve fitting, approximation using Chebyschev polynomials. Numerical integration: Newton-Cottes and Gaussian quadrature.

III. TOPICS

1. Error analysis in arithmetic operations
2. Review: Taylor series and Lagrange formula for the remainder
3. Floating point systems
4. IEEE 754 floating point standard
5. Solving algebraic and transcendental equations: general view
6. Convergence analysis
7. Bisection method
8. Fixed point method
9. Newton-Raphson method
10. Secant method
11. Roots of polynomials
12. Gauss method for linear systems of equations: naïve algorithm
13. Gauss method for linear systems of equations: pivoting
14. Ill-conditioned linear systems
15. Iterative Jacobi method for linear systems of equations
16. Iterative Gauss-Seidel method for linear systems of equations
17. Conjugate gradient method
18. LU factoring
19. Linear interpolations, base functions
20. Lagrange interpolation method
21. Newton interpolation method
22. Divided differences
23. Chebyschev points, Runge phenomenon
24. Splines
25. Method of least squares
26. Nonlinear system of equations: Newton's method
27. Nonlinear system of equations: steepest descent
28. Numerical differentiation
29. Richardson extrapolation
30. Trapezoidal method for numerical integration
31. Simpson methods for numerical integration

32. Newton-Cottes formulas
33. Recursive trapezoidal method, Romberg method
34. Adaptive Simpson method
35. Gaussian quadrature

IV. LEARNING METHODOLOGY

Students must have active role during classes, presenting problems, solving problems.

V. GRADING

Assignments: 20%

Midterm exam: 20%

Final exam: 60%

IV. BIBLIOGRAPHY

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3. HAMMER, R.; HOCKS, M.; KULISH, U. et al. Numerical Toolbox for Verified Computing I:Basic Numerical Problems, Springer-Verlag, 1993.
4. JAJA, J. An Introduction to Parallel Algorithms. Reading: Addison-Wesley, 1992.
5. RALSTON, Anthony; RABINOWITZ, Philip. A first course in numerical analysis. 2. ed. Dover, 2001.
6. SHEN, Alexander. Algorithms and Programming : Problems and Solutions, Birkhauser Boston, 2008.
7. CONTE, S. D. Elementary numerical analysis. 1 ed. New York, NY: McGraw-Hill Kogakusha, 1965.
8. PANG, Tao. An introduction to computational physics. 2. ed. New York, NY: Cambridge University Press, 2008.
9. PALM, William J. Introduction to MATLAB for engineers. Boston, MA: McGraw-Hill, 1998.
10. FROBERG, Carl-Erik. Introduction to Numerical Analysis. 2 ed. Massachusetts: Addison Wesley, 1974.
11. KREYSZIG, Erwin; NORMINTON, E. J. Maple computer guide: a self-contained introduction for Erwin Kreyszig Advanced engineering mathematics, ninth edition. 9th ed. New Jersey: J. Wiley, 2010.
12. PATEL, Vithal A. Numerical analysis. 1 ed. Philadelphia: Saunders College, 1994.
13. CHENEY, E. W.; KINCAID, David. Numerical mathematics and computing. 7th ed. Boston, MA: Brooks/Cole, 2013.