# MATH 3350.001: Introduction to Numerical Analysis

**TIME AND PLACE:** Tue Thu 15:30-16:50pm, Cury 211
**PROFESSOR:** Santiago I. Betelú
**OFFICE:** GAB470B, e-mail: santiago.betelu@unt.edu
**TEXT:** Timothy Sauer "Numerical Analysis" Third edition
**OFFICE HOURS:** Tue Thu 11:55-12:25 and 13:55-15:25pm at GAB 470B

**COURSE DESCRIPTION:** Description and mathematical analysis of methods used for solving problems of a mathematical nature on the computer. Roots of equations, error analysis, systems of linear equations, polynomial interpolation and approximation, numerical solutions of ordinary and partial differential equations, Monte Carlo methods.

**GRADES:** Grades will be based on three midterm exams (20 points each), homeworks and quizes (20 points) and a final exam (40 points). The lowest of the midterm grades is dropped, so the maximum score is 100. To earn an A you need 90 points, 80 for a B, 70 for a C and 60 for a D.

**HOMEWORK:** Will be assigned in Canvas and your solutions must be uploaded within the indicated deadline. Check your solutions with the solutions at the end of the textbook, if you don't get them come to my office for help. The grader evaluates the intermediate steps so you must be clear to get the full grade. Some HW problems are computer assignments, I will ask you to show them to me running in your computer or smartphone during office hours.

**EXAMS:** Midterm exams will be given on February 15, March 21 and April 25 during regularly scheduled class time. The final exam is scheduled on Tue May 7 at 13:30-15:30pm on the same classroom (these dates may change, so ask me one week before).

**PROGRAMMING:** We will do elementary programming in Matlab using the website https://matlab.mathworks.com, accesible by computer, tablet or smartphone. You need to register for online access at https://it.unt.edu/matlab-simulink (click "Mathworks portal" and authenticate with EUID and password). Previous programming experience is not necessary, I will teach the basics during the first few classes, and we shall use only a minimal subset of MATLAB's functions.

**DISSABILITIES:** It is responsibility of students with certified disabilities to provide the instructor with appropriate documentation from the Dean of Students Office. If you qualify for extra time you must take the exam at the ODA Test Center.

**CHEATING:** or homework plagiarism will not be tolerated. Anyone caught cheating will receive an F for the course. Notes, calculators or electronic devices are not allowed during exams.

**SCHEDULE**

| Week | Sections | Summary |
|---|---|---|
| Jan 16 | 0.2 - 0.5 | Binary numbers, floating point representation and loss of significance. Introduction to MATLAB. Taylor theorem. Applications: numerical differentiation. |
| Jan 23 | 1.1 - 1.3 | Solving equations, Bisection method, fixed point iteration, solving linear recursions, limits of accuracy |
| Jan 30 | 1.4 - 1.5, 2.1 | Newton's method, error analysis, secant method, regula falsi, Gaussian elimination, tridiagonal systems |
| Feb 6 | 2.3, 2.5, 2.7 | Iterative methods for systems of equations, nonlinear systems of equations |
| Feb 13 | 3.1 - 3.3 | Lagrange interpolation, interpolation errors, Chebyshev interpolation |
| Feb 20 | 4.1, 4.2, 4.4, 4.5 | Least squares and models. Numerical differentiation, numerical integration |
| Feb 27 | 5.1, 5.2 | Romberg integration, adaptive quadrature, Gaussian quadrature |
| Mar 5 | 5.3, 5.4, 5.5 | Initial value problems, error analysis, systems of ODES |
| Mar 12 | 6.1, 6.2, 6.3 | Runge Kutta, variable step size, implicit methods, stiff equations, multistep methods, stability, convergence and consistency |
| Mar 19 | 6.4, 6.5 6.6, 6.7 | Boundary value problems. Shooting method, finite differences, applications |
| Mar 26 | 7.2, 7.2 | Discretization of PDEs: parabolic methods, Von Neumann stability |
| Apr 2 | 8.1 | Hyperbolic equations, waves, CFL condition, stability, error analysis |
| Apr 9 | 8.2 | Elliptic equations, Laplace equation, Poisson equation. Applications. |
| Apr 16 | 8.3 | Nonlinear PDEs, reaction-diffusion problems, biological problems, fluid flow |
| Apr 23 | 8.4 | Random numbers, Pseudo random numbers generation, and Monte Carlo Simulation. Comprehensive review |
| Apr 30 | | Comprehensive review |
| May 7 | | Final Exam Tue May 7, 13:30-15:30pm |