# MATH 3350.001: Introduction to Numerical Analysis

PLACE: BLB 255, TIME: TR 9:30 - 10:50 am
PROFESSOR: Santiago I. Betelú
OFFICE: GAB 316, e-mail: betelu@unt.edu
TEXT: Timothy Sauer "Numerical Analysis" second edition
OFFICE HOURS: TR 11:00am-12:00 and 15:55-16:55pm

**GRADES:** Grades will be based on three midterm exams (20 points each), homeworks (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 each class, to be completed the same day of the following week. 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. Remember to write your name, problem numbers, due date and staple each HW. 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 Feb 14, Mar 21 and Apr 18 on regularly scheduled class time. The final exam is scheduled on Thursday May 9 at 08:00-10:00 AM on the same classroom (these dates may change, so ask me one week before). Calculators, electronic devices or notes are not allowed during exams.

**PROGRAMMING:** We will do elementary programming in Matlab using the website https://matlab.mathworks.com. It is also available at the University computer labs and for download at: https://it.unt.edu/matlab-simulink (click "Mathworks portal" and authenticate with EUID and password, you also need this to register the online access). Previous programming experience is not necessary, I will teach the basics during the first few classes, and we shall use only a very small 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.

**CHEATING:** or homework plagiarism will not be tolerated.

**SCHEDULE**

| Week | Sections | Summary |
|---|---|---|
| Jan 15 | 0.2 - 0.5 | Binary numbers, floating point representation and loss of significance. Introduction to MATLAB. Taylor theorem. Applications: numerical differentiation. |
| Jan 22 | 1.1 - 1.3 | Solving equations, Bisection method, fixed point iteration, solving linear recursions, limits of accuracy |
| Jan 29 | 1.4 - 1.5, 2.1 | Newton's method, error analysis, secant method, Brent's method, Gaussian elimination, tridiagonal systems |
| Feb 5 | 2.3, 2.5, 2.7 | Iterative methods for systems of equations, nonlinear systems of equations |
| Feb 12 | 3.1 - 3.3 | Lagrange interpolation, interpolation errors, Chebyshev interpolation, MT1 |
| Feb 19 | 4.1, 4.2, 4.4, 4.5 | Least squares and models. Numerical differentiation, numerical integration |
| Feb 26 | 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, MT2 |
| Mar 26 | 7.2, 7.2 | 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, MT3 |
| Apr 23 | 8.4 | Random numbers, Pseudo random numbers generation, and Monte Carlo Simulation. Comprehensive review |
| May 9 | Final Exam Thursday 8:00-10:00am | |