

MAT 581 – Numerical Methods with Programming – Fall 2016

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Office Hours: Su, Mo, Tu, We, Th 2:30–3:30. You can also see me at other times by appointment, or whenever the office door is open.

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Class Time and Location: MWF 11:40–12:35, Carnegie 115.

Course Description: Approximation methods for solution of nonlinear equations. Interpolation problems. Numerical integration. Solution of ordinary differential equations. Other numerical methods, error analysis and writing computer programs.

Prerequisites: MAT 397 and some programming experience with any language (any computational course or programming tutorial like Codecademy's JavaScript course is enough). No prior knowledge of MATLAB is assumed.

Textbook: "Numerical Methods: Using MATLAB" by Lindfield and Penny, 3rd edition. ISBN 9780123869425.

Grading: The grades will be based on homework and programming assignments (35%), two midterm exams (20% each), and final exam (25%). The grading scheme will be no stricter than: 93 for A, 90 for A-, 87 for B+, 83 for B, 80 for B-, 77 for C+, 73 for C, 70 for C-, 60 for D.

Midterm Exams will be given in class on **September 28** and **November 11**. The cumulative **Final Exam** is scheduled for **December 15, 12:45–2:45 pm**. There will be no make-ups: a missed exam counts as zero unless you present a valid excuse from a physician or the Dean's office. If the absence is excused, your final exam grade will be used to replace the missed exam.

Homework will be assigned in almost every class, and collected at the beginning of next class (written part) or on Blackboard by the end of next class day (computational part). Computational assignments will involve Matlab (available at SU computer clusters), and can be done either individually or in pairs: each submitted program must have either 1 or 2 student names in a comment. Written assignments are individual. Two lowest homework scores will be dropped.

Topics covered in this course can be divided into 5 groups.

- Matlab: Matrix/vector manipulation, matrix/vector creation, elementwise operations, built-in functions, input/output, 2d graphics, scripting, functions. (5 class periods)
- Solving equations: linear systems, bisection method, fixed point method, Newton and secant methods, multivariable Newton's method, Broyden's method. (6 class periods)
- Numerical calculus: numerical differentiation, numerical integration: trapezoidal rule, Simpson's rule, orthogonal polynomials (Legendre, Laguerre), Gaussian integration, Gauss-Laguerre integration, multiple integrals, solving ODE with Euler's method and trapezoidal method, ODE systems. (9 class periods)
- Data fitting: polynomial interpolation, spline interpolation, discrete Fourier transform, linear least squares, model comparison, nonlinear least squares, transforming data. (8 class periods)
- Optimization: linear programming, single-variable minimization, steepest descent, conjugate gradient method, Nelder-Mead method, constrained optimization, applications. (8 class periods)

Learning outcomes:

- ✓ Students will be able to use and understand the usage of mathematical notation
- ✓ Students will be able to select an appropriate mathematical model for a given real world problem
- ✓ Students will be able to do hand calculations accurately and appropriately
- ✓ Students will be able to do calculations with the aid of appropriate software
- ✓ Students will be able to apprehend and enunciate the limitations of conclusions drawn from mathematical models

Tips for success in this course:

- It is absolutely essential that you understand how to solve all the assigned problems. Once you understand how to solve a problem, write your solution down neatly and in full detail with explanations that make your reasoning clear.
- Don't fall behind. If you are having difficulties keeping up with the material, see me immediately to discuss the problem.
- Ask questions: in class, during office hours, by email, and via instant messaging.
- Discussing problems with a classmate is very useful.
- Expect to work hard. Don't get discouraged if you find some of the material difficult. Be persistent and patient.

Students with disabilities. If you believe that you need accommodations for a disability, please contact the Office of Disability Services (ODS), <http://disabilityservices.syr.edu>, located in Room 309 of 804 University Avenue, or call (315) 443-4498 or TDD: (315) 443-1371 for an appointment to discuss your needs and the process for requesting accommodations. ODS is responsible for coordinating disability-related accommodations and will issue students with documented Disabilities

Accommodation Authorization Letters, as appropriate. Since accommodations may require early planning and generally are not provided retroactively, please contact ODS as soon as possible.

Religious observances policy. Syracuse University's Religious Observances Policy recognizes the diversity of faiths represented among the campus community and protects the rights of students, faculty, and staff to observe religious holy days according to their tradition. Under the policy, students are provided an opportunity to make up any examination, study, or work requirements that may be missed due to a religious observance provided they notify their instructors no later than the end of the second week of classes for regular session classes and by the submission deadline for flexibly formatted classes. Student deadlines are posted in MySlice under Student Services/Enrollment/My Religious Observances/Add a Notification.

Academic Integrity. Syracuse University's academic integrity policy reflects the high value that we, as a university community, place on honesty in academic work. The policy defines our expectations for academic honesty and holds students accountable for the integrity of all work they submit. Students should understand that it is their responsibility to learn about course-specific expectations, as well as about university-wide academic integrity expectations. The university policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of participation in class activities. The policy also prohibits students from submitting the same written work in more than one class without receiving written authorization in advance from both instructors. The presumptive penalty for a first instance of academic dishonesty by an undergraduate student is course failure, accompanied by a transcript notation indicating that the failure resulted from a violation of academic integrity policy. The presumptive penalty for a first instance of academic dishonesty by a graduate student is suspension or expulsion. SU students are required to read an online summary of the university's academic integrity expectations and provide an electronic signature agreeing to abide by them twice a year during pre-term check-in on MySlice. For more information and the complete policy, see <http://academicintegrity.syr.edu>

Summary of AI Expectations <http://academicintegrity.syr.edu/know-the-code-sus-ai-expectations/>

Full Statement of AI Expectations <http://academicintegrity.syr.edu/full-statement-of-sus-ai-expectations/>

Academic Integrity Policy <http://academicintegrity.syr.edu/academic-integrity-policy/>