

**Fall 2017**  
**Foundations of Computational Mathematics 1**  
**MAD 5403**

## Details

- Time and Place : MWF 10:10 – 11:00, 201 Love Building
- Instructor: K. A. Gallivan (5-0306, 318 Love Building, [gallivan@math.fsu.edu](mailto:gallivan@math.fsu.edu))
- Homepage: <http://www.math.fsu.edu/~gallivan>
- Office Hours: 8:00 – 10:00, 11:00 – 13:00 on Monday and Wednesday, 8:00 – 10:00, 11:00 – 12:00 on Friday, and meetings by appointment.
- Programming Course/Recitation Session
  - Time and Place: M 18:45 – 20:00, 102 Love Building
  - Webpage: [www.math.fsu.edu/~zdeng/acm-computing-seminar](http://www.math.fsu.edu/~zdeng/acm-computing-seminar)
- Teaching Assistant:
  - Zhifeng Deng (404/6B MCH, [zdeng@math.fsu.edu](mailto:zdeng@math.fsu.edu))
  - Homepage: <http://www.math.fsu.edu/~zdeng>
  - Office Hours: 12:00 – 13:30 Tuesday and Thursday
  - Phone: (850) 300-1182
- Prerequisites: programming proficiency, familiarity with finite dimensional vector spaces and basic linear algebra or consent of instructor
- Text: A. Quarteroni, R. Sacco, and F. Saleri, Numerical Mathematics, Springer Texts in Applied Mathematics 37, Second Edition.
- Grades: Programs 25%, Exam 1 20% , Exam 2 20% and comprehensive Final 35 %.
- The final exam will be held at the appointed time on the FSU Final Exam schedule.
- Exams 1 and 2 will be given in the evening at mutually agreed upon times in the regular class room.
- Makeup exams require prior approval or, if not possible, standard university approved documentation of an excused absence.
- Homework: Homework will consist of written exercises assigned approximately weekly and programming assignments. The written exercises are to assist you in understanding the material and preparing for the exams. They do not contribute to your grade and you are not required to submit solutions. It is strongly recommended however that you do all assigned problems and consult the detailed solutions that will be provided approximately one week after assignment. The programming assignments will be graded and contribute to your grade.

They may include graded short written problems related to the programming task. They are due at the time specified in the assignment. Solutions to programming assignments will be accepted after the due date only with prior approval or with documentation of an excused absence.

- All programming assignments must be completed in a compiled and typed language, e.g., Fortran, C, C++, Java. MATLAB and scripting languages are not acceptable for the code implementing the algorithms used to solve the assignment but they may be used to control or support the testing and evaluation of your code.
- All solutions for programming assignments must be submitted in the form described in “A Note on Reporting Programming Assignment Results” available on the class website.
- University Attendance Policy: Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.
- Class Attendance Policy: With the exception of the first class meeting, attendance is not required but is strongly advised. A student absent from class bears the full responsibility for all subject matter and procedural information discussed in class.
- Class Participation Policy: Students are expected to be prepared for class lectures and for any office visits. Students are encouraged to prepare carefully for class by reading relevant posted notes and sections of the textbook; to ask questions; and to initiate and/or participate in discussions in class and office visits.
- Electronic devices may be used to access class notes and related material during lectures. **Other uses of cell phones and similar devices are often disruptive to the lecture and are not permitted.**
- Class Information: Class notes, homework, programming assignments and announcements will be posted on the class website (follow the teaching link from [www.math.fsu.edu/~gallivan](http://www.math.fsu.edu/~gallivan)). You are expected to consult the website in a timely and regular manner. Parts of the class website are password protected. The password will be announced in the first class.

## Content

This course covers mathematics and methods that form the basis of the techniques of scientific computation. It is the first course of a sequence of two meant to prepare beginning graduate students for advanced courses in numerical methods and to be able to solve basic problems on a computer. Although many of the methods have existed for a long time (consider the origins of Newton’s Method; and Gauss Quadrature), today these methods are typically implemented on computers. When someone talks about solving science or engineering problems on computers, such as automobile or aircraft design, weather prediction or financial modeling, they are referring to programs that approximate and solve the equations that model the system under study. In the

two semesters we will study the basic methods for solving equations, optimizing cost functions, approximating functions and using the approximations to evaluate key components of computational mathematical problems and applications. solving those approximations.

The emphasis of the first course is on interpolation/approximation theory, its application to quadrature and the integration of differential equations, the effects of finite precision arithmetic and the stability of the numerical algorithms considered. Below are the expected topics and sections to be covered in the text. (Actual coverage will depend on time constraints.)

Topics:

1. Floating point representation and arithmetic
2. Conditioning and stability of numerical methods
3. Interpolation (Textbook Chapter 8)
  - Lagrange and Newton Interpolation, Complexity, and Interpolation error
  - Hermite Interpolation
  - Piecewise Interpolation and Splines
4. Orthogonal Polynomials and Approximation Theory (Textbook Chapter 10)
  - Minimax approximation and Chebyshev Economization
  - Fourier, Legendre, Chebyshev Series
  - Least Squares approximation – continuous and discrete
  - Trigonometric Interpolation and Discrete Fourier Transforms
5. Numerical Integration and Differentiation (Textbook Chapters 9 and 10)
  - Interpolatory quadrature and Newton-Cotes, composite rules
  - Adaptive quadrature
  - Gauss Quadrature
  - Approximation of derivatives
6. Ordinary Differential Equations (Textbook Chapters 11 and 12)
  - General numerical approach
  - Multistep methods and their analysis
  - One-step methods and their analysis
7. A Brief Introduction to the Numerical Solution of Linear Parabolic Partial Differential Equations

## Objectives

The class covers tools that have been developed to solve problems numerically, generally on a computer. Thus, you will be expected to be able to implement the techniques and to solve problems with them. In addition, you will be expected to know how the methods were derived and when they are and are not appropriate to use.

## Syllabus Changes

Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.

## Honor Code

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to ... be honest and truthful and ... [to] strive for personal and institutional integrity at Florida State University. (Florida State University Academic Honor Policy, found at <http://dof.fsu.edu/honorpolicy.htm>.)

## Americans with Disabilities Act

Students with disabilities needing academic accommodation should during the first week of class:

1. register with and provide documentation to the Student Disability Resource Center;
2. bring a letter to the instructor indicating the need for accommodation and what type.

This syllabus and other class materials are available in an alternative format upon request.

For more information about services available to FSU students with disabilities, contact the :

Student Disability Resource Center  
874 Traditions Way  
108 Student Services Building  
Tallahassee FL, 32306-4167

644-9566 (voice), 644-8504 (TDD), [sdrc@admin.fsu.edu](mailto:sdrc@admin.fsu.edu), <http://www.disabilitycenter.fsu.edu>.