MATH 561 Numerical Analysis I, Fall 2015: Class information

Instructor: Dr. Songting Luo
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Class Page: `http://orion.math.iastate.edu/luos/Teaching/MATH561_15FS/MATH561_15FS.html`

Textbook: Numerical Analysis, Walter Gautschi, second edition 2012. ISBN: 978-0-8176-8259-0 (e-book), ISBN: 978-0-8176-8258-3 (printed).

Lectures: Time and Room: **TR**, **12:40-2:00pm**; location: **0232 Carver Hall**
Office hours: 2:00–4:00pm **TR**, or by appointment.

Official Mathematics Department Policies

For departmental policies on Academic Misconduct, Disability Accommodation, Make up Examinations, Dead Week, Student Behavior in Class, Harassment and Discrimination, Religious Accommodation, etc., please refer to ISU Dept. of Mathematics Class Syllabus and Class Policies in the following link:
`http://www.math.iastate.edu/Faculty/ClassPolicies.html`

Course Description and Objectives

MATH 561 is a one-semester survey course of standard topics in numerical analysis. A companion course MATH 562 covers numerical linear algebra, numerical solution of nonlinear equations and optimization. These two courses can be taken in either order.

After completion of this course, students will be able to solve standard problems in numerical analysis using Matlab or other software. They will be aware of the limitations of various algorithms, and able to estimate errors. They will be prepared for more advanced courses or research in other parts of numerical analysis, such as numerical solution of PDEs or optimization.

MATH 561 and 562 together will also prepare Math graduate students for the Numerical Analysis Qualifying Exam.

Necessary background includes one-dimensional calculus (MATH 165/166), and some basic familiarity with vectors and matrices, ordinary differential equations and computer programming. A course in linear algebra, ODEs or computer programming is not required. Catalog Entry:

MATH 561. Numerical Analysis I.
(3-0) Cr. 3. F. *Prereq: MATH 414 or MATH 501*
Approximation theory, including polynomial spline interpolation and best approximation; numerical differentiation and integration; numerical methods for ordinary differential equations.

Course Objectives:
The course objectives are taken from the list of topics for the Numerical Analysis Qualifying Exam:

- Computer basics

  - computer arithmetic
  - rounding errors
  - error propagation

- Polynomial approximation theory

  - Bernstein polynomials
  - Weierstrass Theorem
  - existence and uniqueness of best approximations
  - alternant set and characterization of best approximations
  - Remez method for finding best approximations
  - Chebyshev polynomials of the first kind, best approximation properties for Chebyshev polynomials
  - Chebyshev expansions
  - best L^2 approximations
  - characterization of best L^2 approximations
  - Legendre polynomials.

- Polynomial interpolation

  - Lagrange interpolation – Vandermonde method, Lagrange formula, error formula
  - Hermite interpolation
  - spline interpolation
  - piecewise Lagrange interpolation.

- Numerical integration

  - Newton-Cotes methods
  - error estimates
  - Gaussian quadratures
  - orthogonal polynomials.

- Numerical ODEs

- general concepts
- linear single step methods
- linear multistep methods
- stability and convergence theorems
- Runge-Kutta methods.

Homework Policy

Homework sets will be assigned according to the progress of the class and can be downloaded as pdf files that will be posted online (class page), approximately a total of 5 homeworks. No late homework will be accepted. Sample solutions to homework problems will be posted on class page. Most likely the homeworks will not all be exactly the same length. I will just add all the points at the end, and convert it to a percentage. This will count for 3/4 of your grade. I encourage group participation in the solution of exercises.

There will be some larger assignment due during Finals Week, which counts for 1/4 of the grade.

There will not be any in-class exams.

Programming Exercises

You will have to use MATLAB for some assignments, but in general I will accept solutions based on any software (hand calculator, Mathematica, Excel spreadsheet, ...)

Matlab Resources:

Matlab Primer of Professor Sigmon of the University of Florida:
http://www.math.pitt.edu/~swigon/Matlab/primer.pdf
Matlab documentation:
http://www.mathworks.com/access/helpdesk/help/techdoc/matlab.html

Assigning Course Grades

The final grade (as a percentage of the total points) will be computed using the following weights: homeworks 3/4 and final assignment 1/4. Letter grades will be assigned according to the following tentative scale:

- $\geq 89\%$ grade is at least $A-$

- $\geq 78\%$ grade is at least $B-$

- $\geq 67\%$ grade is at least $C-$

- $\geq 56\%$ grade is at least $D-$

- $< 56\%$ grade is likely F

I reserve the right to change this scale, provided the change benefits all students.

Attendance
Students are expected to attend all class meetings, although attendance is not counted in the overall course grade. Note that any changes of the class will be only announced during class. If you must miss a class, it is your responsibility to get all the material missed from the class.

Departmental Student Disability Accommodation Policy
If you have a disability and require accommodations, please contact the instructor early in the semester so that your learning needs may be appropriately met. You will need to provide documentation of your disability to the Student Disability Resources (SDR) office, located on the main floor of the Student Services Building, Room 1076, 515-294-6624. The Mathematics Departmental Student Disability Accommodation Policy can also be found in the following link:
http://www.math.iastate.edu/Undergrad/AccommodationPol.html

Academic honesty
Students must be familiar with the academic standards of conduct, please refer to Academic Dishonesty
http://catalog.iastate.edu/academiclife/regulations/#academicdishonestytext

Religious Accommodation
If an academic or work requirement conflicts with a student's religious practices and/or observances, the student may request reasonable accommodations. The request must be in writing at least 10 days in advance if possible, and the course instructor or supervisor will review the request. The student or the instructor may also seek assistance from the Dean of Students Office or the Office of Equal Opportunity and Compliance.

NOTE: I reserve the right to change the policy. Any changes of the syllabus and class information will be announced in class and updated here.