GMU Department of Mathematical Sciences
Math 447/CDS 410: Numerical Analysis II
Spring 2022
Syllabus

Instructor:
Prof. Maria Emelianenko
Email: memelian@gmu.edu
Office Hours: TBA

Time and Room:
Tue/Thr 3:00-4:15pm INN 129
Course materials, assignments and announcements will be available on Blackboard. We will occasionally use computers to do hands-on projects in class.

Prerequisite: Grade of C or better in MATH 214 and MATH 446. Basic level of programming experience.

Textbook: The textbook we will follow is "Numerical Analysis" by T. Sauer, 3rd edition, Pearson 2018. Supplementary materials will be used occadionally and will be announced in class.

Course Description:
The course will focus on advanced numerical methods, connecting ideas from the areas of computational mathematics, operations research and computer science, and using modeling and simulation to solve problems from physics, biology and engineering. From the methodological point of view, students will learn methods for the solution of algebraic equations, differential equations, audio and image processing, and optimization. Mathematical analysis from the textbook will be supplemented with articles from relevant application areas in science and engineering. Methods will be studied in the context of solving representative scientific and engineering problems from the following list:

- Differential equations: Euler Bernoulli beam, Tacoma Narrows bridge, Lorenz attractor and chaos, Orbital mechanics, Buckling of coronary stents, Heat flow on a cooling fin, COVID modeling
- Optimization and least squares: Robotics, Global Positioning System, Protein? folding and conformation, Eigenvalues and Google

- Signal processing: Fourier analysis and interpolation, Noise reduction and filtering, Audio compression, AAC and MP3 etc., Discrete cosine transform and JPEG standard, Compression of images, Time series analysis

For each project, students are required to learn mathematical techniques relevant to the project solution, and to acquire basic competency in the application area of science or engineering through assigned readings. Secondary goals for the course are working proficiency in software packages, including Matlab.

Student participation will be done on the basis of team projects. Each group will consists of 2 students who will collaborate on all aspects of the problem solution. Typical projects will consist of four parts: (1) theoretical study and readings from the application area, identification of the underlying scientific and engineering principles of the problem? (2) mathematical formulation of a solution path using computational methods learned in class? (3) writing of software, following established principles from computer science, in Matlab or another convenient language, and its application to computationally solve the problem? (4) description of results, using text and graphics in a creative way. The description should be easily understandable by peers in the class.

Emphasis will be placed on clear communication of results through text and graphics. Finished writeups for the projects will be submitted by the student working groups as part of oral class presentations at the completion of each project.

Grading policy:
Your grade in this course will depend entirely on your performance on graded team projects. 4-5 projects will be given during the semester.

Academic Policies:

Below are Masons usual course policies. However, this is not a usual time. I fully understand that each of us may face new obstacles, or old obstacles in novel ways, during this time. Please communicate with me if such things are getting in your way in this class. My goal is to facilitate your growth and success in this strange and uncertain time; I can only do that if you tell me what is happening.

It is expected that students adhere to the George Mason University Honor Code as it relates to integrity regarding coursework and grades. The Honor Code reads as follows: "To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the University Community have set forth this: Student members of the George Mason University community pledge not to cheat, plagiarize, steal

and/or lie in matters related to academic work." More information about the Honor Code, including definitions of cheating, lying, and plagiarism, can be found at the Office of Academic Integrity website at http://oai.gmu.edu.

The Mathematical Sciences department, an intentionally inclusive community, promotes and maintains an equitable and just work and learning environment. We welcome and value individuals and their differences including race, economic status, gender expression and identity, sex, sexual orientation, ethnicity, national origin, first language, religion, age, and ability status.

If you are experiencing feelings of anxiety, panic, depression, sadness during the semester, Student Health Services and Counseling and Psychological Services Offices (703-993-2380) provides a range of resources to assist and support you. Students can call (703-993-2831) or walk-in during open hours to schedule an appointment to talk with a healthcare provider. If you or someone you know experiences a mental health crisis or emergency, seek help immediately. Call 911 for local emergency services, the National Suicide Prevention Lifeline (1-800-273-8255), or text the Crisis Text Line (741-741) anytime. I am also available to speak with you about stresses related to your work in my course.