Math 452: Numerical Analysis II

Spring 2021

Instructor:	Dr. Stathis Charalampidis	**Office:**	25-319 (Faculty Offices East)
Email:	echarala@calpoly.edu	**Phone:**	(805) 756-2465

Course Web Page: https://www.egcharalampidis.com/teaching/452_S21/math_452_S21/

Class Virtual Meetings:

- Section 1 (MTRF): 7:10-8:00am

Office Hours: T: 9:00-11:00am, R: 12:00-2:00pm, or by appointment.

Access to the course: Login into:

https://calpoly.zoom.us/

using your Cal Poly credentials. The Zoom ID numbers have already been sent to you in order to attend classes and office hours. In addition, meeting passwords are required and were sent to you as for an extra layer of security.

Required Textbook:

- *Finite difference methods for ordinary and partial differential equations*, Authors: Randall J. LeVeque, Publisher: Society of Industrial and Applied Mathematics (SIAM), 2007.

Additional References (depending on the topic)**:**

- *A First Course in Numerical Methods*, Authors: Uri M. Ascher and Chen Greif, Publisher: SIAM, 2011.
- *Spectral methods in Matlab*, Authors: Lloyd N. Treffethen, Publisher: SIAM, 2000.
- *Matrix Computations*, Authors: Gene H. Golub and Charles F. Van Loan, Publisher: The Johns Hopkins University Press, 2013.
- *A Multigrid tutorial* (second edition), Authors: W. L. Briggs, V. E. Henson and S. F. McCormick, Publisher: SIAM, 2000.
- *Solving Ordinary Differential Equations I* (second edition), Authors: E. Hairer, S.P. Nørsett and G. Wanner, Publisher: Springer Series in Computational Mathematics, Springer, 1993.

Objectives: This course is the second part of the Numerical Analysis sequence (Math 451-Math 452-Math 453) offered at Cal Poly San Luis Obispo, and it complements itself the topics covered in Math 451. In particular, the following topics (not necessarily in the order listed) will be covered: Finite difference schemes for steady-state boundary value problems, numerical methods for ordinary differential equations (ODEs) as well as methods for initial and boundary value problems (IVPs and IBVPs, respectively) containing partial differential equations (PDEs). The use of MATLAB will be adopted in this class where practical implementations of the methods discussed in this course will be presented. For your convenience, a detailed course outline containing the learning objectives for this class may be found at

https://content-calpoly-edu.s3.amazonaws.com/math/1/documents/452.pdf

Class Material by Topic: During the quarter, we will cover the following topics from the **main** textbook:

- Finite Difference approximations
- Steady states, i.e., time-independent solutions and BVPs
- Elliptic equations
- Iterative methods for sparse linear systems (review)

- IVPs for ordinary differential equations
- Convergence and zero as well as absolute stability for ODEs
- Diffusion equations and parabolic problems
- Advection equations and hyperbolic systems

Course Prerequisites: Math 451, or equivalent.

Programming Prerequisites: A solid foundation on programming. It should be noted that **MATLAB** will be used in class and for homework assignments. Of course you can use **any** programming language such as Julia, Python, Fortran, C/C++, and so on. There are a few PDF files (same as the ones used in Math 451) and links for help with MATLAB on the course web page.

Homework and Exams: There will be (almost) weekly **written** homework assignments including **computational tasks**. For the latter, you will have to include/attach your codes in your homework. Please make sure you include as many **comments** as possible in your codes such that they could be read and easily understood. For a complete list of all homework assigned to date, please visit the Canvas page for the course. Each assignment will consist of a group of problems and your task will be to write up solutions for each one and develop codes when the question is asking for doing so. **No late homework will be accepted.** Please keep in mind that you will be rewarded not only for getting a correct answer but most importantly for the structure and presentation of your work. Finally, struggling through a question in the homework and most particularly in a computational/programming task is not something unusual. Please make sure you start developing your codes way in advance in order you to check and debug your programs.

There will be **one take home exam** and **one cumulative final**. For their schedule, see below the "Important Dates" section of this document.

Grading Policy and Exams: Your final grade in this course is computed according to:

Homework	35%
Midterm	25%
Final Exam	40%

Important Dates and Academic Holidays:

César Chavez's Birthday	Wednesday, March 31
Midterm	Friday, April 30
Memorial Day	Monday, May 31
Last day of classes	Friday, June 4
Final Exam	Wednesday, June 9 (7:10-10:00am)

Class Policies:

- All exams are **paper and pencil** as well as **closed-book** exams.
- **Attendance is mandatory**. However, an **excused absence** can be allowed only if the reason for your absence falls into any of the categories listed in the following page:

  https://academicprograms.calpoly.edu/academicpolicies/class-attendance

  Please inform me as soon as possible if you are seeking to make up missed work pursuant to the excusable reasons listed in the url above.

Students with Disabilities: The University provides disability-related support services to qualified students through the Disabilities Resource Center (DRC). If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both me and the DRC (124-119) at (805) 756-1395, as early as possible in the term. In addition, and for your convenience, their website is https://drc.calpoly.edu/. Note that use of DRC services including testing accommodations requires prior authorization by the DRC and compliance with approved procedures. **Make sure you initiate any needed arrangements well in advance of an exam date**.

Diversity and Inclusion: I am fully committed to an academic environment that is free of bias against any group and I firmly believe in the value of diversity in people and ideas. My ultimate goal is to establish that this class is a welcoming environment to every-one regardless of gender identity, sexual orientation, race, ethnicity, or religious identity. The University and I do not tolerate discrimination. Please feel comfortable coming to me or an administration if at any point you ever feel uncomfortable for any reason.