Numerical Solution of Differential Equations

Math 686

Spring 2022

General Information:

Instructor:	Evelyn Sander
Office:	Exploratory Hall 4408
E-mail:	esander@gmu.edu
Office hours:	Mondays 5-6:30, and by appointment

Lectures:	M 7:20-10:00pm, Exploratory Hall 4106
Prerequisites:	Math 446 or Math 685 and an elementary differential equations course.

Textbook:

There is no assigned textbook for the course, but you might find the following books useful for supplementary reading, particularly the first one:

- E. Sander and T. Wanner, *Theory and Numerics of Partial Differential Equations A Beginnerâ€™s Guide to Linear, Nonlinear, and Stochastic Problems*, Preprint available on Blackboard: Personal use only, do not distribute!
- A. Iserles, *A First Course in the Numerical Analysis of Differential Equations*, Cambridge University Press, 1996.
- E. Hairer, S.P. Norsett, G. Wanner, *Solving Ordinary Differential Equations I*, Springer, 2000 (2nd edition).
- E. Hairer, G. Wanner, *Solving Ordinary Differential Equations II*, Springer, 2002 (2nd edition).
- J.C. Butcher, *Numerical Methods for Ordinary Differential Equations*, Wiley, 2003.
- L.F. Shampine, *Numerical Solution of Ordinary Differential Equations*, Chapman & Hall, 1994.

Course Content:

This course covers fundamental numerical methods for solving ordinary and partial differential equations. Specific topics include Runge-Kutta and multistep methods for ordinary differential equations, finite difference methods for initial value problems, boundary value problems, the Poisson equation, the diffusion equation, and hyperbolic equations.

See the course schedule for more details.

Matlab:

The software package Matlab will be used throughout the course. Matlab is a computing environment with programming capability, good graphics, and powerful library functions. There are many online tutorials available for Matlab, as well as a series of department workshops. These workshops are strongly encouraged!

Homework Assignments:

Homework problems will be assigned and collected weekly. They will be posted on Blackboard. The assignments will consist of a combination of theoretical and computational problems. On all problems, I advise everyone strongly to study them and write out the solutions properly. Only some of these problems handed in. You are encouraged to discuss all problems amongst yourselves and make use of the office hours. For the problems you turn in, your writeup should be your own and not shared with others. I will go through many of the homework problems in the following class and you will not benefit from this if you have not made a serious attempt at solving them.

Oral presentations:

Each student will be assigned a section of reading and give an oral presentation of this section for the class. These presentations will start after Spring Break. The oral presentation will be at least 30 minutes and at most 40 minutes long. As part of the presentation, you write one homework problem for the class to solve, and turn in a solution key (please only give this to the instructor so that it doesn't spoil the fun for your classmates).

Grading Policy:

Your final grade in the course will be determined from attendance, homework, and oral presentations. Weights for these items will be distributed approximately according to the following schedule:

Attendance	Homework	Oral presentations
15%	60%	25%
