Course Logistics

All the course material will be on my course web page

https://math.la.asu.edu/~gardner/522.html

as well as on Canvas. Canvas should be available on 8/17.

I will curve the grades to some extent (except A+ = 97.0–100, A = 93.0–96.9, A− = 90.0–92.9), and will give ± grades based on 3 groupings within each letter grade.

Please make sure that your ASU email address is working—I will send important class notices to your ASU email address.

This semester, APM 522 will be taught in ASU Sync mode: online via Zoom lectures (live at the scheduled time, and then available afterwards recorded as well) and Zoom office hours plus Canvas lecture notes and assignments (all of which I will grade myself).

You will be able to ask questions during the live lectures. Attending the live lectures via Zoom is best, but I won’t take attendance and you can choose the mode in which you learn most efficiently.

Course Contents

Free Online Text: *Finite Difference Methods for Ordinary and Partial Differential Equations* by Randy LeVeque (available through the ASU library one chapter at a time)

This course will survey modern numerical methods for computing solutions to parabolic, elliptic, and hyperbolic partial differential equations, focussing mainly on finite difference and finite volume methods. Solution methods for nonlinear PDEs will be emphasized. Major applications include:
• heat (diffusion) equation
  forward and backward Euler, TR, and TRBDF2 methods
• semiconductor process simulation (nonlinear diffusion)
  TRBDF2 method
• Poisson’s equation (electrostatics)
  Jacobi, Gauss-Seidel, SOR, and PCG iterative methods
• drift-diffusion model and ionic flow in biological cells
• wave equations
  upwind, Lax-Friedrichs, and Lax-Wendroff methods
• Burgers’ equation
• gas dynamics and supersonic astrophysical jets
  Lax-Wendroff and WENO methods
• semiconductor device simulation (electro-gas dynamics)
• Navier-Stokes equations (incompressible fluid dynamics)
  Chorin projection method

Course Requirements

Course Prerequisites: Knowledge of a modern programming language and some experience with PDEs will be helpful. Students will use my programs and graphics scripts.

There will be 8 problem sets consisting of problems, computations, and graphics. (No tests or final exam!) PS8 will be a review of the whole semester, similar to a Comprehensive Exam, but take-home (solo but open book and open web). Late homework will get half credit.

Problem sets should be submitted via Canvas. PDFs or JPEGs seem to work best for Canvas submissions. You can typeset your problem sets with LaTeX or Google Docs or MS Windows Equation Editor. If your assignments
are handwritten, there are several good free phone scanning apps (for both iPhone and Android):

CamScanner
Adobe Scan
MS Office Lens

You are encouraged to discuss homework problems with each other. However, the actual writeup should be in your own words and based on your own understanding of the problems. *No credit will be given for exactly similar writeups.*

**ASU Academic Honesty Policy:** *Academic honesty is expected of all students in all examinations, papers, laboratory work, academic transactions and records. The possible sanctions include, but are not limited to, appropriate grade penalties, course failure (indicated on the transcript as a grade of E), course failure due to academic dishonesty (indicated on the transcript as a grade of XE), loss of registration privileges, disqualification and dismissal. For more information, see [http://provost.asu.edu/academicintegrity](http://provost.asu.edu/academicintegrity)*