

## PDE Prelim Topics

- First order PDEs:
  - Cauchy problem, Local existence and uniqueness of solution;
  - Method of characteristics for linear, quasilinear and fully nonlinear equations;
  - IVP's for conservation laws: integral solutions, shock formation, and Rankine-Hugoniot condition.
- Second order PDEs:
  - Classification of 2nd order PDEs
  - Formulation and interpretation of classical initial/boundary value problems; concepts of solution, well-posedness and stability,
  - separation of variables, Fourier series, similarity solutions, Fourier transform.
- Elliptic PDEs-
  - Laplace and Poisson Equation: classical boundary value problems, Green's identities, Green's function, Poisson integral formula; harmonic and subharmonic functions: mean value property, maximum principle; energy methods.
- Parabolic PDEs -
  - Heat equation: fundamental solution and integral formula for solution of the heat equation; maximum principle for solution and subsolution to the heat equation; mean value property, regularity of solution; energy integral and estimates; Duhamel's principle
- Hyperbolic PDEs -
  - Wave Equation: wave propagation, D'Alembert formula; energy integral; energy estimates; spherical means, Kirchoff solution, method of descent, global properties of solutions
- Variational formulation and weak solutions

### Text/References/Resources

- Evans, L.C. Partial Differential Equations, American Mathematical Society
- Han, Q. A basic course in partial differential equations, American Mathematical Society
- Zachmanoglou, E. C. and Thoe, D.W. Introduction to partial differential equations with applications
- W. Strauss, Partial Differential Equations: An Introduction, Wiley.