1. Fundamentals of Real Analysis, emphasis on Banach and Hilbert Space Theory; *par exemplar*
   
   (a) Bounded if and only if Continuous
   (b) Open Mapping Theorem
   (c) Hahn-Banach Theorem
   (d) Riesz Representation Theorem
   (e) Contraction Mapping Theorem (Banach Fixed Point Theorem)

2. Partial Differential Equations
   
   (a) Laplace’s and Poisson’s Equation
      i. Fundamental Radial Solutions
      ii. Mean-Value Property, Max and Min Principles
      iii. Representation Formulae, Green’s Functions for Ball and Half Space
      iv. Perron’s Method, Properties of Sub/Super-Harmonic Functions
      v. Boundary Regularity, Barriers
   (b) Weak Solutions and Sobolev Spaces
      i. Hölder Spaces
      ii. Sobolev Embedding Theorems: Rellich Theorem, Kondrachov Compactness
      iii. Weak Derivatives, Weak Solutions, *etcetera*
   (c) General Variable Elliptic PDE through Functional Analysis
      i. Lax-Milgram Theorem
      ii. Fredholm Alternative
      iii. Application to Hodge Decomposition Theorem
   (d) General First Order Nonlinear PDE
      i. Method of Characteristics: ODE, Boundary Conditions, Application
      ii. General Conservation Laws: Formation of Shocks, Rankine-Hugoniot
      iii. Burger’s Equation: Hopf’s Method, Uniqueness of Solutions, Entropy Criterion

3. References:
   
   (a) Evans “Partial Differential Equations” Chapters 2.2, 3, 5, 6 and Appendices
   (b) Gilbarg and Trudinger “Elliptic Partial Differential Equations of Second Order” Chapters 2, 3, 4, 5, 7, 8
   (c) Hörmander “Lectures on Hyperbolic Non-linear Differential Equation” Ch. 2